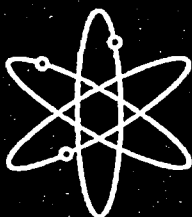




Generic Environmental Impact Statement for License Renewal of Nuclear Plants



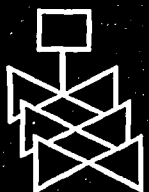
Supplement 16



**Regarding
Quad Cities Nuclear Power Station, Units 1 and 2**



Draft Report for Comment



**U.S. Nuclear Regulatory Commission
Office of Nuclear Reactor Regulation
Washington, DC 20555-0001**



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Generic Environmental Impact Statement for License Renewal of Nuclear Plants

Supplement 16

Regarding Quad Cities Nuclear Power Station, Units 1 and 2

Draft Report for Comment

Manuscript Completed: October 2003
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Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001



COMMENTS ON DRAFT REPORT

Any interested party may submit comments on this report for consideration by the NRC staff. Comments may be accompanied by additional relevant information or supporting data. Please specify the report number NUREG-1437, Supplement 16, draft, in your comments, and send them by January 27, 2004, to the following address:

Chief, Rules Review and Directives Branch
U.S. Nuclear Regulatory Commission
Mail Stop T6-D59
Washington, DC 20555-0001

Electronic comments may be submitted to the NRC by the Internet at QuadCitiesEIS@nrc.gov.

For any questions about the material in this report, please contact:

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Abstract

The U.S. Nuclear Regulatory Commission (NRC) considered the environmental impacts of renewing nuclear power plant operating licenses (OLs) for a 20-year period in its *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2, and codified the results in 10 CFR Part 51. The GEIS (and its Addendum 1) identifies 92 environmental issues and reaches generic conclusions related to environmental impacts for 69 of these issues that apply to all plants or to plants with specific design or site characteristics. Additional plant-specific review is required for the remaining 23 issues. These plant-specific reviews are to be included in a supplement to the GEIS.

This draft supplemental environmental impact statement (SEIS) has been prepared in response to an application submitted to the NRC by the Exelon Generation Company, LLC (Exelon) to renew the OLs for Quad Cities Units 1 and 2 for an additional 20 years under 10 CFR Part 54. This draft SEIS includes the NRC staff's analysis that considers and weighs the environmental impacts of the proposed action, the environmental impacts of alternatives to the proposed action, and mitigation measures available for reducing or avoiding adverse impacts. It also includes the staff's preliminary recommendation regarding the proposed action.

Regarding the 69 issues for which the GEIS reached generic conclusions, neither Exelon nor the staff has identified information that is both new and significant for any issue that applies to Quad Cities. The staff determined that information provided during the scoping process did not call into question the conclusions in the GEIS. Therefore, the staff concludes that the impacts of renewing the Quad Cities OLs will not be greater than impacts identified for these issues in the GEIS. For each of these issues, the staff's conclusion in the GEIS is that the impact is of SMALL^(a) significance (except for collective off-site radiological impacts from the fuel cycle and from high-level waste and spent fuel, which were not assigned a single significance level).

Regarding the remaining 23 issues, 15 apply to Quad Cities and are addressed in this draft SEIS. For 14 of the 15 issues, the staff concludes that the significance of the potential environmental impacts of renewal of the OLs is SMALL. The staff also concludes that for these issues, additional mitigation measures are not likely to be sufficiently beneficial as to be warranted. For the issue of electric shock from induced current along transmission line corridors, the staff concludes that the potential impact is MODERATE for one transmission line and that consideration of additional mitigation measures may be warranted. In addition, the staff determined that information provided during the scoping process did not identify any new issue that has a significant environmental impact.

(a) Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.

Abstract

1 The NRC staff's preliminary recommendation is that the Commission determine that the
2 adverse environmental impacts of license renewal for Quad Cities Units 1 and 2 are not so
3 great that preserving the option of license renewal for energy-planning decisionmakers would
4 be unreasonable. This recommendation is based on (1) the analysis and findings in the GEIS;
5 (2) the Environmental Report submitted by Exelon; (3) consultation with Federal, state, and
6 local agencies; (4) the staff's own independent review; and (5) the staff's consideration of the
7 public comments received during the scoping process.

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Executive Summary

By letter dated January 3, 2003, the Exelon Generation Company, LLC (Exelon) submitted an application to the U.S. Nuclear Regulatory Commission (NRC) to renew the operating licenses (OLs) for Quad Cities Units 1 and 2 for an additional 20-year period. If the OLs are renewed, state regulatory agencies and Exelon will ultimately decide whether the two units will continue to operate based on factors such as the need for power or other matters within the state's jurisdiction or the purview of the owners. If the OLs are not renewed, then the units must be shut down at or before the expiration dates of the current OLs, both of which will expire on December 14, 2012.

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

Upon acceptance of the Exelon application, the NRC began the environmental review process described in 10 CFR Part 51 by publishing in the Federal Register a notice of intent to prepare an EIS and conduct scoping. The staff visited the Quad Cities site in March 2003 and held two public scoping meetings on April 8, 2003, in Moline, Illinois. In preparing this draft supplemental environmental impact statement (SEIS) for Quad Cities Units 1 and 2, the staff reviewed the Exelon Environmental Report (ER) and compared it to the GEIS; consulted with other agencies; conducted an independent review of the issues following the guidance set forth in NUREG-1555, Supplement 1, the *Standard Review Plans for Environmental Reviews for Nuclear Power Plants, Operating License Renewal*, and considered the public comments received during the scoping process. The public comments received during the scoping process that were considered to be within the scope of the environmental review, and NRC staff responses, are provided in Appendix A, Part 1, of this SEIS.

The staff will hold two public meetings in Moline, Illinois, in December 2003, to describe the preliminary results of the NRC environmental review, answer questions, and provide members of the public with information to assist them in formulating comments on this draft SEIS. When the comment period ends, the staff will consider and disposition all of the comments received. These comments will be addressed in Appendix A, Part 2, of the final SEIS.

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

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

5
6 The Commission has adopted the following statement of purpose and need for license renewal
7 from the GEIS:

8
9 The purpose and need for the proposed action (renewal of an operating license) is to
10 provide an option that allows for power generation capability beyond the term of a
11 current nuclear power plant operating license to meet future system generating needs,
12 as such needs may be determined by state, utility, and, where authorized, Federal
13 (other than NRC) decisionmakers.

14
15 The goal of the staff's environmental review, as defined in 10 CFR 51.95(c)(4) and the GEIS, is
16 to determine

17
18 ... whether or not the adverse environmental impacts of license renewal are so great
19 that preserving the option of license renewal for energy planning decisionmakers would
20 be unreasonable.

21
22 Both the statement of purpose and need and the evaluation criterion implicitly acknowledge that
23 there are factors, in addition to license renewal, that will ultimately determine whether an
24 existing nuclear power plant continues to operate beyond the period of the current OL.

25
26 NRC regulations [10 CFR 51.95(c)(2)] contain the following statement regarding the content of
27 SEISs prepared at the license renewal stage:

28
29 The supplemental environmental impact statement for license renewal is not required to
30 include discussion of need for power or the economic costs and economic benefits of
31 the proposed action or of alternatives to the proposed action except insofar as such
32 benefits and costs are either essential for a determination regarding the inclusion of an
33 alternative in the range of alternatives considered or relevant to mitigation. In addition,
34 the supplemental environmental impact statement prepared at the license renewal stage
35 need not discuss other issues not related to the environmental effects of the proposed
36 action and the alternatives, or any aspect of the storage of spent fuel for the facility
37 within the scope of the generic determination in § 51.23(a) ["Temporary storage of spent
38 fuel after cessation of reactor operation—generic determination of no significant
39 environmental impact"] and in accordance with § 51.23(b).

40
41 The GEIS contains the results of a systematic evaluation of the consequences of renewing an
42 OL and operating a nuclear power plant for an additional 20 years. It evaluates 92

Executive Summary

environmental issues using the NRC's three-level standard of significance—SMALL, MODERATE, or LARGE—developed using the Council on Environmental Quality guidelines. The following definitions of the three significance levels are set forth in footnotes to Table B-1 of 10 CFR Part 51, Subpart A, Appendix B:

SMALL – Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.

MODERATE – Environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.

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

For 69 of the 92 issues considered in the GEIS, the analysis in the GEIS led to the following conclusions:

- (1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristics.
- (2) A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective off-site radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal).
- (3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation.

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

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

1 This draft SEIS documents the staff's evaluation of all 92 environmental issues considered in
2 the GEIS. The staff considered the environmental impacts associated with alternatives to
3 license renewal and compared the environmental impacts of license renewal and the
4 alternatives. The alternatives to license renewal that were considered include the no-action
5 alternative (not renewing the OLs for Quad Cities Units 1 and 2) and alternative methods of
6 power generation. Based on projections made by the U.S. Department of Energy's Energy
7 Information Administration, gas- and coal-fired generation appear to be the most likely power-
8 generation alternatives if the power from Units 1 and 2 is replaced. These alternatives are
9 evaluated in detail, assuming that the replacement power generation plant is located at either
10 the Quad Cities site or an unspecified alternate location.

11
12 Exelon and the staff have established independent processes for identifying and evaluating the
13 significance of any new information on the environmental impacts of license renewal. Neither
14 Exelon nor the staff has identified information that is both new and significant related to
15 Category 1 issues that would call into question the conclusions in the GEIS. Similarly, neither
16 Exelon, the scoping process, nor the staff have identified any new issue applicable to Quad
17 Cities Units 1 and 2 that has a significant environmental impact. Therefore, the staff relies upon
18 the conclusions of the GEIS for all of the Category 1 issues that are applicable to Quad Cities
19 Units 1 and 2.

20
21 Exelon's license renewal application presents an analysis of the Category 2 issues that are
22 applicable to Quad Cities Units 1 and 2 plus environmental justice. The staff has reviewed the
23 Exelon analysis for each issue and has conducted an independent review of each issue. Four
24 Category 2 issues are not applicable, because they are related to plant design features or site
25 characteristics not found at Quad Cities. Four Category 2 issues are not discussed in this draft
26 SEIS, because they are specifically related to refurbishment. Exelon has stated that its
27 evaluation of structures and components, as required by 10 CFR 54.21, did not identify any
28 major plant refurbishment activities or modifications as necessary to support the continued
29 operation of Quad Cities Units 1 and 2 for the license renewal period. In addition, any
30 replacement of components or additional inspection activities are within the bounds of normal
31 plant component replacement, and therefore, are not expected to affect the environment
32 outside the bounds of plant operations evaluated in the U.S. Atomic Energy Commission's 1972
33 *Final Environmental Statement Related to the Operation of Quad Cities Nuclear Station Units*
34 *1&2*.

35
36 Thirteen Category 2 issues related to operational impacts and postulated accidents during the
37 renewal term, as well as the remaining two issues, environmental justice and chronic effects of
38 electromagnetic fields, are discussed in detail in this draft SEIS. For 12 Category 2 issues and
39 environmental justice, the staff concludes that the potential environmental effects are of SMALL
40 significance in the context of the standards set forth in the GEIS. In addition, the staff
41 determined that appropriate Federal health agencies have not reached a consensus on the
42 existence of chronic, adverse effects from electromagnetic fields. Therefore, no further

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1 evaluation of this issue is required. For severe accident mitigation alternatives (SAMAs), the
2 staff concludes that a reasonable, comprehensive effort was made to identify and evaluate
3 SAMAs. Based on its review of the SAMAs for Quad Cities Units 1 and 2 and the plant
4 improvements already made, the staff concludes that four of the candidate SAMAs are cost-
5 beneficial and two other SAMAs are potentially cost beneficial. However, these SAMAs do not
6 relate to adequately managing the effects of aging during the period of extended operation.
7 Therefore, they do not need to be implemented as part of license renewal pursuant to
8 10 CFR Part 54.

9
10 For one issue, the staff's preliminary conclusion is that the potential environmental impact of
11 renewal term operations of Quad Cities Units 1 and 2 is greater than SMALL. The staff
12 concludes that the impact of the potential for electric shock from induced current along
13 transmission line corridors is MODERATE on the portion of the north Nelson line where the
14 calculated induced current exceeds the 5 mA criterion specified in the National Electric Safety
15 Code. Exelon's ER reported a calculated value of 6 mA.

16
17 Mitigation measures were considered for each Category 2 issue. Existing measures to mitigate
18 the environmental impacts of plant operation were found to be adequate for 12 issues, and no
19 additional mitigation measures were deemed sufficiently beneficial for these issues to be
20 warranted. However, for the issue of the potential for electric shock along transmission line
21 corridors from transmission line induced current, consideration of further mitigation may be
22 warranted. The NRC staff findings related to this issue have been provided to the transmission
23 line owner.

24
25 If the Quad Cities OLs are not renewed and the units cease operation on or before the
26 expiration of their current OLs, the adverse impacts of likely alternatives will not be smaller than
27 those associated with continued operation of Quad Cities Units 1 and 2. The impacts may, in
28 fact, be greater in some areas.

29
30 The preliminary recommendation of the NRC staff is that the Commission determine that the
31 adverse environmental impacts of license renewal for Quad Cities Units 1 and 2 are not so
32 great that preserving the option of license renewal for energy-planning decisionmakers would
33 be unreasonable. This recommendation is based on (1) the analysis and findings in the GEIS;
34 (2) the ER submitted by Exelon; (3) consultation with other Federal, state, and local agencies;
35 (4) the staff's own independent review; and (5) the staff's consideration of the public comments
36 received during the scoping process and on the draft SEIS.

Abbreviations/Acronyms

1		
2		
3		
4	°	degree
5	μ	micro
6	μCi	microcurie(s)
7	μCi/mL	microcurie(s) per milliliter
8	μGy	microgray(s)
9	μm	micrometer(s)
10	μSv	microsievert(s)
11		
12	A/C	air conditioner
13	AC	alternating current
14	ac	acres
15	ACC	averted cleanup and decontamination costs
16	ADAMS	Agencywide Documents Access and Management System
17	AEA	Atomic Energy Act of 1954
18	AEC	U.S. Atomic Energy Commission
19	AOC	averted offsite property damage costs
20	AOE	averted occupational exposure costs
21	AOSC	averted onsite costs
22	APE	averted public exposure costs
23	AQCR	air quality control region
24	ATWS	anticipated transients without scram
25		
26	BOD	biological oxygen demand
27	Bq	becquerel(s)
28	Bq/mL	becquerel(s) per milliliter
29	Btu	British thermal unit(s)
30	Btu/ft ³	British thermal unit(s) per cubic foot
31	Btu/kWh	British thermal unit(s) per kilowatt hour
32	BWR	boiling water reactor
33	BWROG	boiling water reactor owner's group
34		
35	C	Celsius
36	CAA	Clean Air Act
37	CDF	core damage frequency
38	CEQ	Council on Environmental Quality
39	CFR	Code of Federal Regulations
40	cfs	cubic feet per second
41	Ci	curie(s)
42	cm	centimeter(s)

Abbreviations/Acronyms

1	cm/s	centimeter(s) per second
2	COE	cost of enhancement
3	CWA	Clean Water Act
4		
5	DBA	design-basis accident
6	DC	direct current
7	DOE	U.S. Department of Energy
8	DMR	discharge monitoring report
9	DSM	demand-side management
10		
11	EIA	Energy Information Administration (of DOE)
12	EIS	environmental impact statement
13	ELF-EMF	extremely low frequency-electromagnetic field
14	EPA	Environmental Protection Agency
15	EPU	extended power uprate
16	EPRI	Electric Power Research Institute
17	ER	Environmental Report
18	ESA	Endangered Species Act
19	ESRI	Environmental Systems Research Institute
20	ESRP	Environmental Standard Review Plan
21		
22	F	Fahrenheit
23	FAA	Federal Aviation Administration
24	FES	final environmental statement
25	FIVE	fire-induced vulnerability evaluation
26	FPS	fire-protection system
27	FR	<i>Federal Register</i>
28	ft	foot (feet)
29	ft/s	foot (feet) per second
30	ft ³	cubic foot (feet)
31	ft ³ /s	cubic foot (feet) per second
32	ft ³ /yr	cubic foot (feet) per year
33	F-V	Fussel-Veseley
34	FWS	U.S. Fish and Wildlife Service
35		
36	g	unit measure of ground acceleration
37	gal	gallon(s)
38	gal/s	gallon(s) per second
39	GEIS	<i>Generic Environmental Impact Statement for License Renewal of Nuclear Plants,</i>
40		NUREG-1437
41	GIS	geographic information systems
42	gpd	gallon(s) per day

Abbreviations/Acronyms

1	gpm	gallon(s) per minute
2	Gy	gray(s)
3		
4	ha	hectare(s)
5	HCLPF	high confidence low probability of failure
6	HEPA	high-efficiency particulate air (filter)
7	HLW	high-level waste
8	hr	hour(s)
9	Hz	Hertz
10		
11	IA DNR	Iowa Department of Natural Resources
12	IEPA	Illinois Environmental Protection Agency
13	IL DNR	Illinois Department of Natural Resources
14	INEEL	Idaho National Engineering and Environmental Laboratory
15	in.	inch(es)
16	IPA	integrated plant assessment
17	IPE	individual plant examination
18	IPEEE	individual plant examination of external events
19	IRS	Illinois Revised Statutes
20	ISFSI	independent spent fuel storage installation
21	ISLOCA	interfacing systems loss of coolant accident
22		
23	J	joule(s)
24		
25	km	kilometer(s)
26	kV	kilovolt(s)
27	kW	kilowatt(s)
28	kWh	kilowatt hour(s)
29	kWh/m ²	kilowatt hour(s) per square meter
30		
31	L	liter(s)
32	L/d	liter(s) per day
33	L/min	liter(s) per minute
34	L/s	liter(s) per second
35	lb	pound(s)
36	lb/MWh	pound(s) per megawatt hour
37	LERF	large early release frequency
38	LLC	Limited Liability Corporation
39	LMS	Lawler Matusky Skelley
40	LOCA	loss of coolant accident
41	LOOP	loss of offsite power
42	LOS	level of service
43	LR	license renewal

Abbreviations/Acronyms

1	m	meter(s)
2	m/s	meter(s) per second
3	m ³	cubic meter(s)
4	m ³ /d	cubic meter(s) per day
5	m ³ /s	cubic meter(s) per second
6	m ³ /yr	cubic meter(s) per year
7	mA	milliampere(s)
8	MAB	maximum attainable benefit
9	MACCS2	MELCOR Accident Consequence Code System 2
10	MBq	megabecquerel(s)
11	MBq/L	megabecquerel(s) per liter
12	mGy	milligray(s)
13	mi	mile(s)
14	mL	milliliter(s)
15	mm	millimeter(s)
16	mph	mile(s) per hour
17	mrad	millirad(s)
18	mrem	millirem(s)
19	mrem/yr	millirem(s) per year
20	MSA	Metropolitan Statistical Area
21	mSv	millisievert(s)
22	mSv/yr	millisievert(s) per year
23	MT	metric ton(s) (or tonne[s])
24	MT/yr	metric ton(s) (or tonne[s]) per year
25	MTU	metric ton(s) (or tonne[s])-uranium
26	MW	megawatt(s)
27	MWd/MTU	megawatt-day(s) per metric ton (or tonne) of uranium
28	MW(e)	megawatt(s) electric
29	MWh	megawatt hour(s)
30	MW(t)	megawatt(s) thermal
31		
32	NA	not applicable
33	NAS	National Academy of Sciences
34	NEI	Nuclear Energy Institute
35	NEPA	National Environmental Policy Act of 1969
36	NESC	National Electric Safety Code
37	ng	nanogram(s)
38	ng/J	nanogram(s) per joule
39	NHPA	National Historic Preservation Act
40	NIEHS	National Institute of Environmental Health Sciences
41	NMFS	National Marine Fisheries Service
42	NO _x	nitrogen oxide(s)

Abbreviations/Acronyms

1	NPDES	National Pollutant Discharge Elimination System
2	NRC	U.S. Nuclear Regulatory Commission
3	NREL	National Renewable Energy Laboratory
4	NWFR	National Wildlife and Fish Refuge
5	NWPPC	Northwest Power Planning Council
6		
7	ODCM	<i>Offsite Dose Calculation Manual</i>
8	OL	operating license
9		
10	PBq	petabecquerel(s)
11	PCB	polychlorinated biphenyl
12	pCi	picocurie(s)
13	pCi/L	picocurie(s) per liter
14	PDS	plant damage state
15	PM ₁₀	particulate matter, 10 micrometers or less in diameter
16	PRA	probabilistic risk assessment
17	PSD	prevention of significant deterioration
18		
19	RAI	request for additional information
20	rem	special unit of dose equivalent, equal to 0.01 sievert
21	REMP	radiological environmental monitoring program
22	RFP	reactor feed pump
23	RHR	residual heat removal
24	ROW	right of way
25	RPC	replacement power costs
26	RRW	risk reduction worth
27	RWPB	radioactive-waste-processing building
28		
29	s	second(s)
30	SAMA	severe accident mitigation alternative
31	SAR	safety analysis report
32	SBO	station blackout
33	SEIS	supplemental environmental impact statement
34	SER	safety evaluation report
35	SHPO	State Historic Preservation Office
36	SIP	state implementation plan
37	SIRWT	safety injection refueling water storage tank
38	SO ₂	sulfur dioxide
39	SO _x	sulfur oxide(s)
40	Sv	sievert(s), special unit of dose equivalent
41		
42		

Abbreviations/Acronyms

1	TBq	terabecquerel(s)
2	TEDE	total effective dose equivalent
3	TLD	thermoluminescent dosimeter
4		
5	UFSAR	updated final safety analysis report
6	UMRCC	Upper Mississippi River Conservation Committee
7	U.S.	United States
8	USACE	U.S. Army Corps of Engineers
9	USBC	U.S. Bureau of the Census
10	USC	United States Code
11	USDA	U.S. Department of Agriculture
12	USDI	U.S. Department of Interior
13	USGS	U.S. Geological Survey
14		
15	V	volt(s)
16	VOC	volatile organic compound
17		
18	yr	year(s)

1.0 Introduction

Under the Nuclear Regulatory Commission's (NRC's) environmental protection regulations in Title 10 of the Code of Federal Regulations (CFR) Part 51, which implement the National Environmental Policy Act of 1969 (NEPA), renewal of a nuclear power plant operating license (OL) requires the preparation of an environmental impact statement (EIS). In preparing the EIS, the NRC staff is required first to issue the statement in draft form for public comment and then issue a final statement after considering public comments on the draft. To support the preparation of the EIS, the staff has prepared a *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996; 1999).^(a) The GEIS is intended to (1) provide an understanding of the types and severity of environmental impacts that may occur as a result of license renewal of nuclear power plants under 10 CFR Part 54, (2) identify and assess the impacts that are expected to be generic to license renewal, and (3) support 10 CFR Part 51 to define the number and scope of issues that need to be addressed by the applicants in plant-by-plant renewal proceedings. Use of the GEIS guides the preparation of complete plant-specific information in support of the OL renewal process.

Exelon Generation Company, LLC (Exelon) operates Quad Cities Units 1 and 2 in Illinois under OLs DPR-29 and DPR-30, which were issued by the NRC. These OLs will both expire on December 14, 2012. On January 3, 2003, Exelon submitted an application to the NRC for renewal of the Quad Cities Units 1 and 2 OLs for an additional 20 years under the procedures in 10 CFR Part 54 (Exelon 2003a). Exelon is a *licensee* for the purposes of its current OLs and an *applicant* for the renewal of the OLs. Pursuant to 10 CFR 54.23 and 51.53(c), Exelon submitted an Environmental Report (ER) in which Exelon analyzed the environmental impacts associated with the proposed license renewal action, considered alternatives to the proposed action, and evaluated mitigation measures for reducing adverse environmental effects (Exelon 2003b).

This report is the draft plant-specific supplement to the GEIS (the supplemental EIS [SEIS]) for the Exelon license renewal application. This draft SEIS is a supplement to the GEIS because it relies, in part, on the findings of the GEIS. The staff will also prepare a separate safety evaluation report in accordance with 10 CFR Part 54.

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

1.1 Report Contents

The following sections of this introduction (1) describe the background for the preparation of this SEIS, including the development of the GEIS and the process used by the staff to assess the environmental impacts associated with license renewal; (2) describe the proposed Federal action to renew the Quad Cities Units 1 and 2 OLS; (3) discuss the purpose and need for the proposed action; and (4) present the status of Exelon's compliance with environmental quality standards and requirements that have been imposed by Federal, state, regional, and local agencies that are responsible for environmental protection.

The ensuing chapters of this draft SEIS closely parallel the contents and organization of the GEIS. Chapter 2 describes the site, power plant, and interactions of the plant with the environment. Chapters 3 and 4, respectively, discuss the potential environmental impacts of plant refurbishment and plant operation during the renewal term. Chapter 5 contains an evaluation of potential environmental impacts of plant accidents and includes a consideration of severe accident mitigation alternatives (SAMAs). Chapter 6 discusses the uranium fuel cycle and solid waste management. Chapter 7 discusses decommissioning, and Chapter 8 discusses alternatives to license renewal. Finally, Chapter 9 summarizes the findings of the preceding chapters and draws conclusions about the adverse impacts that cannot be avoided; the relationship between short-term uses of the human environment and the maintenance and enhancement of long-term productivity; and the irreversible or irretrievable commitment of resources. Chapter 9 also presents the staff's preliminary recommendation with respect to the proposed license renewal action.

Additional information is included in appendices. Appendix A contains public comments received on the environmental review for license renewal and staff responses. Appendices B through G, respectively, list the following:

- the preparers of the supplement
- the chronology of NRC correspondence regarding this draft SEIS
- the organizations contacted during the development of this draft SEIS
- Exelon's permit compliance status (Table E-1) and copies of consultation correspondence prepared and sent during the evaluation process
- GEIS environmental issues that are not applicable to Quad Cities Units 1 and 2
- severe accident mitigation alternatives.

1.2 Background

Use of the GEIS, which examines the possible environmental impacts that could occur as a result of renewing individual nuclear power plant OLs under 10 CFR Part 54, and the established license renewal evaluation process support the thorough evaluation of the impacts of the renewal of OLs.

1.2.1 Generic Environmental Impact Statement

The NRC initiated a generic assessment of the environmental impacts associated with the license renewal term to improve the efficiency of the license renewal process by documenting the assessment results and codifying the results in the Commission's regulations. This assessment is provided in the GEIS, which serves as the principal reference for all nuclear power plant license renewal EISs.

The GEIS documents the results of the systematic approach that was taken to evaluate the environmental consequences of renewing the licenses of individual nuclear power plants and operating them for an additional 20 years. For each potential environmental issue, the GEIS (1) describes the activity that affects the environment, (2) identifies the population or resource that is affected, (3) assesses the nature and magnitude of the impact on the affected population or resource, (4) characterizes the significance of the effect for both beneficial and adverse effects, (5) determines whether the results of the analysis apply to all plants, and (6) considers whether additional mitigation measures would be warranted for impacts that would have the same significance level for all plants.

The NRC's standard of significance was established using the Council on Environmental Quality (CEQ) terminology for "significantly" (40 CFR 1508.27, which requires consideration of both "context" and "intensity"). Using the CEQ terminology, the NRC established three significance levels—SMALL, MODERATE, or LARGE. The definitions of the three significance levels are set forth in the footnotes to Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, as follows:

SMALL – Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.

MODERATE – Environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.

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

Introduction

The GEIS assigns a significance level to each environmental issue, assuming that ongoing mitigation measures would continue.

The GEIS includes a determination of whether the analysis of the environmental issue could be applied to all plants and whether additional mitigation measures would be warranted. Issues are then assigned a Category 1 or a Category 2 designation. As set forth in the GEIS, **Category 1** issues are those that meet all of the following criteria:

- (1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristics.
- (2) A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective off-site radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal).
- (3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely to not be sufficiently beneficial to warrant implementation.

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

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

In the GEIS, the staff assessed 92 environmental issues and determined that 69 qualified as Category 1 issues, 21 qualified as Category 2 issues, and 2 issues were not categorized. The latter 2 issues, environmental justice and chronic effects of electromagnetic fields, are to be addressed in a plant-specific analysis. Of the 92 issues, 11 are related only to refurbishment, 6 are related only to decommissioning, 67 apply only to operation during the renewal term, and 8 apply to both refurbishment and operation during the renewal term. A summary of the findings for all 92 issues in the GEIS is codified in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B.

1.2.2 License Renewal Evaluation Process

An applicant seeking to renew its OLS is required to submit an ER as part of its application (10 CFR 54.23). The license renewal evaluation process involves a careful review of the applicant's ER and assurance that all new and potentially significant information not already

addressed in or available during the GEIS evaluation is identified, reviewed, and assessed to verify the environmental impacts of the proposed license renewal.

In accordance with 10 CFR 51.53(c)(2) and (3), the ER submitted by the applicant must

- provide an analysis of the Category 2 issues in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B in accordance with 10 CFR 51.53(c)(3)(ii)
- discuss actions to mitigate any adverse impacts associated with the proposed action and environmental impacts of alternatives to the proposed action.

In accordance with 10 CFR 51.53(c)(2), the ER does not need to

- consider the economic benefits and costs of the proposed action and alternatives to the proposed action except insofar as such benefits and costs are either (1) essential for making a determination regarding the inclusion of an alternative in the range of alternatives considered or (2) relevant to mitigation
- consider the need for power and other issues not related to the environmental effects of the proposed action and the alternatives
- discuss any aspect of the storage of spent fuel within the scope of the generic determination in 10 CFR 51.23(a) in accordance with 10 CFR 51.23(b)
- contain an analysis of any Category 1 issue unless there is significant new information on a specific issue—this is pursuant to 10 CFR 51.23(c)(3)(iii) and (iv).

New and significant information is (1) information that identifies a significant environmental issue not covered in the GEIS and codified in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, or (2) information that was not considered in the analyses summarized in the GEIS and that leads to an impact finding that is different from the finding presented in the GEIS and codified in 10 CFR Part 51.

In preparing to submit its application to renew the Quad Cities Units 1 and 2 OLS, Exelon developed a process to ensure that information not addressed in or available during the GEIS evaluation regarding the environmental impacts of license renewal for Quad Cities Units 1 and 2 would be properly reviewed before submitting the ER and to ensure that such new and potentially significant information related to the renewal of the licenses would be identified, reviewed, and assessed during the period of the NRC review. Exelon reviewed the Category 1 issues that appear in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, to verify that the conclusions of the GEIS remained valid with respect to Quad Cities Units 1 and 2. This review

Introduction

1 was performed by personnel from Exelon and its support organization who were familiar with
2 NEPA issues and the scientific disciplines involved in the preparation of a license renewal ER.

3
4 The NRC staff also has a process for identifying new and significant information. That process
5 is described in detail in *Standard Review Plans for Environmental Reviews for Nuclear Power*
6 *Plants, Supplement 1: Operating License Renewal (ESRP)*, NUREG-1555, Supplement 1
7 (NRC 2000). The search for new information includes (1) review of an applicant's ER and the
8 process for discovering and evaluating the significance of new information; (2) review of
9 records of public comments; (3) review of environmental quality standards and regulations;
10 (4) coordination with Federal, state, and local environmental protection and resource agencies;
11 and (5) review of the technical literature. New information discovered by the staff is evaluated
12 for significance using the criteria set forth in the GEIS. For Category 1 issues where new and
13 significant information is identified, reconsideration of the conclusions for those issues is limited
14 in scope to the assessment of the relevant new and significant information; the scope of the
15 assessment does not include other facets of the issue that are not affected by the new
16 information.

17
18 Chapters 3 through 7 discuss the environmental issues considered in the GEIS that are
19 applicable to Quad Cities Units 1 and 2. At the beginning of the discussion of each set of
20 issues, there is a table that identifies the issues to be addressed and lists the sections in the
21 GEIS where the issue is discussed. Category 1 and Category 2 issues are listed in separate
22 tables. For Category 1 issues for which there is no new and significant information, the table is
23 followed by a set of short paragraphs that state the GEIS conclusion codified in Table B-1 of
24 10 CFR Part 51, Subpart A, Appendix B, followed by the staff's analysis and conclusion. For
25 Category 2 issues, in addition to the list of GEIS sections where the issue is discussed, the
26 tables list the subparagraph of 10 CFR 51.53(c)(3)(ii) that describes the analysis required and
27 the SEIS sections where the analysis is presented. The SEIS sections that discuss the
28 Category 2 issues are presented immediately following the table.

29
30 The NRC prepares an independent analysis of the environmental impacts of license renewal
31 and compares these impacts with the environmental impacts of alternatives. The evaluation of
32 the Exelon license renewal application began with publication of a notice of acceptance in the
33 *Federal Register* (68 FR 10273 [NRC 2003a]) on March 4, 2003. The staff published a notice
34 of intent to prepare an EIS and conduct scoping (68 FR 12385 [NRC 2003b]) on March 14,
35 2003. Two public scoping meetings were held on April 8, 2003, in Moline, Illinois. Comments
36 received during the scoping period were summarized in the *Environmental Impact Statement*
37 *Scoping Process: Summary Report — Quad Cities Units 1 and 2, Illinois* (NRC 2003c) dated
38 June 16, 2003. Comments applicable to this environmental review are presented in Part 1 of
39 Appendix A.
40

1 The staff followed the review guidance contained in the ESRP. The staff and its contractors
2 retained to assist the staff visited the Quad Cities site on March 12, 2003, to gather information
3 and to become familiar with the site and its environs. The staff also reviewed the comments
4 received during scoping and consulted with Federal, state, regional, and local agencies. A list
5 of the organizations consulted is provided in Appendix D. Other documents related to Quad
6 Cities were reviewed and are referenced in this report.

7
8 This draft SEIS presents the staff's analysis that considers and weighs the environmental
9 effects of the proposed renewal of the OLs, the environmental impacts of alternatives to license
10 renewal, and the mitigation measures available for avoiding adverse environmental effects.
11 Chapter 9, "Summary and Conclusions," provides the NRC staff's preliminary recommendation
12 to the Commission on whether or not the adverse environmental impacts of license renewal are
13 so great that preserving the option of license renewal for energy-planning decisionmakers
14 would be unreasonable.

15
16 A 75-day comment period will begin on the date of publication of the U.S. Environmental
17 Protection Agency Notice of Filing of the draft SEIS to allow members of the public to comment
18 on the preliminary results of the NRC staff's review. During this comment period, two public
19 meetings will be held in Moline, Illinois, in December 2003. During these meetings, the staff will
20 describe the preliminary results of the NRC environmental review and will answer questions
21 related to it to provide members of the public with information to assist them in formulating their
22 comments.

23 24 **1.3 The Proposed Federal Action**

25
26 The proposed Federal action is renewal of the OLs for Quad Cities Units 1 and 2. The Quad
27 Cities nuclear plant is located on the bank of the Mississippi River in Rock Island County,
28 Illinois. The Quad Cities (Moline/East Moline, Rock Island, Davenport, and Bettendorf) are the
29 largest cities within 80 km (50 mi) of Quad Cities Units 1 and 2.

30
31 The current OLs for Unit 1 and Unit 2 expire on December 14, 2012. By letter dated January 3,
32 2003, Exelon submitted an application to the NRC (Exelon 2003a) to renew these OLs for an
33 additional 20 years of operation (i.e., until December 14, 2032).

34
35 The plant has two boiling water reactors designed by General Electric Company. Each reactor
36 has a design rating for a net electrical-power output of 930 megawatts electric [MW(e)]. Once-
37 through cooling water from the Mississippi River is used to remove heat from the main (turbine)
38 condensers via the circulating-water system and from other auxiliary equipment via the service
39 water system. Quad Cities produces enough electricity to supply the needs of 350,000
40 industrial users, commercial establishments, and residences.

1.4 The Purpose and Need for the Proposed Action

Although a licensee must have a renewed license to operate a reactor beyond the term of the existing OL, the possession of that license is just one of a number of conditions that must be met for the licensee to continue plant operation during the term of the renewed license. Once an OL is renewed, state regulatory agencies and the owners of the plant will ultimately decide whether the plant will continue to operate based on factors such as the need for power or other matters within the state's jurisdiction or the purview of the owners.

Thus, for license renewal reviews, the NRC has adopted the following definition of purpose and need from GEIS Section 1.3 (NRC 1996).

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

This definition of purpose and need reflects the Commission's recognition that, unless there are findings in the safety review required by the Atomic Energy Act of 1954 (AEA 1954) or findings in the NEPA environmental analysis that would lead the NRC to reject a license renewal application, the NRC does not have a role in the energy-planning decisions of state regulators and utility officials as to whether a particular nuclear power plant should continue to operate. From the perspective of the licensee and the state regulatory authority, the purpose of renewing an OL is to maintain the availability of the nuclear plant to meet system energy requirements beyond the current term of the plant's license.

1.5 Compliance and Consultations

Exelon is required to hold certain Federal, state, and local environmental permits, as well as meet relevant Federal and state statutory requirements. In the Quad Cities ER (Exelon 2003b), Exelon provided a list of the authorizations from Federal, state, and local authorities for current operations, as well as environmental approvals and consultations associated with renewal of the Quad Cities OLs. Authorizations and consultations most relevant to the proposed OL renewal actions are included in Appendix E.

The staff reviewed the list and consulted with the appropriate Federal, state, and local agencies to identify any compliance or permit issues or environmental issues of concern to the reviewing agencies. These agencies did not identify any new and significant environmental issues. The ER (Exelon 2003b) states that Exelon is in compliance with applicable environmental standards

1 and requirements for Quad Cities Units 1 and 2. The staff has not identified any environmental
2 issues that are both new and significant.

3 4 **1.6 References**

5
6 10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy*, Part 51, "Environmental
7 Protection Regulations for Domestic Licensing and Related Regulatory Functions."

8
9 10 CFR Part 54. Code of Federal Regulations, Title 10, *Energy*, Part 54, "Requirements for
10 Renewal of Operating Licenses for Nuclear Power Plants."

11
12 40 CFR Part 1508. Code of Federal Regulations, Title 40, *Regulations for Implementing the*
13 *Procedural Provisions of the National Environmental Policy Act*, Part 1508, "Terminology and
14 Index."

15
16 Atomic Energy Act of 1954 (AEA). 42 USC 2011, et seq.

17
18 Exelon Generation Company (Exelon). 2003a. *Application for Renewed Operating Licenses,*
19 *Quad Cities Units 1 and 2.* Docket Nos. 50-254 and 50-265, Warrenville, Illinois.

20
21 Exelon Generation Company (Exelon). 2003b. *Applicant's Environmental Report — Operating*
22 *License Renewal Stage Quad Cities Units 1 and 2.* Docket Nos. 50-254 and 50-265.
23 Warrenville, Illinois.

24
25 National Environmental Policy Act of 1969 (NEPA). 42 USC 4321, et seq.

26
27 U.S. Nuclear Regulatory Commission (NRC). 1996. *Generic Environmental Impact Statement*
28 *for License Renewal of Nuclear Plants.* NUREG-1437, Volumes 1 and 2, Washington, D.C.

29
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31 *for License Renewal of Nuclear Plants, Main Report*, "Section 6.3 – Transportation, Table 9.1,
32 Summary of findings on NEPA issues for license renewal of nuclear power plants, Final
33 Report." NUREG-1437, Volume 1, Addendum 1, Washington, D.C.

34
35 U.S. Nuclear Regulatory Commission (NRC). 2000. *Standard Review Plans for Environmental*
36 *Reviews for Nuclear Power Plants, Supplement 1: Operating License Renewal.* NUREG-1555,
37 Supplement 1, Washington, D.C.

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Introduction

1 License Nos. DPR-29, and DPR-30 for an Additional 20-Year Period." *Federal Register*, Vol.
2 68, No. 42, pp. 10274–10275. March 4, 2003.

3
4 U.S. Nuclear Regulatory Commission (NRC). 2003b. "Notice of Intent to Prepare an
5 Environmental Impact Statement and Conduct Scoping Process." *Federal Register*, Vol. 68,
6 No. 50, pp. 12385-12386. March 14, 2003.

7
8 U.S. Nuclear Regulatory Commission (NRC). 2003c. *Environmental Impact Statement*
9 *Scoping Process: Summary Report — Quad Cities Units 1 and 2, Moline, Illinois*. Washington,
10 D.C. June 16, 2003.
11

2.0 Description of the Nuclear Power Plant and Site and Plant Interaction with the Environment

Exelon Generation Company's (Exelon's) Quad Cities Plant is located on the shore of the Mississippi River near East Moline, Illinois. The plant's two units, Unit 1 and Unit 2, are operating nuclear reactors and are the subject of this action. Each nuclear reactor is a boiling water reactor (BWR) which produces steam that turns turbines to generate electricity. In addition to the nuclear units, the site features intake and discharge canals, auxiliary buildings, switchyards, and a spent fuel pool. The plant and its environs are described in Section 2.1, and the plant's interaction with the environment is presented in Section 2.2.

2.1 Plant and Site Description and Proposed Plant Operation During the Renewal Term

Quad Cities Units 1 and 2 are located on 331 ha (817 ac) of Exelon-owned land in Rock Island County, Illinois. Quad Cities is 32 km (20 mi) northeast of the Quad Cities Metropolitan Area of Davenport and Bettendorf, Iowa, and Rock Island, Moline and East Moline, Illinois (Exelon 2003a). The site is on the east bank of Pool 14 of the Mississippi River, between Lock and Dams 13 and 14 and approximately 810 km (506 mi) upstream from its confluence with the Ohio River. The west bank of the Mississippi River, visible from the plant site, is in Iowa. Figures 2-1 and 2-2 show the site location and features within 80 km (50 mi) and 10 km (6 mi), respectively. There are four counties within the 10 km (6 mi) radius of the site: Rock Island and Whiteside counties in Illinois and Scott and Clinton counties in Iowa. In addition to the two nuclear reactors and associated structures, the site includes a retired spray canal now used as a facility to raise game fish for release into the Mississippi River (Exelon 2003a).

The region surrounding the Quad Cities site was identified by the applicant as being in sparseness category 4 and proximity category 2 (Exelon 2003a), using the guidance in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants (GEIS)*, NUREG-1437, Volumes 1 and 2 (NRC 1996; 1999).^(a)

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

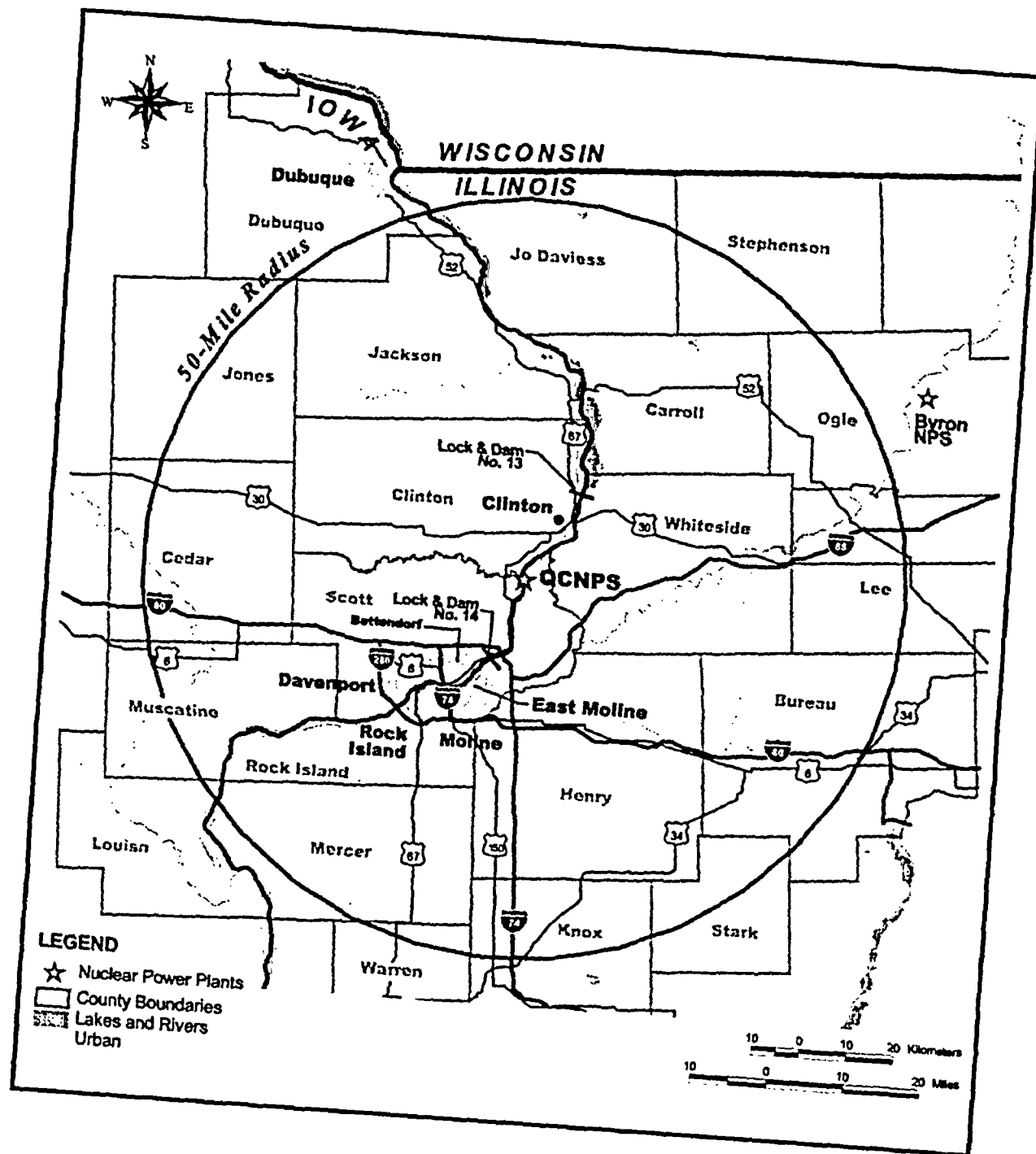


Figure 2-1. Location of Quad Cities, 80-km (50-mi) Region

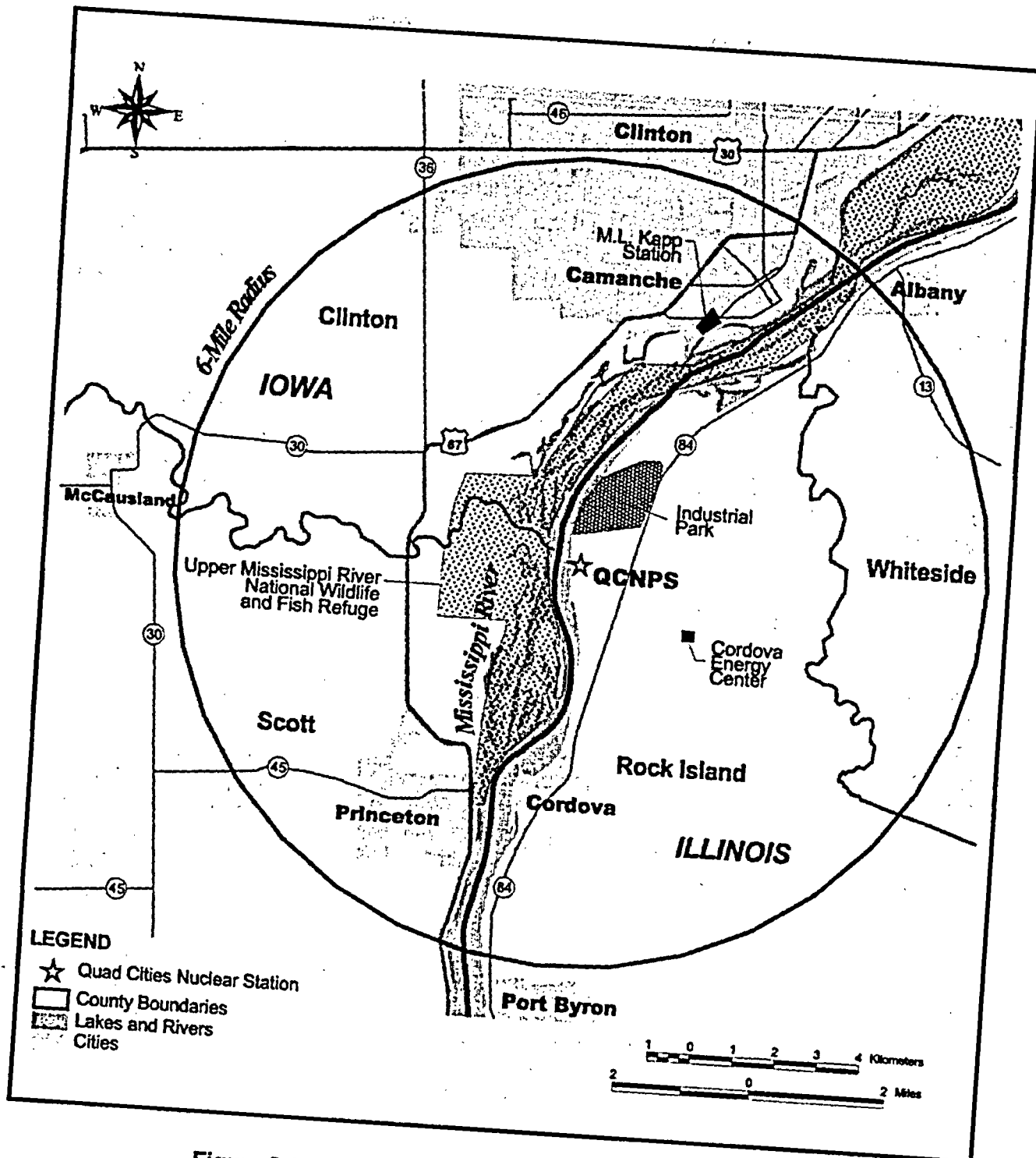


Figure 2-2. Location of Quad Cities, 10-km (6-mi) Region

2.1.1 External Appearance and Setting

The area surrounding the Quad Cities site is rural farmland and woods with an industrial park located 1.6 km (1 mi) north of the station, and the Cordova Energy Center, a gas-fired power plant approximately 1.6 km (1 mi) southeast of the station. The site is flat with a grade level of approximately 2.7 m (9 ft) above maximum flood stage. The Upper Mississippi River National Wildlife and Fish Refuge (NWFR), across the Mississippi River from the Quad Cities site, provides habitat for numerous plant and animal species in wood and wetland areas (Exelon 2003a). The Mississippi River is a source of municipal water and is used for commercial and sport fishing as well as recreational boating.

The major structures include the two reactors, the associated turbine buildings, and ancillary buildings, which are sheathed with metal panels colored in subdued tones, a 94.5-m (310-ft) main stack, and intake and discharge canals. Figure 2-3 identifies the main structures and the station layout. Most of the view of the station is obstructed by evergreen forest, with only the stack and transmission lines being visible from the highway (AEC 1972). The plant structures are clearly visible from the Mississippi River.

2.1.2 Reactor Systems

Quad Cities is a two-unit nuclear-powered steam electric plant. Each unit is a General Electric BWR that produces 2957 megawatts thermal (MW[t])^(a) with a design net electrical capacity of 930 megawatts electric (MW[e]) per unit. The nuclear fuel is low-enriched uranium dioxide with enrichments below 5 percent by weight uranium-235 and fuel burnup levels less than 60,000 megawatt days per metric ton uranium. Unit 1 began commercial operation on February 18, 1973, and Unit 2 began operation on March 10, 1973 (Exelon 2003a). Refueling of the reactors is performed on a 24-month schedule with approximately 33 to 40 percent of the fuel replaced during each refueling outage. At this time, all spent fuel is placed in storage in the spent fuel pool. Exelon plans to build an independent spent fuel storage installation (ISFSI) for storage of spent fuel in dry storage casks. Exelon plans to begin use of the ISFSI in 2005.

Each unit has a primary containment consisting of a drywell, a steel structure that encloses the reactor vessel and related piping, a pressure suppression chamber containing water, and a vent system that connects the drywell to the suppression chamber. The primary containments are designed to limit the release of fission products during a loss-of-coolant accident and contain the reactor vessels, recirculating system and other key components. The reactor building is

(a) In December 2000, Exelon submitted an application for an increase of the rated core thermal power for Quad Cities of 17.8 percent, for an uprated power level from 2511 to 2957 MW(t) (ComEd 2000). The power uprates for both units have been completed.

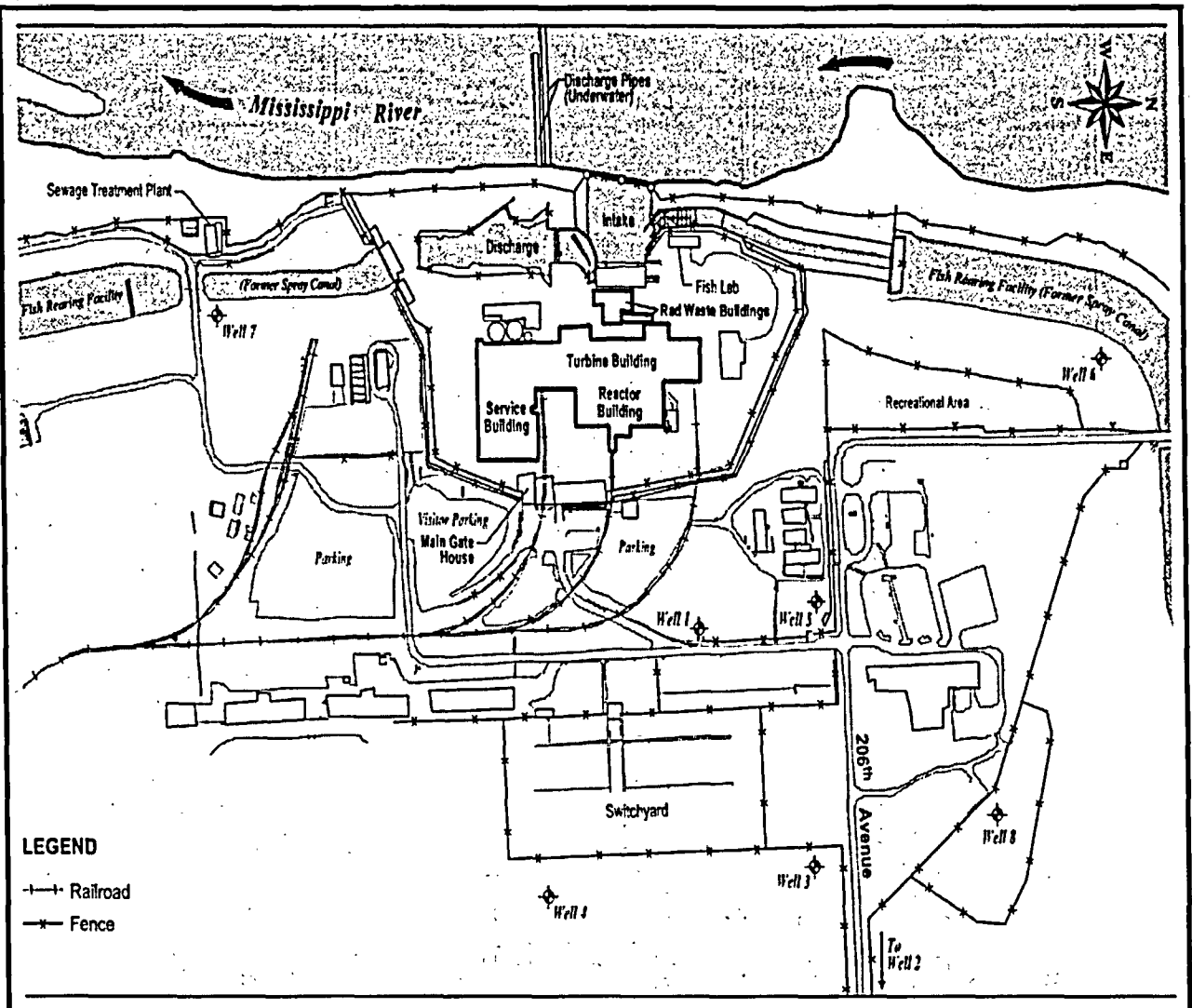


Figure 2-3. Quad Cities Site Layout

Plant and the Environment

shared by both units and contains the primary containments, reactor auxiliary systems, spent fuel storage, and a new fuel storage vault (Exelon 2003c). The concrete reactor building is maintained under a slight negative pressure and provides secondary containment and shielding. The release of the building atmosphere during an accident would be monitored and filtered (Exelon 2003a).

The turbine building is shared by Units 1 and 2 and contains the turbine-generators, exciters, condensers, feedwater and condensate pumps, condenser circulating water systems, and electrical switchgear. The radioactive waste building is a concrete structure located adjacent to the west side of the turbine building. This building is also shared by both units and contains the control, processing, packaging, and storage facilities necessary to process the solid and liquid waste (Exelon 2003c).

2.1.3 Cooling- and Auxiliary-Water Systems

The Mississippi River is the source for cooling and most auxiliary water systems for Quad Cities Units 1 and 2. The plant utilizes a once-through condenser cooling system drawing water from a canal intake structure located along the east side of the river and discharging through submerged piping into the main river channel (Figure 2-4). The total flow of Mississippi River water through Quad Cities Units 1 and 2 for condenser circulating water and service water is approximately 61,000 L/s (970,000 gpm). The temperature increase at the edge of the discharge mixing zone is required to be less than 2.8 °C (5 °F) above ambient (IEPA 2000b).

Condenser cooling water is withdrawn from the Mississippi River through a canal that is perpendicular to the river flow. The 72 m (235 ft) long canal is 55 m (180 ft) wide, and 3.6 m (12 ft) deep where it meets the river. Intake velocity at the mouth of the canal is approximately 0.3 m/s (1 ft/s). A floating boom, extending to a depth of 84 cm (33 in.), traverses the mouth of the canal to deflect floating material. At the other end of the canal, a trash rack consisting of a series of vertical metal bars spaced 6.3 cm (2.5 in.) apart screens large pieces of debris from the intake. Prior to the circulating water pumps, water flows through 12 sets of traveling screens that have a 1-cm (0.38-in.) mesh, to prevent debris and aquatic organisms from being entrained into the cooling system.

Quad Cities utilizes a two-pipe diffuser system to return cooling water to the river. The two pipes are 4.9 m (16 ft) in diameter and lie on the bottom of the river across the main river flow (Figure 2-4). The combined cooling and service water, with an increase of as much as 15.6 °C (28 °F) above intake temperature, is discharged into the deepest part of the river through regularly spaced jet nozzles in the pipes. When both units are operating at full power, approximately 61,000 L/s (970,000 gpm) of cooling water are discharged to the river.

1 The service water system provides strained water from the Mississippi River for cooling several
2 closed-cycle cooling water systems, the recirculation motor-generator set oil coolers, the
3 generator stator coolers, the turbine oil coolers, the generator hydrogen coolers, and other
4 systems. It also is used to wash the circulating water traveling screens and for the fire
5 protection system. The flow rate is variable, and maximum capacity is 4400 L/s (69,000 gpm).
6 The service water pumps draw from the same intake system as the circulating water system.
7 The system discharges to the plant discharge flume that leads to the diffusers.
8

9 The Quad Cities plant has used open-cycle cooling (Figure 2-4) since 1983. Between 1974 and
10 1983, the plant used a three-mile cooling canal with spray coolers and operated in either a
11 closed-cycle mode or partial open-cycle mode. Since the conversion to open-cycle cooling, the
12 canal has been converted to a fish-rearing facility. Walleye and hybrid striped bass fingerlings
13 are reared for release into Pool 14 of the Mississippi River.
14

15 Groundwater from five wells is used for domestic water consumption, for raising fish in the
16 former spray canals, and for other industrial purposes that do not include condenser cooling.
17 Groundwater use has averaged 45 L/s (717 gpm) over the last 10 years. In the winter of 1997,
18 groundwater was used to heat the water in the fish-rearing facility while the plant was shut
19 down. Without this period of high use, the 10-year average yield for the site is approximately
20 31.9 L/s (505 gpm).
21

22 **2.1.4 Radioactive-Waste Management Systems and Effluent-Control Systems**

23

24 Quad Cities uses liquid, gaseous, and solid radioactive waste management systems to collect
25 and process the liquid, gaseous, and solid wastes that are the by-products of operations, before
26 they are released to the environment. The waste disposal systems for Quad Cities meet the
27 design objectives of 10 CFR Part 50, Appendix I (*Numerical Guides for Design Objectives and*
28 *Limiting Conditions for Operation to Meet the Criterion 'As Low as Reasonably Achievable' for*
29 *Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents*).
30

31 Radioactive material in the reactor coolant is the source of gaseous, liquid, and solid radioactive
32 wastes in light water reactors. Radioactive fission products build up within the fuel as a
33 consequence of the fission process. These fission products are primarily contained in the
34 sealed fuel rods, but small quantities escape from the fuel rods and contaminate the reactor
35 coolant. Neutron activation of the primary coolant system is also responsible for coolant
36 contamination.
37
38

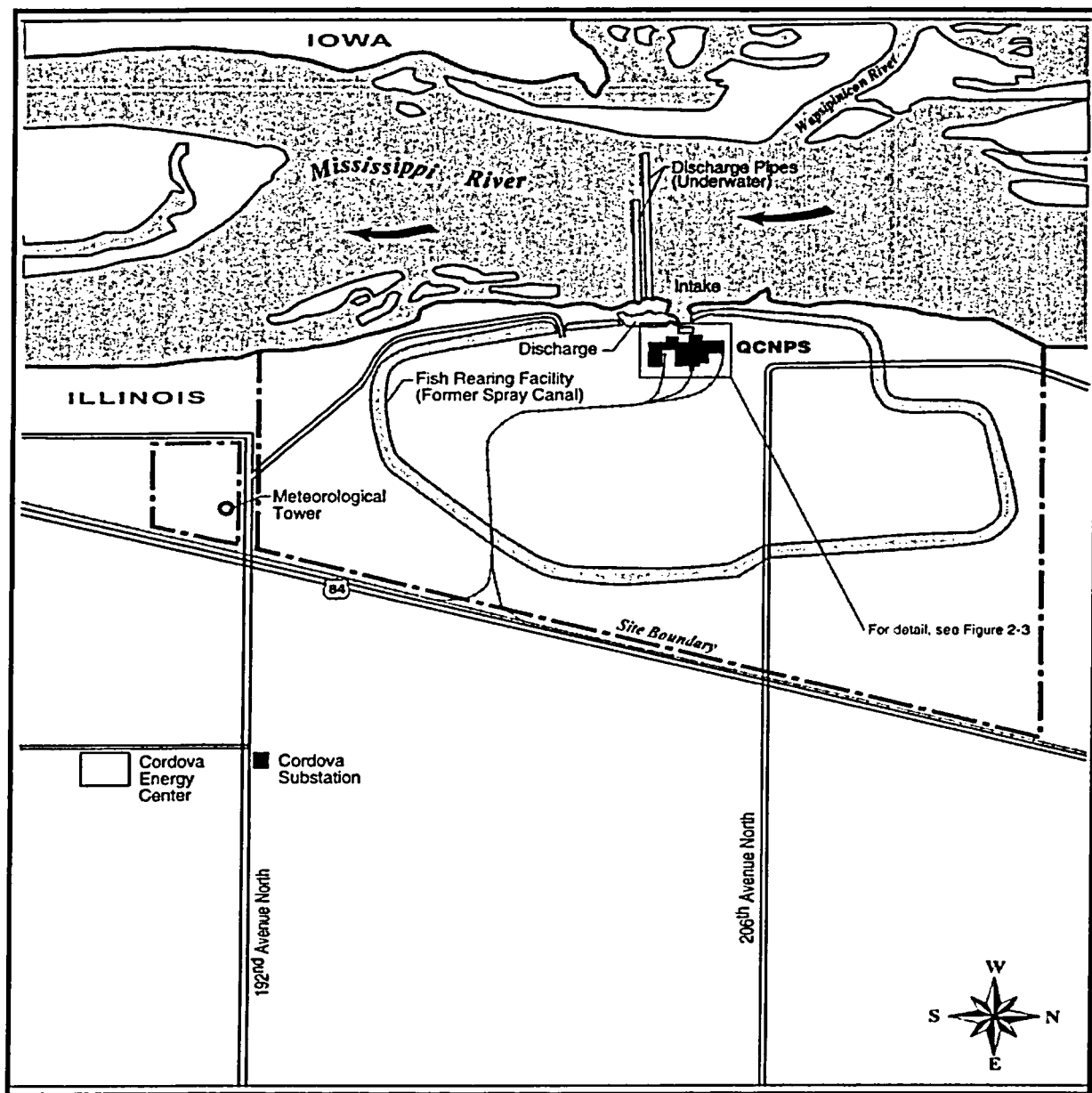


Figure 2-4. Quad Cities Site Cooling System

1 Nonfuel solid wastes result from treating and separating radionuclides from gases and liquids,
2 and from removing contaminated material from various reactor areas. Solid wastes also consist
3 of reactor components, equipment, and tools removed from service, as well as contaminated
4 protective clothing, paper, rags, and other trash generated from plant-design modifications,
5 operations, and routine maintenance activities. Solid wastes are shipped to a waste processor
6 for volume reduction before disposal at a licensed burial site. Spent resins and filters are
7 stored or packaged for shipment to a licensed offsite processing or disposal facility.

8
9 Fuel rods that have exhausted a certain percentage of their fuel and that have been removed
10 from the reactor core for disposal are called spent fuel. The reactor core is refueled
11 approximately every 24 months. Currently, all spent fuel is stored in the spent-fuel pool located
12 in the reactor building. Exelon also plans to build an ISFSI for storage of spent fuel in dry
13 storage casks. Exelon plans to begin use of the ISFSI in 2005.

14
15 The *Offsite Dose Calculation Manual* (ODCM) for Quad Cities (Exelon 2002a) is subject to NRC
16 inspection and describes the methods and parameters used for calculating offsite doses
17 resulting from radioactive gaseous and liquid effluents. It is also used for calculating gaseous
18 and liquid effluent monitoring alarm/trip setpoints for release of effluents from Quad Cities Units
19 1 and 2. Operational limits for releasing liquid and gaseous effluents are specified to ensure
20 compliance with NRC regulations.

21
22 In December 2000, Exelon submitted a request for a license amendment for a power uprate at
23 Quad Cities from 2511 to 2957 MW(t) (ComEd 2000). In December, 2001, NRC granted
24 Exelon a license amendment allowing an increase in power level to 2957 MW(t) for both units at
25 Quad Cities (NRC 2001b). This power uprate was implemented at both units by the end of
26 2002. The reports from Exelon documenting the impact of this 18-percent power uprate on the
27 amount of radioactive material released in effluents from Quad Cities during the first year of full
28 implementation will be submitted to the NRC in May, 2004. Also in December, 2001, NRC
29 issued an environmental assessment of the power uprate (NRC 2001a). In this assessment,
30 the NRC estimated that the power uprate could potentially increase both gaseous and liquid
31 radiological effluent releases by approximately 18 percent. Even if the increase in radiological
32 effluents is as much as 18 percent because of the power uprate, Quad Cities will still meet all
33 NRC limits for the amounts of radiological effluents that may be released. Therefore, the staff
34 finds that the power uprate does not represent new or significant information which would cause
35 it to revisit the GEIS' Category I determinations applicable to Quad Cities. In its finding, the
36 staff relies on the GEIS' generic determinations regarding the environmental impacts of
37 operation by the current fleet of reactors.

2.1.4.1 Liquid-Waste Processing Systems and Effluent Controls

The Quad Cities liquid radioactive waste system is designed to collect, treat, store, and dispose of radioactive liquid wastes. Radioactive liquid wastes are collected in sumps and drain tanks at various locations and then transferred to appropriate tanks in the radwaste building for processing, storage, and release. Liquid wastes that have been demineralized and purified and meet the criteria for reuse are recycled back into the contaminated condensate storage tank. Wastes that have come in contact with organics or other impurities that do not meet the recycle requirements are reprocessed or discharged. Liquid wastes meeting the requirements to be discharged are discharged from the plant to the Mississippi River with dilution from the south diffuser or discharge flume weir.

The liquid waste disposal system segregates lower-activity wastes from higher-activity wastes and is divided into four subsystems: 1) floor drains, 2) waste collector, 3) chemical waste, and 4) laundry drain. The liquid wastes from the floor drains are processed through a filter and a demineralizer and routed to the floor drain sample tanks. These wastes are usually outside the criteria for reuse and are returned to the radwaste system for reprocessing or discharged to the river. Wastes that can be reused are returned to the condensate storage station. The wastes collected in the waste collector tank are high-purity wastes with variable radioactive concentrations. These wastes are processed through a filter and one or more demineralizers, then sent to waste sample tanks. If the wastes do not meet reuse criteria, they are returned for reprocessing or discharged to the river. Wastes in the chemical waste system are from laboratory drains, leakage from reactor water cleanup and fuel pool demineralizer drain valves, and decontamination operations. These wastes may be transferred to the floor or equipment drain system or to the chemical waste sample tank. Laundry wastes are filtered and sent to the laundry sample tank for sampling and further filtering, if required, and then discharged to the river.

Liquid wastes are collected in the river discharge tank in batches and released to the river after sampling and analysis through a monitored radioactive liquid waste line, which is alarmed. The discharge from the tanks is combined with station condenser circulating water and directed to the south diffuser line or discharge flume weir. The radioactive waste discharges to the river are monitored and recorded; the monitoring system provides an alarm to operators if expected radiation levels are exceeded. Prior to release, the liquid wastes are kept in holdup tanks for radioactive decay from one hour to one week.

1 The radwaste system uses four deep-bed demineralizers. Radwaste filter sludges are collected
2 in the waste sludge tank or in the condensate phase-separators. Spent resins from the waste
3 demineralizer are collected in the waste-spent resin tank.
4

5 The power uprate to 2957 MW(t) could increase the activity in the liquid waste discharged by
6 18 percent due to an increase in the flow rate through the condensate demineralizers and
7 increases in the production of fission products and activated corrosion products. Even with
8 these increases, releases will still be within the regulatory limits of 10 CFR Part 50, Appendix I
9 (ComEd 2000).
10

11 During 2001, there were 17 batch releases (Exelon 2002c) with a total volume of 5.8×10^6 liters
12 (Exelon 2002a) prior to mixing with the station condenser circulating water. In this liquid waste,
13 there was a total fission and activation product activity of 1.04×10^9 Bq (0.028 Ci) and a total
14 tritium activity of 7.2×10^{11} Bq (19.4 Ci). These volumes and activities are typical of the annual
15 liquid releases for Quad Cities. The actual liquid waste generated is reported in the *Quad Cities*
16 *Nuclear Power Station's Radioactive Effluent Report for January through December 2001*
17 (Exelon 2002c). See Section 2.2.7 for a discussion of the theoretical doses to the maximally
18 exposed individual as a result of these releases.
19

20 Exelon does not anticipate any increase in liquid waste releases on an annual average basis
21 during the renewal period once the increase in releases due to the power uprate has taken
22 effect.
23

24 2.1.4.2 Gaseous-Waste Processing Systems and Effluent Controls

25

26 The gaseous waste management systems at Quad Cities are designed to filter, monitor, and
27 record the process off-gases before release through the 94.5-m (310-ft) chimney during normal
28 and abnormal plant operation. There is also a system to monitor and record the amount of
29 radioactive material in the air released from the reactor building through the reactor building
30 vent stack (Exelon 2003c). The major source of gaseous effluents from Quad Cities operations
31 are the condenser air ejector effluent and the steam-packing exhaust system effluent which
32 include small quantities of activation gases and noble gases. The gaseous waste system is
33 designed to effectively control and process off-gases and prevent releases over the limits
34 specified in 10 CFR Part 50. The system minimizes releases of radioactive particles to the
35 atmosphere, allowing short-term decay, and minimizes the hazard of explosion of hydrogen and
36 oxygen gas in the off-gas system.
37

38 Three systems are used to process gaseous waste: 1) the off-gas system, 2) the turbine-gland
39 seal system and 3) the mechanical vacuum pump system. The off-gas system collects,

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contains, and processes the radioactive gases that come from the steam condenser and are exhausted by the steam jet ejectors. The steam is condensed and returned as condensate and the noncondensable gases are sent to a holdup pipe and then processed and sent through the efficiency particulate air (HEPA) filters and released through the chimney. The mechanical vacuum pump system establishes and maintains the main condenser vacuum when steam is not available. The vacuum pump effluent is discharged to the chimney (Exelon 2003c).

Releases of gaseous effluents are from two release points: the 94.5-m (310-ft) chimney and the reactor building ventilation stack. Natural dispersion of gases occurs by discharge from the chimney due to the combination of height and exit velocity of the effluent and the buoyancy of the exit gases. Releases from the chimney include radioactive gases from the off-gas system, the turbine gland-seal systems, and the standby gaseous treatment system. Exhaust from the reactor building ventilation systems and the drywell ventilation and purge systems for both units are discharged from the reactor building ventilation stack (Exelon 2003c).

The gaseous effluents released from the chimney and the reactor building stack are sampled on a continuous basis. In addition, there are provisions for sampling gaseous effluents manually at process points, such as at the steam jet air ejector or at the exit of the recombiner. The limits for release of gaseous effluents from Quad Cities are given in the ODCM. The power uprate is expected to increase the activity in gaseous effluents by approximately 18 percent. Even with this increase, releases will still be within the regulatory limits of 10 CFR Part 50, Appendix I (ComEd 2000).

During 2001, a total of 8.9×10^{12} Bq (240 Ci) of noble gases was released to the atmosphere. A total of 3×10^8 Bq (8.1×10^{-3} Ci) of iodine 131, 3.3×10^{12} Bq (89.5 Ci) of tritium, and 7.9×10^8 Bq (0.021 Ci) of beta-gamma emitters was released in gaseous effluents. These activities are typical of the annual gaseous releases for Quad Cities. The details for these radioactive gaseous releases are reported in the *Quad Cities Nuclear Power Station 2001 Annual Radiological Environmental Operating Report* (Exelon 2002b). See Section 2.2.7 for a discussion of the theoretical doses to the maximally exposed individual as a result of these releases.

Exelon does not anticipate any increase in gaseous waste releases on an annual average basis during the renewal period once the increase in releases due to the power uprate has taken effect.

2.1.4.3 Solid-Waste Processing

The solid waste management system is used to process, package, and handle wet and dry solid radioactive waste generated as a result of normal operations at Quad Cities. The process control program is used to process all low-level radioactive wet wastes to meet applicable Federal, state, and burial site requirements. For Class A unstable wastes, there is an in-plant cement solid waste system installed, but it is not normally used. Instead, contract services are used for processing Class A unstable waste. Processing is performed in shielded and ventilated facilities to minimize personnel radiation exposure. Spent-control rod blades and fuel channels are stored in the spent fuel pool to allow for radioactive decay and then packaged and sent offsite for disposal in approved shipping containers.

In 2001, 18 shipments of solid waste were sent to the waste processor and 22 shipments went to the disposal site. For the waste stream of resins, filters, and evaporator bottoms, a volume of 132 m³ with an activity of 2.93×10^{13} Bq (794 Ci) was shipped in 2001. Dry, active waste shipments in that year totaled 638 m³ and had an activity of 7.7×10^{11} Bq (20.8 Ci). A volume of 7.12 m³ and activity of 2.2×10^{15} Bq (6×10^4 Ci) of irradiated components was shipped offsite in 2001. These volumes and activities are typical of the annual solid waste production for Quad Cities, and the power uprate is not expected to significantly impact the estimates of shipped radioactive waste (Exelon 2003c). The actual solid waste generated is reported in the *Quad Cities Nuclear Power Station's Radioactive Effluent Report* for January through December 2001 (Exelon 2002c).

2.1.5 Nonradioactive Waste Systems

Plant effluents containing chemicals used for plant operation, such as chemicals added to cooling water, process-water streams for control of marine fouling and for maintenance of water quality are released from the plant by the cooling-water blowdown discharge to the river. Based on information from the 1972 Final Environmental Statement (FES) and review of recent applicant environmental reports, releases of these chemicals to the river are only a small fraction of established limits (AEC 1972, ComEd 2000). The station has its own operable sewage treatment plant, licensed by the State of Illinois. The station monitors wastewater streams and discharges to the Mississippi River from the wastewater treatment system, the sanitary waste treatment plant, and the open-cycle diffusers, covered under NPDES Permit No. IL0005037 (ComEd 2000).

2.1.6 Plant Operation and Maintenance

Routine maintenance performed on plant systems and components is necessary for safe and reliable operation of a nuclear power plant. Maintenance activities conducted at Quad Cities include inspection, testing, and surveillance to maintain the current licensing basis of the plant and to ensure compliance with environmental and safety requirements. Certain activities can be performed while the reactor is operating. Other activities require that the plant be shut down. Long-term outages are scheduled for refueling and for certain types of repairs or maintenance, such as replacement of a major component. Exelon refuels each of the Quad Cities units about every 24 months on a staggered schedule. Each outage is typically scheduled to last about 20 days, and 33 to 40 percent of the core is replaced at each refueling. Approximately 1100 additional workers are onsite during a typical reactor outage.

Exelon performed an aging management review and developed an integrated plant assessment (IPA) for managing the effects of aging on systems, structures, and components in accordance with 10 CFR Part 54. The aging management program is described in the *Application for Renewed Operation Licenses, Quad Cities Nuclear Power Station, Units 1 and 2, Appendix B* (Exelon 2003b). The IPA identified the programs and inspections that are managing the effects of aging at Quad Cities Units 1 and 2. Exelon expects to conduct activities related to the management of aging effects during plant operation or during normal refueling and other outages, but no outages specifically for refurbishment activities are planned. Exelon has no other plans to add additional full-time staff (non-outage workers) at the plant during the license renewal period.

2.1.7 Power Transmission System

Four 345-kV transmission lines connecting Quad Cities Units 1 and 2 to the transmission system were identified in the FES for operation of Quad Cities Units 1 and 2 (AEC 1972). These lines included a pair of lines extending east to the Nelson substation in Illinois (Nelson lines), a line to the Iowa-Illinois Gas and Electric Company's substation 39 in Rock Island County, Illinois (Barstow line), and a line to substation 56 near Davenport, Iowa (Davenport line). According to the FES, the lines to substations 39 and 56 were planned and would have been to an alternate source of power in the area had Quad Cities Units 1 and 2 not been built. The FES only considers the impact of the lines to the Nelson substation. Potential electric shock impacts of the Barstow and Davenport lines, which were built along slightly different rights-of-way, were not considered in the FES.

Exelon describes changes that have been made since 1972 in the way that Quad Cities Units 1 and 2 are connected to the transmission system (Exelon 2003a). Quad Cities Units 1 and 2 are now connected to the transmission system by five lines. The Davenport line now connects the plant to the transmission system at a new substation (substation 91) about 21 km (12.8 mi) from the Quad Cities plant. In 2000, a new substation was built on the Barstow and southern Nelson lines about 3 km (2 mi) southeast of the Quad Cities site. A new 345-kV line (the Rock Creek line) has been constructed from Quad Cities Units 1 and 2 to the Rock Creek substation on the north side of the Mississippi River near Comanche, Iowa. The Nelson line currently terminates at the Northwest Steel and Wire substation, 33 miles from the Quad Cities plant.

The transmission lines considered to be within the scope of this review include the entire lengths of the four transmission lines described in the FES (AEC 1972) and the new line to the Rock Creek substation. These lines and their corridors are shown in Figure 2-5 and listed in Table 2-1. The corridors have a total length of approximately 185 km (115 mi) and cover

Table 2-1. Quad Cities Transmission Line Corridors

Substation (line)	Number of Lines	kV	Approximate Corridor Length		Corridor (Right-of-Way) Width		Estimated Corridor Area	
			km	(mi)	m	(ft)	ha	(ac)
Davenport (0401)	1	345	20.6	12.8	55	180	110	280
Barstow (0402)	1	345	28.1 ^(a)	17.5 ^(a)	158, 44 ^(b)	520, 145 ^(b)	160 ^(c)	400 ^(c)
Nelson (South line 0403)	1	345	67.4 ^(a)	41.9 ^(a)	158, 44 ^(b)	520, 145 ^(b)	330 ^(c)	830 ^(c)
Nelson (North line 0404)	1	345	63.9	39.7	44	145	280	700
Rock Creek (0405)	1	345	8.0	5	52	170	40	100
Total	5	185	115				880	2200

Source: Exelon 2003a (Note: Totals are derived based on information in the ER.)

(a) The initial 3.2 km (2 mi) of corridor is shared by Barstow and Nelson South lines. The initial 3.2 km is counted once in the total.

(b) The initial 3.2 km (2 mi) of the corridor is 158 m (520 ft) wide.

(c) The area includes the area of the shared corridor but this area is only included once in the total.

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approximately 880 ha (2200 ac). The Davenport (0401) and Barstow (0402) lines are owned and operated by the MidAmerican Energy Company; the two lines to the Nelson substation (0403 and 0404) are owned and operated by Commonwealth Edison Company (ComEd); and the Rock Creek line (0405) is owned and operated by Alliant Energy (Exelon 2003a).

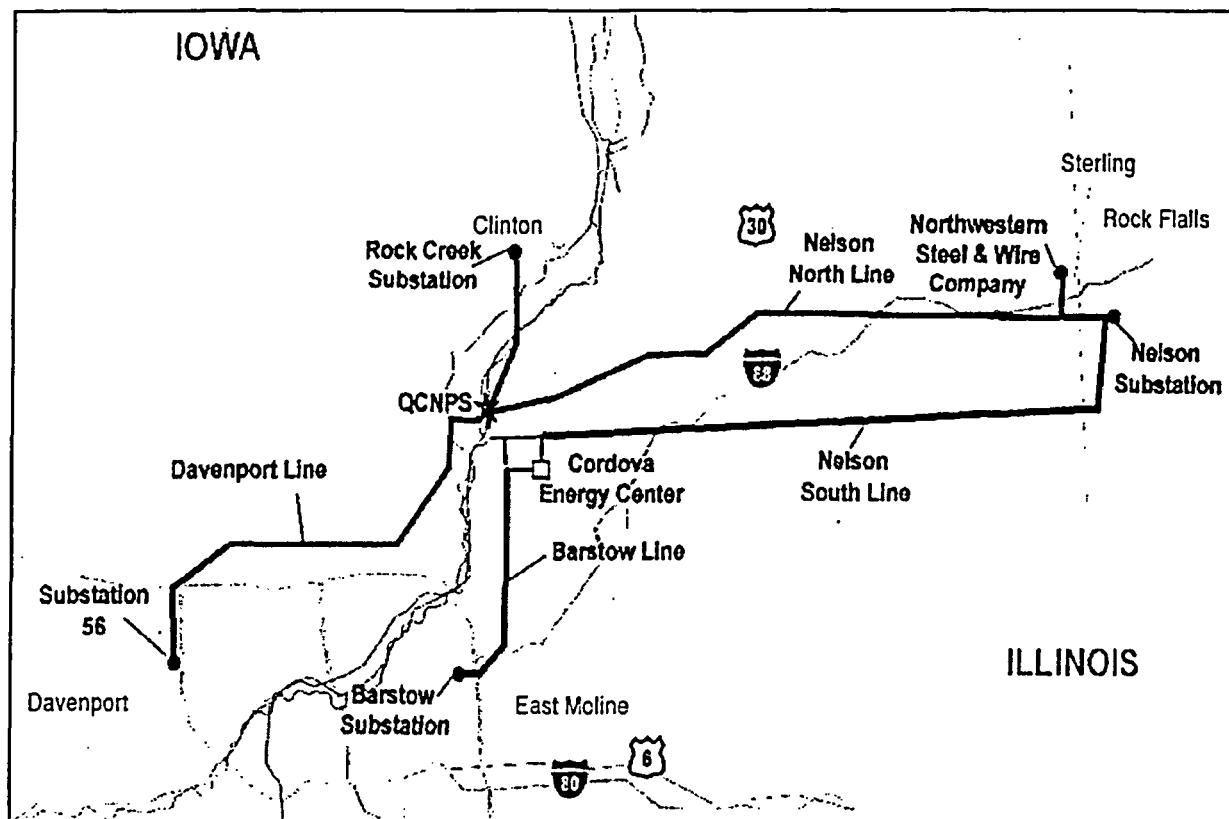


Figure 2-5. Quad Cities Units 1 and 2 Transmission Lines

The Davenport transmission line passes through both the Upper Mississippi River NWFR as well as the Princeton State Wildlife Management Area (in Iowa, managed by the Upper Mississippi River NWFR). Except for these two areas, the transmission line corridors generally pass through agricultural lands cultivated for row crops and pasture that are typical of eastern Iowa and northwestern Illinois. The Davenport and Rock Creek transmission lines cross the

Mississippi River, although for a very short distance, and the two Nelson lines cross the Rock River. All five of the lines cross other small creeks and their tributaries.

The transmission corridors are maintained by trimming and mowing, and by the use of approved herbicides (Cunningham 2003; Exelon 2003a; Exelon 2003d; Exelon 2003e). vegetation management follows a three-to-six-year cycle (Cunningham 2003; Exelon 2003e).

2.2 Plant Interaction with the Environment

Sections 2.2.1 through 2.2.8 provide general descriptions of the environment near Quad Cities Units 1 and 2 as background information. They also provide detailed descriptions where needed to support the analysis of potential environmental impacts of refurbishment and operation during the renewal term, as discussed in Chapters 3 and 4. Section 2.2.9 describes the historic and archaeological resources in the area, and Section 2.2.10 describes possible impacts associated with other Federal project activities.

2.2.1 Land Use

The Quad Cities site is located in the Upper Mississippi Basin, on the Illinois side of the Mississippi River approximately 80 km (50 mi) south of the northern boundary of the State of Illinois and 810 km (506 mi) upstream from its confluence with the Ohio River. The site is on moderately high ground that rises abruptly from the surface of the river to form bluffs between 6 m (20 ft) and 12 m (40 ft) high. It is situated in the Meredosia Channel, an ancient channel of the Mississippi River. The topography of the site is flat, with an elevation of 7 m (23 ft) above normal river level and a grade level approximately 2.7 m (9 ft) above the maximum recorded flood stage over a 102-year period. The river flow of the adjacent Pool 14 (an approximately 40-km [25-mi] section), between Lock and Dam 13 and Lock and Dam 14 is controlled below flood stage.

Approximately 40 ha (100 ac) of the western and northern portions of the Quad Cities site (Figure 2-3), are industrial in character, containing the major generating facilities, switchyard, warehouses, training center, offices, parking lots, and roads. Approximately 40 ha (100 ac) of forests, including areas of planted pines along Illinois State Route 84, and 211 ha (527 ac) of open fields and scrub woodlands occupy most of the eastern and southern portions of the site. The retired spray canal, approximately 5 km (3 mi) long and 76 m (250 ft) wide, surrounds the plant and occupies approximately 36 ha (90 ac); it is now utilized as a fish-rearing facility (Exelon 2003a). A publicly available, paved bicycle trail passes along the eastern edge of the

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site property, adjacent to Route 84. The Rock Island County Land Use Plan designates the site area as industrial use (Rock Island County Land Use Plan 1998).

2.2.2 Water Use

The Mississippi River is the source for cooling and most auxiliary water systems. Quad Cities Units 1 and 2 utilize a once-through condenser cooling system. The total design flow of Mississippi River water through Quad Cities Units 1 and 2 for condenser circulating water and service water is 61,000 L/s (970,000 gpm, or 2,160 cfs). At Camanche, Iowa, approximately 10 km (6 mi) upstream of the Quad Cities site, the Mississippi River has an annual mean flow of 1,380,000 L/s (48,750 cfs) (USGS 2000). The Wapsipinicon River flows into the Mississippi River from the west immediately upstream of the Quad Cities site, contributing an additional 48,000 L/s (1700 cfs) (USGS 2000), bringing the average river flow at the Quad Cities site to 1,430,000 L/s (50,500 cfs).

In addition, there are currently five operating wells (Figure 2-3) providing water to various systems on the property. The two primary wells for station operations are Wells 1 and 5. These wells provide water for the domestic drinking water system, make-up demineralizer system, and gland-seal condenser. The largest single use of groundwater is to maintain the former spray canal for raising fish. Water for this purpose is drawn from Well 6 and Well 7. The final well, Well 8, provides water for fire fighter training exercises. Wells 2, 3, and 4 have been capped or abandoned.

Groundwater use from all wells has averaged 45 L/s (717 gpm) over the last 10 years. In the winter of 1997, groundwater was used to raise the temperature of the water in the fish-rearing facility while the plant was shut down. Without this period of high use, the 10-year average yield for the site is approximately 31.9 L/s (505 gpm). There is no water piped to the facility from offsite water supply systems. Movement of groundwater at the site typically is toward the Mississippi River, except for short periods associated with high river level.

2.2.3 Water Quality

Quad Cities operates with approximately 61,000 L/s (970,000 gpm) discharged to the river with two units running at full power. The combined cooling and service water, heated 15.6 °C (28 °F) above the intake temperature, is discharged through two 4.9-m (16-ft) diameter diffuser pipes with nozzles that jet the water into the deepest part of the river channel. Biocides, chlorine, and bromine, are used at the condenser inlets to minimize aquatic growth and bacteria in the condenser tubes. Quad Cities injects a chemical to neutralize the biocide in the

discharge bay so that river organisms are not affected by the biocide. A silt dispersant and scale inhibitor are also injected at the river intake. Additionally, biocide, silt dispersant, and a corrosion inhibitor are injected into the service water system.

Sanitary waste from the Quad Cities site is sent to the wastewater treatment system and discharged to the Mississippi River.

In addition to serving the cooling needs of Quad Cities Units 1 and 2, the Upper Mississippi River provides water of sufficiently high quality to serve a variety of other uses, including propagation of fish and wildlife and contact recreation. However, river reach IL-M04, which includes a portion of Pool 14, is identified on the Illinois State 2002 Section 303(d) list of impaired water due to the presence of polychlorinated biphenyls (PCBs).

Pursuant to the Federal Water Pollution Control Act of 1977, also known as the Clean Water Act (CWA), the water quality of the plant effluents is regulated through the National Pollutant Discharge Elimination System (NPDES). The Illinois Environmental Protection Agency (IEPA) is authorized to issue NPDES permits. The current permit (IL0005037) was issued May 26, 2000, and is due to expire May 31, 2005 (IEPA 2000b). This permit specifies effluent limits for pH, total residual chlorine, oil, grease, biological oxygen demand, fecal coliform, total suspended solids, boron, temperature, and flow. Any new regulations promulgated by the U.S. Environmental Protection Agency (EPA) or the State of Illinois would be reflected in future permits. The Iowa Department of Natural Resources (IA DNR) is also a signatory on the original Illinois NPDES permit, as the effluents discharge to the waters of both states.

The NPDES permit for Quad Cities defines a mixing zone as an area of the river where plant releases mix with river water. The plant is required not to exceed the temperature criteria specified in the NPDES permit outside the mixing zone. To ensure compliance with State of Illinois water quality standards, the NPDES permit for Quad Cities contains monthly maximum temperature limits for "representative locations in the main river" at the edge of the designated mixing zone, a maximum temperature increase 2.8 °C (5 °F) above ambient at the edge of the mixing zone, and restrictions on the size of the thermal mixing zone (IEPA 2000b).

The NPDES permit for Quad Cities also contains specific requirements for daily continuous monitoring of plant circulating water flows, daily continuous monitoring of discharge temperatures, weekly determination of river flow rate, daily monitoring of the ambient temperature of the river, daily determination of plant load (percent power), and, as warranted, daily determination of the temperature at a river cross-section 152 m (500 ft) downstream from the plant's diffuser system. This monitoring program allows Quad Cities to respond to changing

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conditions in the river and to adjust power levels to ensure compliance with NPDES temperature limits (IEPA 2000b).

Based on a study of the diffuser system, Exelon concluded that Quad Cities Units 1 and 2 could operate at full load without violating discharge permit limits under most river flow conditions (ComEd 1981). To demonstrate compliance at low river flows, Exelon developed a temperature monitoring curve that allowed calculation of permissible plant load as a function of river flow. With these data and the lack of biological effects in the river, as demonstrated by ongoing monitoring, the parties agreed in 1983 to allow open-cycle operation (Open-Cycle Agreement 1983). The temperature monitoring curve was last modified in 2001 to more accurately represent current conditions. The curve may continue to be modified over the license renewal period, under agreement with the affected parties.

2.2.4 Air Quality

The area in the vicinity of the Quad Cities site has a temperate continental climate with a wide temperature range throughout the year. Climatological records for Moline, Illinois, which is about 40 km (25 mi) southwest of the Quad Cities site, are generally representative of the Quad Cities site. These records indicate that the normal daily maximum temperatures for Moline range from about -2 °C (28 °F) in January to a high of about 30 °C (86 °F) in July. Normal minimum temperatures range from about -12 °C (11 °F) in January to about 18 °C (65 °F) in July.

The average precipitation is about 99 cm (39 in.) per year. Of this total, about 73 cm (29 in.) falls during the growing season (March through September). There is an average of approximately 51 thunderstorms per year in the area, with about 50 percent of the thunderstorms occurring in July and August. Based on statistics for the 30 years from 1954 through 1983 (Ramsdell and Andrews 1986), the probability of a tornado striking the site is expected to be about 4×10^{-4} per year.

Wind energy potential is generally rated on a scale of 1 through 7. Areas suitable for wind turbine applications have a rating of 3 or higher. The wind energy potential in the immediate vicinity of the Quad Cities site, which has a rating of 2, may not be suitable for wind energy applications. However, there are areas in Illinois and Iowa where the annual average wind-energy resource is rated 3 or higher and is generally suitable for generation of electricity (Elliott et al. 1986). The wind energy potential for Illinois is estimated to be about 9000 MW (NREL 2003), which is higher than the 1986 estimate.

1 The Quad Cities site is located within the Metropolitan Quad Cities Interstate Air Quality Control
2 Region. The air quality in the region is designated as better than national standards, in
3 attainment, or unclassified for all criteria pollutants in 40 CFR 81.314 and 40 CFR 81.316. In
4 addition, air quality in all counties in Illinois and Iowa within 80 km (50 mi) is designated as
5 better than national standards, in attainment, or unclassified for all criteria pollutants in 40 CFR
6 81.314 and 40 CFR 81.316. There is no mandatory Federal Class I area in which visibility is an
7 important value as designated in 40 CFR Part 81 within 160 km (100 mi) of the Quad Cities site.

8
9 Diesel generators, boilers, and other activities and facilities associated with Quad Cities Units 1
10 and 2 emit various pollutants. Emissions from these sources are regulated under Permit
11 161807AAB issued by the IEPA (IEPA 2000a).

12 13 2.2.5 Aquatic Resources

14
15 The principal aquatic resources in the vicinity of the Quad Cities site are associated with the
16 Mississippi River. Other important aquatic habitats include several tributaries to the Mississippi
17 River (e.g., the Wapsipinicon River in Iowa that flows into the Mississippi River immediately
18 upstream of the Quad Cities site) and the Quad Cities Units 1 and 2 retired spray canal. The
19 spray canal is currently used to raise walleye (*Stizostedion vitreum*) primarily for release into
20 Pool 14 of the Mississippi River. The transmission lines associated with the Quad Cities Units 1
21 and 2 cross a number of streams ranging in size from small intermittent streams to the Rock
22 River. Transmission line right-of-way maintenance activities in the vicinity of streams and river
23 crossings employ procedures to minimize erosion and shoreline disturbance while encouraging
24 vegetative cover.

25
26 Quad Cities Units 1 and 2 are located on the east bank of Pool 14 of the Mississippi River
27 upstream of Lock and Dam 14. Pool 14 is 47 km (29 mi) long and 4165 ha (10,580 ac) in area
28 (Bowzer and Lippincott 2000). The main channel of the river is approximately 0.6 km (0.4 mi)
29 wide in the vicinity of the Quad Cities site. The Mississippi River is used for a variety of
30 purposes, including navigation, recreation, tourism, and conservation.

31
32 Since 1938 (the year that the current lock and dam system was put in place) the annual flow
33 rate in the Mississippi River has varied from 752.6 to 2619 m³/s (26,579 to 92,500 cfs) at
34 Clinton, Iowa (USGS 2003a). Flows at the Quad Cities site are about one percent higher due to
35 the contribution of the Wapsipinicon River (AEC 1972). The highest flow rates generally occur
36 in spring (April–June) and the lowest in winter (December–February), with mean monthly flow
37 rates ranging from 732 m³/s (25,840 cfs) in January to 2551 m³/s (90,080 cfs) in April (USGS
38 2003c). Daily flow rates have ranged from a low of 272 m³/s (9,600 cfs) on December 5, 1976
39 to a high of 7589 m³/s (268,000 cfs) on April 23, 2001 (USGS 2003b). The flow of the

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Mississippi River through Quad Cities Units 1 and 2 for cooling and service water is about 61,000 L/s (970,000 gpm or 2,160 cfs). This is about 4 percent of mean average flow in the river (Section 2.1.3). Sedimentation is one of the most critical resource problems affecting the impounded areas within the Upper Mississippi River, which continues to degrade the quantity and quality of non-channel aquatic habitats. Sediments tend to settle in the deeper portions of the aquatic habitats, which results in a continued loss of depth diversity and simplification of pools (USGS 1999).

The major changes and modifications within the Upper Mississippi River that have had the greatest effect on aquatic resources include: (1) loss of floodplain connectivity due to extensive levee construction; (2) impoundment of the river from construction of locks and dams; (3) river channelization related to navigation; (4) water quality degradation in tributary streams; and (5) invasion of exotic species through man-made navigation projects (UMRCC 1993). The main channel of the Mississippi River is dredged in some reaches to maintain the 2.7-m (9-ft) navigation channel (Fremling and Dratzkowski 2000). While pollution from domestic sewage has been reduced since passage of the Federal Water Pollution Control Act of 1972, the Mississippi River still receives contaminants from agricultural, industrial, municipal, and residential sources. The impacts of these contaminants on river biota are largely unknown (Fremling and Dratzkowski 2000).

Despite the modifications and multiple competing uses of the Upper Mississippi River, the overall fish biodiversity has been persistent and resilient (USGS 1999). The river's main channel, navigation and wing dams, side channels, sloughs, chutes, backwater lakes and ponds, marsh areas, flooded bottomland forests, and tributaries create diverse habitats for at least 118 species of fish (FWS 1991a). However, overwintering habitats for fish have declined due to water depth reductions caused by sedimentation. Also, recent die-offs of aquatic vegetation have reduced the suitability of many areas as nursery habitats for fishes (Fremling and Dratzkowski 2000).

Fish species considered abundant within the Upper Mississippi River include gizzard shad (*Dorosoma cepedianum*), common carp (*Cyprinus carpio*), emerald shiner (*Notropis atherinoides*), river shiner (*N. blennius*), bullhead minnow (*Pimephales vigilax*), and bluegill (*Lepomis macrochirus*). Common species include longnose and shortnose gar (*Lepisosteus osseus* and *L. platostomus*), bowfin (*Amia calva*), mooneye (*Hiodon tergisus*), spottail shiner (*N. hudsonius*), river carpsucker (*Carpionodes carpio*), quillback (*C. cyprinus*), bigmouth buffalo (*Ictiobus cyprinellus*), shorthead redhorse (*Moxostoma macrolepidotum*), channel catfish (*Ictalurus punctatus*), white and hybrid white bass (*Morone chrysops* and *M. chrysops* x *M. saxatilis*), rock bass (*Ambloplites rupestris*), green sunfish (*Lepomis cyanellus*), and river darter

(*Percina shumardi*) (Bowzer and Lippincott 2000; FWS 1991a). Favorite sport fish species include walleye, sauger (*Stizostedion canadense*), largemouth bass (*Micropterus salmoides*), smallmouth bass (*M. dolomieu*), white bass, bluegill, black and white crappie (*Pomoxis nigromaculatus* and *P. annularis*), pumpkinseed (*L. gibbosus*), and channel catfish (FWS 1991a). Commercial fisheries also exist for some species, such as the bigmouth buffalo, common carp, catfish and bullheads, and freshwater drum (*Aplodinotus grunniens*) (FWS 1991a). The carp is the most important non-native fish species in the Mississippi River, comprising most of the commercial harvest; it is the dominant species in the Upper Mississippi River (USGS 1999). Ninety-two fish species have been collected in Pool 14 of the Mississippi River (Bowzer and Lippincott 2000).

The abundance of walleye and hybrid striped bass has increased in the vicinity of the Quad Cities site since 1985 due to stocking of these fish (Bowzer and Lippincott 2000; LaJeone and Monzingo 2000). The walleye are reared in the Quad Cities Units 1 and 2 inactive spray canal, while the hybrid white bass are maintained in the fish laboratory at the Quad Cities site (Exelon 2003a). Conservatively, the adult walleye population in Pool 14 is comprised of 30 percent stocked fish, with lesser, yet measurable contributions to downstream pools (LaJeone and Monzingo 2000). Riverine species, such as the freshwater drum, channel catfish, flathead catfish, and white bass have generally increased in Pool 14; while backwater species, such as white and black crappies have generally decreased due to degradation of the backwater areas and sloughs from sedimentation associated with operation of the 2.7-m (9-ft) navigation channel (Bowzer and Lippincott 2000).

Due to the importance of vegetation as both a food and habitat resource, and its influence on physicochemical conditions in the river, the status of aquatic and terrestrial vegetation has been documented within the Upper Mississippi River. For example, wild celery (*Vallisneria spiralis*) produces a vegetative tuber that is important as a food item for migratory waterfowl. It became the dominant submersed plant around 1960 within much of the river between Pools 4 and 19. Purple loosestrife (*Lythrum salicaria*) is an introduced wetland plant that forms dense monotypic stands, replaces many native wetland plants, and has no food value for wildlife. Introduced submersed species, such as Eurasian watermilfoil (*Myriophyllum spicatum*) cause nuisance problems throughout the river system (Fremling and Drazkowski 2000). Kohrt (1999) summarized the status of vegetation in Pool 14 of the Mississippi River over three growing seasons. Wild celery demonstrated a greatly increasing trend. Other plant species or groups whose status showed an increasing trend over three growing seasons included: submersed aquatic plants, arrowhead (*Sagittaria* spp.), purple loosestrife, and Eurasian watermilfoil. Those plant species or groups whose status was static over those three growing seasons included: floating-leaved aquatic plants, emergent aquatic plants, terrestrial plants, forest plants, and sago pondweed (*Potamogeton pectinatus*). Factors that affect submersed aquatic vascular

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plants include weather and hydrology, sedimentation, suspended solids and water clarity, and consumption and disturbance by fish and wildlife. The impoundments for the navigation system on the Mississippi River favor submersed aquatic vegetation by increasing shallow water surface area and stabilizing low-discharge water levels (USGS 1999).

Generally, benthic macroinvertebrate densities are low throughout the Upper Mississippi River, but site-specific areas of high density do occur. The non-channel areas of the Upper Mississippi River consistently support more benthic macroinvertebrates than the channel areas (USGS 1999). The impoundments in the Mississippi River have provided habitat for hexagenian mayflies that thrive in areas where there is a silt bottom and well-oxygenated water. These mayflies are an important food resource for many fish and wildlife species. However, their populations will decrease as pool areas and backwaters are lost to sedimentation (Fremling and Drazkowski 2000).

The Upper Mississippi River contains a rich assemblage of freshwater mussels. Historically, as many as 50 species of mussels have been documented from the Upper Mississippi River, but only 30 species have been reported in recent surveys. Two of these are listed as Federally endangered; and most of the rest are rare (i.e., listed as endangered, threatened, rare, or of special concern by one or more states [USGS 1999]). The freshwater mussels have been adversely impacted by activities such as the pearl button and cultured pearl industries, siltation (associated with agriculture, poor land management, and impoundments), pollution from agricultural and industrial chemicals, establishment and maintenance of the navigation channel, and competition from exotic species, particularly the zebra mussel (*Dreissena polymorpha*) (Exelon 2003a; USGS 1999). A high mussel die-off occurred in Pools 14 and 15 in the 1980s, but the cause was not identified (USGS 1999).

Mussels are often found in dense aggregations called mussel beds. While these beds may be miles apart, an individual bed can be up to several miles long (USGS 1999). Thirty-one species of unionid have been collected from Pool 14. The most abundant species include threeridge (*Amblema p. plicata*; 37.9 percent), pimpleback (*Quadrula p. pustulosa*; 16.4 percent), plain pocketbook (*Lampsilis cardium*; 10.1 percent), Wabash pigtoe (*Fusconaia flava*; 6.2 percent), threehorn wartyback (*Obliquaria reflexa*; 5.8 percent), mapleleaf (*Quadrula quadrula*; 4.8 percent), and giant floater (*Pyganodon grandis*; 4.5 percent) (Exelon 2003a). These species are widespread and relatively common throughout the Mississippi River and its tributaries (Cummings and Mayer 1992). Populations of fingernail clams (Sphaeriidae) have declined in certain reaches of the Upper Mississippi River during recent decades. The declines have occurred chiefly during low-flow periods associated with droughts (Fremling and Drazkowski 2000).

The zebra mussel became established in the Upper Mississippi River by 1992 and has continued to spread throughout the river system. Their increase causes a decline among many native mussels, as it can out-compete native species for oxygen and food and is so prolific that it can smother native mussel beds (FWS 2001c). The zebra mussel has also increasingly displaced other macroinvertebrates, such as hydropsychid caddisflies that live on submerged hard surfaces (Fremling and Drazkowski 2000).

Aquatic species that are listed by the FWS, the State of Illinois, or the State of Iowa and that have the potential to occur in the vicinity of Quad Cities site are presented in Table 2-2.

The Higgins' eye pearlymussel (*Lampsilis higginsii*) was listed as a Federally endangered species on June 14, 1976 (41 FR 24064) (FWS 1976). It is only found in the Mississippi River, St. Croix River in Wisconsin, the Wisconsin River, and the Rock River in Illinois. It was never abundant, historically comprising only about 0.5 percent of the mussel population. At the time the original recovery plan was written in 1983, the Higgins' eye pearlymussel had undergone a 53 percent decrease in its known range (FWS undated). The Higgins' eye pearlymussel most

Table 2-2. Federally Listed and Illinois and Iowa State-Listed Aquatic Species Potentially Occurring in Rock Island and Whiteside Counties, Illinois and Clinton and Scott Counties, Iowa

Scientific Name	Common Name	Federal Status	Illinois Status	Iowa Status
<i>Cumberlandia monodonta</i>	spectaclecase	—	E	E
<i>Ellipsaria lineolata</i>	butterfly	—	T	T
<i>Lampsilis higginsii</i>	Higgins' eye pearlymussel	E	E	E
<i>Ligumia recta</i>	black sandshell	—	T	—
<i>Plethobasus cyphus</i>	sheepnose	—	E	E
<i>Acipenser fulvescens</i>	lake sturgeon	—	E	E
<i>Ammocrypta clarum</i>	western sand darter	—	E	T
<i>Hybopsis amnis</i>	pallid shiner	—	E	—

E = Endangered; T = Threatened; — = Not listed or not afforded protection

Source: FWS (2003c); Herkert (1992, 1998), IA DNR (2002), IL DNR (1999), Upper Mississippi River NWFR (undated)

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frequently occurs in medium to large rivers with current velocities of about 0.15 to 0.46 m/sec (0.49 to 1.51 ft/sec) and in depths of 1.0 to 6.0 m (3.3 to 19.7 ft) with firm, coarse sand or mud-gravel substrates (FWS 2000a, 2001b). It is generally found in mussel beds with at least 15 other species present (FWS 2003b).

No critical habitat has been designated for the Higgins' eye pearlymussel. However, ten Essential Habitat Areas for the Higgins' eye pearlymussel occur within the Upper Mississippi River watershed. Essential Habitat Areas are locations known to contain reproducing populations of the Higgins' eye pearlymussel in association with a healthy and diverse unionid community (e.g., mussel beds) (FWS 1998). An Essential Habitat Area begins approximately 1.6 km (1.0 mi) downstream of Quad Cities, Units 1 and 2 at River Mile 505.5 and continues to River Mile 503.0 at Cordova, Illinois (FWS 2003b).

The only other Essential Habitat Area located downstream of the Quad Cities site occurs in Pool 15 in the Sylvan Slough at River Miles 485.5 through 486.0. The other Essential Habitat Areas are in Pools 9 and 10 of the Mississippi River, St. Croix River, and the Wisconsin River (FWS 2003b). Nearly all of the remaining habitat for the Higgins' eye pearlymussel within the Mississippi River occurs within the navigation channel. In a 2000 Biological Opinion, the FWS concluded that the continued operation and maintenance of the navigation channel would jeopardize the continued existence of the Higgins' eye pearlymussel (FWS 2000a).

Suitable host species for the glochidia (mussel larvae) of the Higgins' eye pearlymussel include sauger, freshwater drum, largemouth bass, smallmouth bass, walleye, yellow perch (*Perca flavescens*), and black crappie; while marginal host species include bluegill, northern pike (*Esox lucius*), and green sunfish (FWS 2003b). Most of these fish species are common to abundant and widespread; thus, it is doubtful that the presence of fish hosts is a limiting factor affecting the Higgins' eye pearlymussel (Rasmussen 1979).

A number of aquatic species have been designated as threatened or endangered by the State of Illinois and the State of Iowa. These include four freshwater mussels and three fish species (Table 2-2). The spectaclecase (*Cumberlandia monodonta*) inhabits large rivers with swiftly flowing waters among boulders in patches of sand, cobble, or gravel in areas where current is reduced (Cummings and Mayer 1992). Within Illinois, it is currently restricted to the Mississippi River (Heckert 1992). The butterfly (*Ellipsaria lineolata*) usually inhabits medium to large rivers. It inhabits areas of strong current on coarse sand or gravel bottoms and at water depths from a few inches to four feet (Parmelee 1967). The black sandshell (*Ligumia recta*) is a medium to large river species that occurs in riffles or raceways on firm sand or gravel bottoms at depths of four-to-six feet or more. It is less tolerant of siltation and pollution than many other mussel

species (Cummings and Mayer 1992; Heckert 1998; Parmelee 1967). The sheepnose (*Plethobasus cyphus*) inhabits currents of medium to large rivers in gravel or mixed sand and gravel substrates at depths of up to 2 m (6.6 ft) (Cummings and Mayer 1992; Parmelee 1967). Reasons for the decline of these mussel species are similar to those discussed above for the Higgins' eye pearlymussel: dredging, sand and gravel mining, siltation, pollution, and/or zebra mussels (Herkert 1992, 1998).

Several State-listed fish species have been infrequently collected from Pool 14 of the Mississippi River (Bowzer and Lippincott 2000). The lake sturgeon (*Acipenser fulvescens*) inhabits the bottoms of lakes and larger rivers that are usually 5 to 9 m (16 to 30 ft) deep over mud, sand or gravel substrates (Page and Burr 1991). Reasons for the decline of the lake sturgeon include impoundments, channelization, pollution, and overfishing (Pflieger 1975; Smith 1979). Within Illinois, the pallid shiner (*Hybopsis amnis*) is confined to the Mississippi and Kankakee rivers. It occurs in pools with negligible current, clear water, and sand-silt substrate. It is apparently intolerant of excessive siltation and turbidity (Herkert 1992). While the pallid shiner is not listed for Iowa in Table 2-2, it was listed as rare by Duyvejonck (1996) and as depleted (not included on Iowa endangered fishes list but meriting special concern) by Menzel (1981). The western sand darter (*Ammocrypta clarum*) inhabits rivers and is restricted to habitats of almost pure sand. It avoids strong currents, preferring the quiet margins of the stream channels and shallow backwaters. It is nocturnal, burying itself in sand during the day. The reason for its decline is probably the result of siltation (Pflieger 1975; Smith 1979).

Several other State-listed fish species have been collected from Pool 14 of the Mississippi River in conjunction with the long-term fisheries monitoring done near the Quad Cities site (Bowzer and Lippincott 2000). These species include: chestnut lamprey (*Ichthyomyzon castaneus*, Iowa threatened), grass pickerel (*Esox americanus*, Iowa threatened), pearl dace (*Margariscus margarita*, Iowa endangered), weed shiner (*Notropis texanus*, Illinois and Iowa endangered), and longnose sucker (*Catostomus catastomus*, Illinois threatened) (IA DNR 2002; IL DNR 1999). There is the potential that some of these records could be misidentifications. For example, within Illinois the longnose sucker is confined to Lake Michigan. Smith (1979) believed that an old record of the longnose sucker from the Rock River was almost certainly based on a misidentified white sucker. In other cases, the Mississippi River is not the primary habitat for the species (e.g., pearl dace and weed shiner) (Page and Burr 1991; Smith 1979).

2.2.6 Terrestrial Resources

The Quad Cities site consists of approximately 331 ha (817 ac) of both developed and undeveloped areas. The developed areas mostly occupy the western half of the site. Undeveloped areas are located generally on the eastern half of the site and support habitats

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1 that include open fields and planted pines. Approximately 22 ha (55 ac) are leased for farming
2 (i.e., hay). Prior to plant operations, the primary use of the site was agricultural and residential
3 (AEC 1972).
4

5 The site is located in an area with sandy soil and little bushy or wooded habitat. The agricultural
6 lands in the vicinity are used for grain and cattle forage crops (AEC 1972). It is expected that a
7 number of the species (i.e., especially terrestrial mammals) inhabiting adjacent areas to the
8 Quad Cities site will also use the limited natural areas within the boundaries of the site. Other
9 local areas with important habitats are the river islands located nearby and the area adjacent to
10 the river in Scott and Clinton counties in Iowa. These areas, which are generally encompassed
11 by the Upper Mississippi River NWFR and the Princeton Wildlife Management Area, provide
12 upland and bottomland habitats including hardwood forests, grasslands, agricultural fields,
13 islands, wetlands, sloughs, lakes, and shoreline (FWS 2000d). Birds (e.g., migratory
14 passerines, raptors, waterfowl, shorebirds) use the area extensively. The wetlands, forests, and
15 prairies are used by more than 50 species of mammals that include deer, raccoon, muskrat, red
16 and gray fox, coyote, weasel, mink, badger, skunk, river otter, and many other small mammals
17 (FWS 2000d; AEC 1972).
18

19 The Princeton Wildlife Management Area is a 482 ha (1190 ac) habitat management unit within
20 the Upper Mississippi River NWFR constructed to provide optimum habitat conditions for fish
21 and wildlife species. The water levels within these units are managed to provide emergent
22 vegetation and mud/sand flats to maintain diverse habitat types for many wetland-dependent
23 species (FWS 2000d). Floodplain forest habitats dominate this management area and include
24 species such as silver maples, green ash, and cottonwoods. Large numbers of bald eagles use
25 this area during the winter months, in addition to waterfowl and migratory passerines
26 (IBB 2002).
27

28 A total of five transmission lines (Table 2-1 and Figure 2-5) connect Quad Cities Units 1 and 2
29 to the electric grid (Exelon 2003a; AEC 1972). These lines occupy 880 ha (2200 ac) of land
30 along 185 km (115 mi) of right-of-way (ROW) that traverses mainly agricultural land along with
31 some natural terrestrial habitats (Exelon 2003a; AEC 1972). Approximately 90 to 95 percent of
32 the transmission corridor can be classified as agricultural. The transmission lines include the
33 Davenport line (Line 0401), the Barstow line (Line 0402), the south Nelson line (Line 0403), the
34 north Nelson line (Line 0404), and the Rock Creek line (Line 0405).
35

36 The Davenport transmission line runs 20.6 km (12.8 mi) with a ROW of 55 m (180 ft). It
37 crosses the Mississippi River and the Upper Mississippi River NWFR immediately south of the
38 Quad Cities site as it runs from Illinois into Iowa. The portion of the Upper Mississippi River

NWFR transversed by the Davenport corridor is within the Princeton Wildlife Management Area. This area is managed by the IDNR under a cooperative agreement with the Savanna District of the Upper Mississippi River NWFR; the portion of the Davenport corridor crossing this area is just slightly more than 1.6 km (1 mi) in length. All ROW maintenance activities for this transmission line that occur in the refuge must be reviewed and approved by the FWS through the Savanna District Office of the Upper Mississippi River NWFR. The transmission line then crosses predominantly agricultural land with an exception of a short passage (< 0.8 km [<0.5 mi]) through dense timber and one crossing of a lesser distance through sparse timber.

Although the Davenport transmission line crosses agricultural lands for the remainder of its run, it also transverses several small creeks and their tributaries (e.g., Lost Creek, Hickory Creek, and Duck Creek tributaries) (Exelon 2003a; FWS 2000d; AEC 1972).

The Barstow transmission line runs 28.1 km (17.5 mi), sharing the initial 3.2 km (2 mi) of the corridor with the south Nelson line. The initial 3.2 km (2 mi) has a ROW of 158 m (520 ft), with the remainder a ROW of 44 m (145 ft). The Barstow line passes through agricultural lands (i.e., row crops and pasture) throughout its entire corridor that are typical of eastern Iowa and northwestern Illinois. The Barstow line also crosses Zuma Creek and its tributaries several times along its run (Exelon 2003a; AEC 1972).

The corridor for the south Nelson transmission line runs 67.4 km (41.9 mi) with a ROW of 158 m (520 ft) for the first 3.2 km (2 mi), followed by a 44-m (145-ft) ROW. The north Nelson corridor runs for 63.9 km (39.7 mi) with a 44-m (145-ft) ROW. The terrain traversed by these lines is mostly flat farmland. Both lines cross the Rock River and several small creeks (e.g., Rock Creek, Deer Creek, or Lynn Creek). Both Nelson transmission lines terminate at the Nelson Transmission substation approximately 64 km (40 mi) due east of Quad Cities (AEC 1972).

The Rock Creek transmission line runs through the industrial park just north of Quad Cities Station and then crosses the river into Iowa. This line has a ROW of 52 m (170 ft) and is 8 km (5 mi) long (Exelon 2003a). Its corridor crosses the Mississippi River and the Savanna District of the Upper Mississippi River NWFR approximately 3 km (2 mi) north of the site^(a) (Exelon 2003a). The Savanna District extends along both sides of the Mississippi River and covers three navigational pools, including Pool 14 where the Quad Cities site is located. The Rock Creek transmission line crosses only open water and riparian habitats within the Upper Mississippi River NWFR.^(a) All ROW maintenance activities for this transmission line that occur

(a) Personal communication with Ed Britton, District Manager, Savanna District, Upper Mississippi National Wildlife and Fish Refuge, May 8, 2003.

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1 in the refuge must be reviewed and approved by the FWS through the Savanna District Office
2 of the Upper Mississippi River NWFR.

3
4 With the exception of the Upper Mississippi River NWFR and the Princeton Wildlife
5 Management Area, the Quad Cities transmission lines traverse lands cultivated for row crops
6 and pasture that are typical of eastern Iowa and northwestern Illinois. The Quad Cities
7 transmission lines do not cross any state or Federal parks — other than the aforementioned
8 refuge and wildlife management area — wildlife refuges or wildlife management areas
9 (Exelon 2003a).

10
11 The transmission corridors are maintained by mowing (Cunningham 2003; Exelon 2003d),
12 trimming, tree removal, and by the use of approved herbicides (Exelon 2003a; Exelon 2003d;
13 Exelon 2003e; Cunningham 2003). Unless otherwise noted, vegetation management follows a
14 three year cycle within the Davenport and Barstow corridors (Exelon 2003d), a five year cycle
15 within both Nelson corridors (Cunningham 2003), and a six year cycle within the Rock Creek
16 corridor (Exelon 2003e). Herbicide application is performed according to label specifications by
17 certified applicators. Pre-activity surveys are carried out along the Nelson corridors, although
18 not along the other three transmission line corridors (Cunningham 2003). Training is provided
19 to line maintenance staff in identifying Federally and State listed species -- and the species'
20 habitats -- that may occur in the vicinity of both Nelson lines and the Rock Creek line, as well as
21 steps to take if one of these species is encountered while carrying out maintenance activities
22 (Cunningham 2003; Exelon 2003e).

23
24 Table 2-3 presents terrestrial species that are listed, proposed for listing, or candidates for
25 listing by the Federal government or the States of Iowa and Illinois. State or Federally listed
26 species that could occur in the vicinity of the Quad Cities site include three plants, one reptile,
27 one bird, one mollusk, and two mammals. Of these species, six are Federally protected under
28 the Endangered Species Act (ESA). They are the Indiana bat (*Myotis sodalis*; endangered),
29 Iowa Pleistocene snail (*Discus macclintocki*; endangered), bald eagle (*Haliaeetus*
30 *leucocephalus*; threatened), western prairie fringed orchid (*Platanthera praeclara*; threatened),
31 eastern prairie fringed orchid (*Platanthera leucophaea*; threatened) and the prairie bush clover
32 (*Lespedeza leptostachya*; threatened). No designated critical habitat exists for any of the listed
33 species on or in the vicinity of Quad Cities Station. No terrestrial species in the area are
34 proposed for listing or are candidates for listing.
35

Table 2-3. Terrestrial Species Listed as Endangered or Threatened or Candidates for Listing by the FWS or the States of Illinois and Iowa That Occur or Potentially Occur Within Rock Island, Whiteside and Lee Counties, Illinois, and Clinton and Scott Counties, Iowa

Scientific Name	Common Name	Federal Status	Illinois Status	Iowa Status
Mammals				
<i>Myotis sodalis</i>	Indiana bat	E	E	—
<i>Lutra canadensis</i>	river otter	—	T	—
Birds				
<i>Haliaeetus leucocephalus</i>	bald eagle	T	T	—
Mollusks				
<i>Discus macclintocki</i>	Iowa Pleistocene snail	E	E	—
Reptiles				
<i>Heterodon nasicus</i>	western hognose snake	—	T	—
Plants				
<i>Plantanthera praeclara</i>	western prairie fringed orchid	T	—	—
<i>Platanthaera leucophaea</i>	eastern prairie fringed orchid	T	E	—
<i>Lespedeza leptostachya</i>	prairie bush-clover	T	E	—

T = Threatened; E = Endangered;

— = Not listed or not afforded protection

Source: FWS (1999a, 1999b), Brandrup (2002); Pietruszka (2002); Nelson 2003; IL DNR (1999), Herkert (1992, 2002)

The Indiana bat was originally listed in 1967 as Federally endangered. Its decline is largely attributed to cave destruction and disturbance (FWS 1991b). The Indiana bat is very small, with a wingspan of 23 to 28 cm (9 to 11 in.) and weighing approximately 9 g (0.3 ounces) (FWS 2003c). In winter, the Indiana bat uses limestone caves or abandoned mines for hibernation, although some hibernate under bridges, in old buildings, or under loose bark and in hollows of trees (Nelson 2003; FWS 1991b). This species forages for insects along stream corridors, within the canopy of floodplain and upland forests, over clearings with early successional vegetation (old fields), along the borders of croplands, along wooded fencerows, and over farm ponds and in pastures. It has been shown that the foraging range for the bats

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1 varies by season, age, and sex and ranges up to 33 ha (81 ac) (Nelson 2003). Roosting and
2 rearing of young usually occurs in caves, although it may occur in the loose bark of trees
3 (FWS 1991b). Exelon has not noted any Indiana bats in the vicinity of the Quad Cities site or
4 its associated transmission lines. Undeveloped portions of the Quad Cities site have not been
5 surveyed for the Indiana bat.^(a) The FWS notes that the bat may occur in all counties in Iowa
6 south of Interstate 80 (Nelson 2003). Interstate 80 is a major east-west highway in Illinois and
7 Iowa approximately 5 miles south of the Quad Cities site. The Iowa Department of Natural
8 Resources did not note any occurrences of threatened or endangered species in the vicinity of
9 the transmission lines associated with Quad Cities (Brandrup 2002).

10
11 The Federally endangered Iowa Pleistocene snail was originally listed in July 1978 (43 FR
12 28932 [FWS 1978]). This small land snail inhabits algific (i.e., cold producing) talus slopes,
13 within the leaf litter of cool and moist hillsides (Nelson 2003; FWS 2002b). It breeds from late
14 March to August by laying two-to-six eggs in this leaf litter, with the eggs hatching
15 approximately 28 days later. The snail feeds on fallen leaves of birch and maple trees or
16 dogwood shrubs. Climate change is attributed as the primary cause of long-term decline of this
17 snail although the most immediate threats are from habitat degradation and destruction, human
18 disturbance, and livestock grazing, as well as misapplication of pesticides (FWS 1997; FWS
19 2002b). The snail has been found in approximately 30 sites in Iowa and Illinois (FWS 2002b)
20 with none noted by Exelon at Quad Cities (Exelon 2003a). Suitable habitat is unlikely to occur
21 at the site or in the immediate vicinity of Quad Cities transmission lines and their corridors, with
22 the majority of traversed land characterized as flat and agricultural (Exelon 2003a).

23
24 The bald eagle was originally listed as endangered by the FWS in 1978, but population
25 increases prompted downlisting to threatened status in 1995, and the species is currently
26 proposed for delisting (64 FR 36453 [FWS 1999c]). The bald eagle is a common visitor to the
27 Upper Mississippi River Valley, within which the Savanna District of the Upper Mississippi River
28 NWFR is located and the Quad Cities site is adjacent. The bald eagle uses this area as a
29 winter migration corridor and for summer nesting habitat. During the October to March
30 timeframe, hundreds of bald eagles congregate in the area to feed on fish, typically near lock
31 and dams or in ice-free backwater areas (FWS 2000d). These attractive winter feeding
32 grounds include open water areas created by the warm water effluents from the power plant
33 (Nelson 2003). The Savanna District also documents nesting activity, usually on islands or
34 along backwater shorelines (FWS 2000d). Bald eagles build their nests in large trees near
35 rivers or lakes and often use the same nest year after year. The Savanna district notes that

(a) Personal communication with Ed Cunningham during Quad Cities site audit, March 12, 2003.

presently there are seven active bald eagle nesting territories and some of these nests have been known to successfully produce young (FWS 2000d). The nearest known bald eagle nest to the Quad Cities site is located at river mile (RM) 514.3 on Beaver Island and has been established for over a decade with observed success in producing young. This nest is approximately 8 RM (7 mi, 11.3 km) north of the Quad Cities site and 5 RM (4.5 mi, 7.2 km) north of the Rock Creek transmission line. No other known bald eagle nests occur in the vicinity of the Quad Cities site or its associated transmission lines.^(b)

The Federally threatened western prairie fringed orchid was listed as threatened in 1989, along with the eastern prairie fringed orchid (54 FR 39857 [FWS 1989]). It occurs in mesic to wet tallgrass prairies and meadows, but is also found in old fields or roadside ditches (FWS 1996; FWS 2003c). The western prairie fringed orchid is restricted to areas west of the Mississippi River and is known to occur in about 75 sites in 8 states (FWS 2003a). The prairie fringed orchids are mostly threatened by conversion of its habitats to cropland and other habitat loss activities. Other threats include invasive species competition, wetland destruction, intensive hay mowing, fire suppression, and overgrazing (FWS 2003c; Herkert 2002). Based on the known distribution of the species, it is unlikely to be found at the Quad Cities site, but it could be found along the Davenport and Rock Creek transmission lines.

The eastern prairie fringed orchid also occupies mesic to wet tallgrass prairie or grassland habitats (Herkert 2002; FWS 2003c; Nelson 2003). However, it can also occupy bogs, fens, and sedge meadows (FWS 2003c). This species formerly occurred throughout Illinois yet has been nearly eliminated from all but northeastern Illinois. There are 30 known Illinois populations; no known populations occur in Whiteside County, although it could occur in Rock Island or Lee counties (records for these counties are no longer extant [Herkert 2002]). No occurrences of either species (eastern or western prairie fringed orchid) have been documented for the Quad Cities site or in areas along its associated transmission lines (Exelon 2003a). Neither the undeveloped portions of the Quad Cities site nor the transmission corridors have been surveyed for these species.^(a)

The Federally-threatened (52 FR 781 [FWS 1987]) prairie bush clover occurs on dry gravel and sand prairies (Herkert 2002). It is found only in the tallgrass prairie region of four Midwestern states and is currently found at fewer than 40 sites in 23 counties of Iowa, Illinois, Minnesota, and Wisconsin (FWS 2003c), although it could occur throughout Illinois (Nelson 2003).

(a) Personal communication with E. Cunningham during the Quad Cities site audit, March 12, 2003.

(b) Personal communication with D. Dee, Field Staff, Savanna District, Upper Mississippi River NWFR, September 23, 2003.

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Fourteen known populations occur in Illinois at present with five of these populations protected on public land; none of these known populations occur in Rock Island or Whiteside counties, although a recent record of a population is known for Lee County (Herkert 2002). Undeveloped portions of the Quad Cities site have not been surveyed for the prairie bush clover.^(b) The decline of the prairie bush clover is primarily due to the historic loss of tallgrass prairie habitat from conversion to agricultural land, and this species tends to only occur presently in areas that escaped plowing due to being too rocky or steep (FWS 2003c).

Two species, the river otter and the western hognose snake, are listed as threatened by the Illinois Department of Natural Resources (IL DNR 1999). The river otter uses habitats that include streams, rivers, lakes, ponds, drainage ditches, and backwater areas. It is active during the day and at night and feeds on fish, frogs, and crayfish (IL DNR 1999). The Savanna District of the Upper Mississippi River NWFR notes that river otters do occur in the vicinity of Quad Cities and its associated transmission lines (FWS 2000d; Pietruszka 2002).^(a) The river otter is increasing in population due to the success of a reintroduction project carried out by the Iowa Department of Natural Resources, and the first legal harvest in many years may occur in 2005.^(a)

The western hognose snake could occur on or in the vicinity of the Quad Cities site and its associated transmission lines (IL DNR undated). This snake is recorded in sandy areas in the northwestern and west-central parts of Illinois, with a preference for dry, sandy prairie areas (Herkert 1992). The primary cause for its decline is habitat destruction. This species is known to occur in Whiteside, Rock Island, and Lee counties, with recent documented occurrences (Herkert 1992). The Savanna District of the Upper Mississippi River NWFR notes the snake does occur in the district's area (FWS 2000d) and the IDNR has documented an occurrence of this snake in the vicinity of the Quad Cities site in 1977 (Pietruszka 2002). Undeveloped portions of the Quad Cities site have not been surveyed for the western hognose snake^(b).

2.2.7 Radiological Impacts

Exelon has conducted a radiological environmental monitoring program (REMP) around the Quad Cities site since 1968 (AEC 1972). Through this program, radiological impacts to

(a) Personal communication with Ed Britton, District Manager, Savanna District, Upper Mississippi National Wildlife and Fish Refuge, May 8, 2003.

(b) Personal communication with Ed Cunningham during the Quad Cities site audit, March 12, 2003.

workers, the public, and the environment are monitored, documented, and compared to the appropriate standards. The objectives of the REMP are:

- Provide representative measurements of radiation and of radioactive materials in those exposure pathways and for those radionuclides that lead to the highest potential radiation exposures of members of the public resulting from the station operation.
- Verify that the measurable concentrations or radioactive materials and levels of radiation are not higher than expected on the basis of the effluent measurements and the modeling of the environmental exposure pathways.

Radiological releases are summarized in the annual reports titled, *The Quad Cities Nuclear Power Station 2001 Annual Radiological Environmental Operating Report* (Exelon 2002b) and, *Quad Cities Nuclear Power Station's Radioactive Effluent Report for January through December 2001* (Exelon 2002c). The limits for all radiological releases are specified in the Quad Cities ODCM, and these limits are designed to meet Federal standards and requirements (Exelon 2002a). The REMP includes monitoring of the aquatic environment (fish, invertebrates, and shoreline sediment), atmospheric environment (airborne radioiodine, gross beta and gamma), terrestrial environment (vegetation), and direct radiation (Exelon 2002a).

A review of the historical data on releases and the resultant dose calculations revealed that the doses to maximally exposed individuals in the vicinity of Quad Cities were a small fraction of the limits specified in the EPA's environmental radiation standards in 40 CFR Part 190, as required by 10 CFR 20.1301(d). For 2001 (the most recent year for which data were available), the total effective dose equivalent (TEDE) due to licensed activities at the Quad Cities site calculated for the maximally exposed individual for the year 2001 was 0.069 mSv (6.9 mrem). Most of this dose is due to the direct radiation from Units 1 and 2 (0.064 mSv [6.4 mrem]). The balance of the calculated dose, (0.0059 mSv [0.59 mrem]), is attributable to radiological effluent releases (Exelon 2002b). Calculations were performed using the plant effluent-release data, onsite meteorological data, and appropriate pathways identified in the ODCM.

2.2.8 Socioeconomic Factors

The staff reviewed the applicant's ER (Exelon, 2003a), the Updated Final Safety Analysis Report (UFSAR) (Exelon, 2003c), information from the US Bureau of the Census, and information obtained from several county, city, and economic development staff during a site visit to the Quad Cities vicinity from March 11 to March 13, 2003. The following information describes the economy, population, and communities in the region of Quad Cities.

2.2.8.1 Housing

Exelon employs approximately 1000 workers at Quad Cities Units 1 and 2, with about 850 being permanent employees. Approximately 54 percent of these employees live in Rock Island and Whiteside counties, and 23 percent live in Scott County. The remaining 23 percent of the employees reside in 16 other counties in both Illinois and Iowa.

Given the predominance of Quad Cities employees living in Rock Island, Whiteside, and Scott counties and the absence of likely significant socioeconomic effects in other, more distant locations, the focus of the analyses undertaken in this SEIS is on these 3 counties (Exelon 2003a).

Exelon refuels Quad Cities Units 1 and 2 on a 24-month cycle. During these refueling outages, site employment increases by approximately 1100 temporary workers for 20 days. Most of these temporary workers are assumed to be located in the same geographic areas as permanent Exelon staff.

Table 2-4 shows the number of housing units and vacancies in the Quad Cities vicinity for 1990 and 2000. This data shows a reasonable consistency among the various geographic units in vacancy rates for 1990 and 2000. The pattern mirrors the growth in population, shown in Table 2-6. Homeowner and rental vacancy show a general consistency between the two census years for most of the jurisdictions.

Rock Island and Scott counties have developed comprehensive land-use plans that encourage growth within the existing municipalities and infrastructure. Whiteside County does not have a formal land-use plan but uses zoning and use permits as methods of directing growth to areas currently served by infrastructure (Exelon 2003a).

Table 2-4. Housing Units and Housing Units Vacant (Available) by County During 1990 and 2000

	1990	2000	Approximate Percentage Change 1990 to 2000
Rock Island County, IL			
Housing Units	63,327	64,489	2
Vacant Units	4010	3777	-6
Whiteside County, IL			
Housing Units	24,000	25,025	4
Vacant Units	1260	1341	6
Scott County, IA			
Housing Units	61,379	65,649	7
Vacant Units	3941	3315	-16
Source: USBC 2000			

2.2.8.2 Public Services

- **Water Supply**

At the present time, the water supply systems in all three counties are operating substantially below their maximum capacities. The Quad Cities site pumps groundwater for use as potable water and is not connected to a municipal system (Exelon 2003a). The three counties most affected by current Quad Cities employees, in terms of consumption of domestic water—Rock Island and Whiteside counties in Illinois, and Scott County in Iowa—are served by a variety of small- to medium-sized water companies and by domestic water wells in the unincorporated areas of the three counties. The current maximum capacity of the major suppliers in each county exceeds the average daily demand by a factor of from 1.7 to 2.9 and averages 2.3 times demand for all three counties (Exelon 2003a).

- **Education**

In 2002, approximately 62,000 students attended schools in Rock Island, Whiteside and Scott counties. Although the region's school districts do not keep track of Quad Cities employees' children, Table 2-5 shows the total enrollment for students in the Quad Cities vicinity.

Table 2-5. School District Enrollment in Counties with Significant Numbers of Quad Cities Employees

County	Enrollment
Scott, IA	27,130
Rock Island, IL	24,519
Whiteside, IL	10,367
Total	62,016
Source: National Center for Educational Statistics, 2003	

• **Transportation**

Route 84 provides road access to the Quad Cities site. Route 84 is a two-lane paved road oriented in a generally north-south direction along the eastern bank of the Mississippi River. Route 84 intersects with Interstate 80, the major east-west route in the region, approximately 23 km (14 mi) south of the Quad Cities site. Interstate 88 branches east from Interstate 74 about 16 km (10 mi) south of the Quad Cities site. Illinois State Route 74 turns west just north of its intersection with Illinois State Route 88, and it becomes Interstate 80, providing access to Des Moines and other points west. The Quad Cities vicinity is served by an international airport and river barge traffic, in addition to the active trucking activity that makes use of the interstate freeway (Exelon 2003a).

Route 84 is used by employees traveling from the Quad Cities vicinity, from other points south of the site in Rock Island County, and from Whiteside County north of the site. Scott County employees travel across the Interstate 80 bridge and then north on Route 84, along with other employees traveling from Rock Island County to the site. Employees coming from Whiteside County travel south on Route 84 to reach the site (Exelon 2003a).

2.2.8.3 Offsite Land Use

Rock Island County is predominately rural, consisting of farmland and woods. The county's population in 2000 was 149,374. The county contains 1170 km² (452 mi²) or 117,000 ha (289,000 ac) of land/water area. Land use patterns in the county reflect the key importance of livestock production and agriculture to the area. Current land use in the county by category is: cropland (37.3 percent), grassland (30.2 percent), forest/woodland (12.6 percent), wetland (4.6 percent), urban/built-up (8.1 percent), open water (7.0 percent), and barren/exposed land (0.2 percent) (IL DNR 1999). Agriculture is also a significant land use in

nearby Scott and Whiteside counties, representing 77 percent and 88 percent of land area, respectively (USDA 1997).

Annual property taxes from Quad Cities Units 1 and 2 accounted for approximately 2.7 percent of Rock Island County's total levee extension and approximately 2.8 percent of the county's total collections available for distribution for the years 1997 to 2000. The local Cordova taxing districts for the township, library, school district, road and bridge district, and fire department all derive significant revenue from the plant (Rock Island County Board of Review 2002).

Negotiations are underway with Rock Island County for a graduated reduction in payments to minimize the financial disruption to county and local operations caused by a change in the Rock Island County methods of plant value assessment due to the deregulation of the utility industry in the State of Illinois (Exelon 2003a).

Rock Island County utilizes four major tools in an effort to manage current and future land use: County Land Use Plan, County Zoning Ordinance, County Land Evaluation and Assessment Program, and County Subdivision Resolution. The county had a population increase of 0.4 percent during 1990 and 2000 after having experienced a 10.4 percent decline in population between 1980 and 1990 (Exelon 2003a). Strong farmland preservation policies in Rock Island and Scott counties dictate that settlement will occur mainly in existing municipalities rather than in rural unincorporated areas (Bi-State 2002). Whiteside County uses a combination of zoning ordinance and use permits to guide county development.

The Quad Cities Metropolitan Statistical Area, consisting of the cities of Davenport and Bettendorf, Iowa, and Rock Island, Moline and East Moline, Illinois, is located about 32 km (20 mi) southwest of the site with a combined population in 2000 of 359,062; an increase of 8201 from 1990 (Bi-State 2002). The nearest town, situated approximately 6 km (4 mi) south from the site, is the village of Cordova, Illinois, with 623 residents in 2000. The nearest population center is the city of Clinton, Iowa, which is approximately 11 km (7 mi) northeast from the site (AEC 1972).

The area immediately surrounding the site is predominantly rural, consisting of farmland and woods; however, there is an industrial park approximately 1.6 km (1 mi) north from the site. A gas-fired 500-megawatt generating plant (Cordova Energy Center) is located approximately 1.6 km (1 mi) southeast from the site and a 235-megawatt coal-fired electrical generating station (M.L. Kapp) is located 4 km (2 mi) north from the site (Exelon 2003a). Rock Island, Scott, and Whiteside counties are actively seeking to attract and to assist in the development of industrial parks to foster economic growth and promote job creation.

2.2.8.4 Visual Aesthetics and Noise

The lands surrounding the Quad Cities site are largely agricultural, with an industrial park directly north from the site and a gas-fired power plant southeast from the site. The major buildings are metal-sheathed structures with the metal panels covered in subdued tones. The highest portions of the major buildings, the stack, and the transmission lines are clearly visible from Illinois Route 84 and the Mississippi River. Much of the view of the station is obstructed by a grove of evergreen trees along the highway. The transmission line towers used on the site are four-legged open-steel structures. The river crossing towers are painted red and white to increase their visibility for safety purposes (AEC 1972).

The noise from most equipment is confined within the plant buildings, yielding boundary noise at the ambient level (AEC 1972). Testing of on-site and off-site warning sirens occurs monthly.

2.2.8.5 Demography

All or parts of 21 counties are located within 80 km (50 mi) of Quad Cities (Figure 2-2). Of these counties, 13 are in Illinois, and 8 are in Iowa. Between 1990 and 2000, the area's population grew 2.3 percent to 359,062, well below the growth of the state of Iowa (5.4 percent), Illinois (8.6 percent), the midwest (7.9 percent), and the nation (13.2 percent) in the same decade.

According to U.S. Bureau of the Census (USBC) 2000 information, at least 281,423 people live within 32 km (20 mi) of Quad Cities (Exelon 2003a). Applying the GEIS sparseness measures, Quad Cities has a population density of 86 persons/km² (224 persons/mi²) within 32 km (20 mi) and falls into the least-sparse category, Category 4 (having greater than or equal to 46 persons/km² [120 persons/mi²] within 32 km [20 mi]). As estimated from USBC 2000 information, at least 656,527 people live within 80 km (50 mi) of Quad Cities (Exelon 2003a). This equates to a population density of 32 persons/km² (83 persons/mi²) within 80 km (50 mi), which is classified as Category 2 (no city with 100,000 or more persons and between 50 and 190 persons per square mile within 80 km [50 mi]). Applying the GEIS sparseness and proximity matrix, Quad Cities is classified as sparseness Category 4 and proximity Category 2, resulting in the conclusion that Quad Cities is located in a medium-population area.

There are no known Native American lands or reservations within 80 km (50 mi) of the Quad Cities site.

Table 2-6 shows estimated population numbers for the three counties where the majority of the Quad Cities site employees have lived from 1980 and are expected to live through 2030. By the year 2030, the populations of Rock Island and Whiteside counties are projected to decrease at average annual rates of 0.2 percent, in contrast to the growth rate of 0.5 percent projected for the State of Illinois during the same period. The population of Scott County is expected to increase at an average annual rate of 0.4 percent, while Iowa is projected to have an annual average growth rate of 0.1 percent and rise to 3 million people (Exelon 2003a).

Exelon uses Census 2000 data from the U.S. Bureau of the Census to describe general demographic characteristics in the Quad Cities vicinity and for the minority portion of the environmental justice calculations. Exelon used Census 1990 data for the low-income portion of the environmental justice calculations (Exelon 2003a). The discussion of demography in this section and environmental justice in Section 4.4.6 relies on Census 2000 data, which now includes both population and economic data (Geolytics Software 2000).

- **Resident Population Within 80 km (50 mi)**

Table 2-7 presents the population distribution within 80 km (50 mi) of Quad Cities for the year 2000.

- **Transient Population**

There is little transient population, either for recreation or for agriculture, in the vicinity of Quad Cities. Almost all of the laborers on farms in the area are believed to be residents in the area. Seasonal migrant labor plays little or no role in field agriculture in the region. Some permanent immigrant workers are employed at a meat-packing plant in the area.^(a)

- **Agricultural Labor**

Agriculture contributes significantly to the Quad Cities and surrounding regional economy. Principal crops in the region include corn, soybeans, and hay. According to the U.S. Department of Agriculture's 1997 Census of Agriculture, receipts from all agricultural products totaled \$49.8 million in Rock Island County and \$157.0 million in Whiteside

(a) Personal communications with M. Bazik, Director of Illinois Educational Extension; J. Boudi, Director of Planning and Geographic Information Systems, Rock Island County; and G. Steinert, Regional Superintendent, Whiteside County Regional Office of Education.

Table 2-6. Regional Demographies

Estimated Populations and Average Annual Growth Rates in Rock Island and Whiteside Counties, Illinois, and Scott County, Iowa from 1980 to 2030							
	Rock Island County		Whiteside County		Scott County		
Year	Population	Percent	Population	Percent	Population	Percent	
1980	165968	-0.1	65970	0.5	160022	1.2	
1990	148723	-1	60186	-0.9	150979	-0.6	
2000	149374	0.4	60653	0.1	158668	0.5	
2010	150990	0.1	58773	-0.3	171960	0.8	
2020	149574	-0.1	57987	-0.1	171283	0	
2030	142219	-0.5	56517	-0.3	179740	0.5	

Source: Exelon 2003a

Table 2-7. Population Distribution in 2000 Within 80 km (50 mi) of Quad Cities

0 to 16 km (0 to 10 mi)	16 to 32 km (10 to 20 mi)	32 to 48 km (20 to 30 mi)	48 to 64 km (30 to 40 mi)	64 to 80 km (40 to 50 mi)	Total
29906	253556	139946	99163	131938	654509

Source: Geolytics Software 2000

County in 1997. For the State of Illinois, the total from agricultural products was \$8.6 billion. Receipts from agricultural products in Scott County totaled \$95.1 million. Iowa's total from agricultural products was \$11.9 billion (USDA 1997).

2.2.8.6 Economy

The Quad Cities region has a transportation network of trucking and rail terminals, interstate highway access to east-west and north-south routes, one international and a number of regional airports, and access to international seaports via the Mississippi River, giving the area access to both domestic and international markets (Exelon 2003a). The unemployment rates are similar among all the jurisdictions, ranging from just below 3 percent for Iowa to just over

4 percent for Rock Island County. Household income varies from \$38,600 for Rock Island County to \$42,700 in Scott County, compared with \$40,600 for the Quad Cities Metropolitan Statistical Area, \$39,500 for Iowa, nearly \$47,000 for Illinois, and nearly \$42,000 for the nation (USBC 2000).

A recession in the 1980s and the accompanying farm crisis affected both the agricultural and traditional heavy manufacturing sectors of the economy. While the area is still recovering from this period, a shift has occurred from an economy that was dominated by agriculture to one that is now centered on services, including the gaming industry.

From 1980 to 1996, the nonprofessional employment service sector in Rock Island County increased by 121 percent, manufacturing declined by 41 percent, durable goods employment declined by 54 percent, and non-electrical machine production declined by 63 percent. By 1997, the leading economic employment sectors were services (32 percent), retail trade (22 percent), and manufacturing (19 percent) (Exelon 2003a).

In 1997, the leading economic employment sectors in Whiteside County were manufacturing (36 percent), services (28 percent), and retail trade (20 percent). In Scott County for that same year, the leading sectors were services (34 percent), retail trade (24 percent), and manufacturing (19 percent) (Exelon 2003a). Table 2-8 lists the largest companies in terms of employment in the Illinois-Iowa Quad Cities vicinity.

There are a number of large industrial parks in various stages of planning, implementation, and completion in Rock Island, Henry, and Whiteside counties in Illinois and Scott County in Iowa. In recent years, developments along the Mississippi riverfront designed to complement the corporate presence in the area and to attract convention and shopping have been built or are in the process of being built, both in Iowa and Illinois.

In the State of Illinois, sub-county entities, particularly townships, play a major role in local real property tax administration. Each local taxing body examines its fiscal needs and creates a budget, then extends a levee, or proposed claim, to the county in an amount that will cover the portion of its proposed budget that is to be covered by local real property taxes. The county then evaluates the assessed value of the real property in the township and associated taxing bodies with the total levee and develops a tax rate schedule to issue property tax bills to property owners. The county collects the taxes and redistributes them to the local agencies (Exelon 2003a).

Table 2-8. Largest Employers in the Illinois and Iowa Quad Cities Vicinity

Company	Number of Employees
Deere and Company	7317
Rock Island Arsenal	6000
Genesis Medical Center	3000
ALCOA	2513
Trinity Regional Health	2500
IBP, Inc.	2300
MidAmerica Energy Company	1200
Kraft Foods North America, Inc	1200
Illini Hospital	950
CNH Global	816
ComEd	800
APAC Customer Service	800
KONE, Inc	600
Bituminous Casualty Corp	520
Source: Quad Cities Development Group, 2003	

In 1997, the State of Illinois deregulated the electric power utility industry, which, in turn, led to a change in the method used to assess the value of utilities' real property for county tax purposes. Before deregulation, utility real property was assessed on the basis of depreciated book value. Following deregulation, real property was assessed on the basis of fair market value. Because fair market values are influenced by economic conditions and market forces, current fair market values are expected to differ from (and generally be lower than) depreciated book values, with attendant lower overall tax revenues, at current tax rates. Therefore, it is anticipated that Rock Island County's property tax revenues from Quad Cities Units 1 and 2 will most likely be lower than in the past. Table 2-9 lists the amount of Quad Cities tax payments to Rock Island County's levee extensions and collections of available distributions. In addition, Exelon has appealed its 2001 real property assessment and associated tax bill and is negotiating a graduated reduction in payments to minimize the final disruption to the districts caused by a sudden revenue reduction (Exelon 2003a). Exelon is also appealing its 2002 real property assessment and tax bill. The appeal process and any attendant negotiations over

assessed value and tax payments are outside the scope of the current SEIS; it is noted that tax revenues from Quad Cities Units 1 and 2 will likely be lower in the future, although how much lower is not known at this time.

Table 2-9. Quad Cities Contributions to Rock Island County Operating Budgets

Year	Property Tax Paid by Quad Cities	Percent of Collections Available for Distribution	Rock Island County Collections Available for Distribution to Districts
1997	\$3,241,673	2.8	\$117,630,496
1998	\$3,394,251	2.8	\$122,356,796
1999	\$3,524,299	2.7	\$129,713,348
2000	\$3,607,871	2.7	\$135,791,633
Source: Exelon 2003a			

2.2.9 Historic and Archaeological Resources

This section discusses the cultural background and the known historic and archaeological resources at the Quad Cities site and in the surrounding area.

2.2.9.1 Cultural Background

The region around the Quad Cities site contains numerous prehistoric and historic Native American and EuroAmerican cultural resources. The applicant's ER mentions 322 properties listed in the National Register of Historic Places for the four counties near Quad Cities Units 1 and 2 (Exelon 2003a). These registered properties are mostly historic EuroAmerican places and none are located in areas affected by operation of the Quad Cities site. The region of the United States in the vicinity of the Quad Cities site is rich in prehistoric archaeological remains as well (Fowler and Hall 1978).

"Paleo Indians" occupied North America from 10,000 to 12,000 years ago, living off the land and subsisting on large game that has since become extinct. From approximately 10,000 years ago and lasting until approximately 1 AD, "archaic people" were present in the native oak/hickory deciduous forests of the area where they hunted animals and gathered plants. (State of Illinois 2001). Following the existence of these people came the "Woodland" culture,

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1 which archaeologists define as occupying the region between 500 BC and 900 AD. In the
2 Woodland culture, Native Americans became regionally distinct cultural entities. Woodland
3 people were dependent on maize agriculture, lived in villages, practiced a religion manifested
4 by burial mounds, used the bow and arrow in hunting, and began to make pottery (Fowler and
5 Hall 1978).

6
7 The "Mississippian" culture followed the Woodland culture from 900 to 1500 AD. This culture is
8 seen as a complex society of people who lived in large fortified villages, built temple mounds,
9 and practiced improved agricultural methods (Fowler and Hall 1978).

10
11 Known examples of older prehistoric sites are rare on the banks of the Mississippi River, but
12 Native American archaeological sites that date to the Woodland and Mississippian periods are
13 fairly common. Albany Mounds, a middle Woodland site located just south of the present town
14 of Albany and less than 16 km (10 mi) from the Quad Cities site, is located on the Mississippi
15 River flood plain (Illinois State Museum 2000). Locally, the majority of recorded prehistoric
16 archaeological sites are found either on top of or within terraces of the Mississippi River and its
17 tributaries.

18
19 The Native American societies in the project region shared several important characteristics at
20 the time they were first contacted by Europeans. These included an economic base that
21 combined hunting and gathering with growing corn; and an annual settlement cycle that varied
22 between population concentrations into semi-permanent river-side villages in summer, large
23 camps in winter, and population dispersal among scattered camps in the spring and fall
24 (Callender 1978).

25
26 The Quad Cities site was on the edge of several tribal territories at the time of historic contact.
27 Territorial boundaries were in flux throughout the historic period and until the mid-Nineteenth
28 Century. By the mid-1600s eastern tribes were displaced to the west and had begun to put
29 pressure on the tribes in the region where Quad Cities is located today. By 1650, the Miami
30 had settled in northwestern Illinois and probably had encompassed the Quad Cities site within
31 their territory. The country of the loosely affiliated Illinois tribes was several tens of kilometers
32 to the west and south when Europeans made first note of their existence. In 1673, the Illinois
33 occupied a region that extended from the southern tip of Lake Michigan westward into Iowa and
34 south into Arkansas (Bauxar 1978).

35
36 Upon settling near the present day Quad Cities site, the Miami were in conflict with the Sioux,
37 who occupied territories to the north and west, and shortly after 1700 the Miami moved out of
38 the area. By the 1730s, Sauk and Fox peoples occupied the lands abandoned by the Miami.

1 They lived on the banks of the Mississippi River as far south as the mouth of the Rock River. In
2 just 10 years, they left the area (Bauxar 1978).

3
4 The Sauk and Fox were back in the vicinity of Quad Cities by the late 1700s. After defeat by
5 the Chippewa in 1783 at their village above the mouth of the Wisconsin River, they withdrew
6 down the Mississippi River, establishing villages on both sides of the river as far south as the
7 mouth of the Des Moines River.

8
9 By 1829, under pressure from EuroAmerican settlement and with the encouragement of the
10 territorial governor, Sauk and Fox leaders moved their villages to the west side of the
11 Mississippi River. The Sauk and Fox continued to make visits to the Illinois side to hunt and
12 gather, but in 1832, U.S. General Henry Atkinson engaged in a campaign against them that
13 defeated the tribes and definitively removed them from the territory east of the Mississippi
14 River.

15
16 The Potawatomi are also said to have expanded their territory into the project area in the 1800s
17 (Clifton 1978). The Kickapoo may have passed through the area around 1700 (Tanner 1986).
18 All lands in the region surrounding the Quad Cities site were ceded in treaties dating to the
19 decade of the 1830s. By the 1870s there were no recognized Native American villages near
20 the project area.

21
22 Today, there are tribes in Texas, Oklahoma, Kansas, Iowa, Wisconsin, and Michigan who
23 could, because of past association with lands at or near Quad Cities, have an interest in the
24 plans for operation of Quad Cities Units 1 and 2. They include Kickapoo, Sauk and Fox, Iowa,
25 and Potawatami tribal organizations.

26 27 **2.2.9.2 Historic and Archaeological Resources at Quad Cities**

28
29 The applicant's ER makes no mention of historic architecture, historic landscape, traditional
30 cultural property, or archaeological sites recorded at the Quad Cities site in Illinois (Exelon
31 2003a). The Nuclear Regulatory Commission did conduct historic and archaeological site file
32 searches at repositories in Illinois, where it found a record of an archaeological site at or near
33 Quad Cities. That record dates to 1933 when the University of Chicago documented an
34 archaeological site that contained surface features, which "look remarkably like Indian mounds,"
35 in association with stone tools and pottery. They attributed the archaeological site to the
36 Woodland period and plotted it on land that would eventually be used by Quad Cities.

37
38 The original environmental statement related to operation of Quad Cities (AEC 1972)
39 incorrectly concluded that there were no known archaeological remains in the immediate vicinity
40 of the station near Cordova, Illinois. The U.S. Department of Interior commented on the draft
41 environmental statement in late August, 1972, by expressing concern over the proposed

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1 construction of a spray canal and its potential to affect archaeological resources (USDI 1972).
2 The U.S. Department of Interior recommended that the Atomic Energy Commission should
3 consult with Charles Bareis, an expert archaeologist.

4
5 By the first week of September 1972, Bareis, the expert archaeologist, had written a letter to the
6 Commission noting that on "page 16 of the Environmental Statement, it is stated that there is an
7 absence of archaeological materials at the plant site. This is an error because a check of our
8 records indicates that at least one archaeological site, Ri-60, consisting of five mounds, were or
9 are located in the plant area" (Bareis 1972a).

10
11 Within less than three weeks Bareis again wrote to the Commission to report that he had
12 conducted a reconnaissance survey on a portion of a spray canal then under construction near
13 the Mississippi River (Bareis 1972b). Mr. Bareis found no evidence of archaeological materials
14 in the canal right-of-way south of the plant and a few "areas of interest" in the right-of-way north
15 of the plant. Though he felt what he had observed had little likelihood of proving significant, he
16 recommended "use of due caution" during excavation.

17 **2.2.10 Related Federal Project Activities and Consultations**

18
19
20 The staff reviewed the possibility that the activities of other Federal agencies might impact the
21 renewal of the Quad Cities OLs. Any such activities could result in cumulative environmental
22 impacts and the possible need for a Federal agency to become a cooperating agency for the
23 preparation of the SEIS.

24
25 Quad Cities Units 1 and 2 are located on the east side of Pool 14 of the Mississippi River, a
26 reservoir that was established by the U.S. Army Corps of Engineers and continues to be subject
27 to routine maintenance, such as dredging.

28
29 Federal facilities and lands in proximity to the Quad Cities site are the Rock Island Arsenal,
30 Savanna Army Depot, and the Upper Mississippi River NWFR. The Rock Island Arsenal is
31 located 32 km (20 mi) south in the City of Rock Island and the Savanna Army Depot is 48 km
32 (30 mi) north near Hanover, Illinois. The Upper Mississippi River NWFR is located on the Iowa
33 side of the Mississippi River, across from the Quad Cities site. It was established in 1924 to
34 protect bottomland habitat and extends 418 km (261 mi) along the west shore of the Mississippi
35 River.

36
37 After reviewing the Federal activities in the vicinity of Quad Cities, the staff determined there are
38 no Federal project activities that could result in cumulative impacts or would make it desirable
39 for another Federal agency to become a cooperating agency for preparing this SEIS.
40

NRC is required under Section 102 of the National Environmental Policy Act (NEPA) to consult with and obtain the comments of any Federal agency that has jurisdiction by law or special expertise with respect to any environmental impact involved. NRC consulted with the U.S. Department of the Interior, Fish and Wildlife Service, and the consultation correspondence is included in Appendix E.

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3.0 Environmental Impacts of Refurbishment

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

- (1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristics.
- (2) A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective off-site radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal).
- (3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation.

For issues that meet the three Category 1 criteria, no additional plant-specific analysis is required in this supplemental environmental impact statement (SEIS) unless new and significant information is identified.

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

License renewal actions may require refurbishment activities for the extended plant life. These actions may have an impact on the environment that requires evaluation, depending on the type of action and the plant-specific design. Environmental issues associated with refurbishment that were determined to be Category 1 issues are listed in Table 3-1.

Environmental issues related to refurbishment considered in the GEIS for which these conclusions could not be reached for all plants, or for specific classes of plants, are Category 2 issues. These are listed in Table 3-2.

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

Environmental Impacts of Refurbishment

Table 3-1. Category 1 Issues for Refurbishment Evaluation

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section
SURFACE WATER QUALITY, HYDROLOGY, AND USE (FOR ALL PLANTS)	
Impacts of refurbishment on surface water quality	3.4.1
Impacts of refurbishment on surface water use	3.4.1
AQUATIC ECOLOGY (FOR ALL PLANTS)	
Refurbishment	3.5
GROUND-WATER USE AND QUALITY	
Impacts of refurbishment on ground-water use and quality	3.4.2
LAND USE	
Onsite land use	3.2
HUMAN HEALTH	
Radiation exposures to the public during refurbishment	3.8.1
Occupational radiation exposures during refurbishment	3.8.2
SOCIOECONOMICS	
Public services: public safety, social services, and tourism and recreation	3.7.4; 3.7.4.3; 3.7.4.4; 3.7.4.6
Aesthetic impacts (refurbishment)	3.7.8

Category 1 and Category 2 issues related to refurbishment that are not applicable to Quad Cities because they are related to plant design features or site characteristics not found at Quad Cities are listed in Appendix F.

The potential environmental effects of refurbishment actions would be identified, and the analysis would be summarized within this section, if such actions were planned. Exelon Generation Company, LLC (Exelon) indicated that it has performed an assessment of structures and components pursuant to 10 CFR 54.21 to identify activities that are necessary to continue operation of Quad Cities Units 1 and 2 during the requested 20-year period of extended operation. These activities include replacement of certain components as well as new inspection activities and are described in the Environmental Report (Exelon 2003). However, Exelon stated that the replacement of these components and the additional inspection activities are within the bounds of normal plant component replacement and inspections; therefore, they are not expected to affect the environment outside the bounds of plant operations as evaluated in the final environmental statement (AEC 1972). In addition, Exelon's evaluation of structures and components as required by 10 CFR 54.21 did not identify any major plant refurbishment activities or modifications necessary to support the continued operation of Quad Cities Units 1 and 2 beyond the end of the existing operating licenses. Therefore, refurbishment is not considered in this draft SEIS.

Table 3-2. Category 2 Issues for Refurbishment Evaluation

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section	10 CFR 51.53 (c)(3)(ii) Subparagraph
TERRESTRIAL RESOURCES		
Refurbishment impacts	3.6	E
THREATENED OR ENDANGERED SPECIES (FOR ALL PLANTS)		
Threatened or endangered species	3.9	E
AIR QUALITY		
Air quality during refurbishment (nonattainment and maintenance areas)	3.3	F
SOCIOECONOMICS		
Housing impacts	3.7.2	I
Public services: public utilities	3.7.4.5	I
Public services: education (refurbishment)	3.7.4.1	I
Offsite land use (refurbishment)	3.7.5	I
Public services, transportation	3.7.4.2	J
Historic and archaeological resources	3.7.7	K
ENVIRONMENTAL JUSTICE		
Environmental justice	Not addressed ^(a)	Not addressed ^(a)
(a) Guidance related to environmental justice was not in place at the time the GEIS and the associated revision to 10 CFR Part 51 were prepared. If a licensee plans to undertake refurbishment activities for license renewal, environmental justice must be addressed in the licensee's environmental report and the staff's environmental impact statement.		

3.1 References

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

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

Environmental Impacts of Refurbishment

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- 5 U.S. Atomic Energy Commission (AEC). 1972. *Final Environmental Statement Related to the*
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8 Washington, D.C. September, 1972.
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- 10 U.S. Nuclear Regulatory Commission (NRC). 1996. *Generic Environmental Impact Statement*
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4.0 Environmental Impacts of Operation

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

- (1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristics.
- (2) A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective off-site radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal).
- (3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation.

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

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

This chapter addresses the issues related to operation during the renewal term that are listed in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, and are applicable to the Quad Cities plant. Section 4.1 addresses issues applicable to the Quad Cities plant cooling system. Section 4.2 addresses issues related to the transmission lines and onsite land use. Section 4.3 addresses the radiological impacts of normal operation. Section 4.4 addresses issues related to the socioeconomic impacts of normal operation during the renewal term. Section 4.5 addresses issues related to groundwater use and quality. Section 4.6 discusses the impacts of renewal-term operations on threatened and endangered species. Section 4.7 addresses potential new and significant information that was identified during the scoping period. Section 4.8 addresses cumulative impacts of operations during the renewal term. The results of the

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

Environmental Impacts of Operation

evaluation of environmental issues related to operation during the renewal term are summarized in Section 4.9. Finally, Section 4.10 lists references cited in the chapter. Category 1 and Category 2 issues that are not applicable to Quad Cities because they are related to plant design features or site characteristics not found at Quad Cities are listed in Appendix F.

4.1 Cooling System

Category 1 issues in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B that are applicable to Quad Cities Units 1 and 2 cooling-system operation during the renewal term are listed in Table 4-1. Exelon Generation Company, LLC (Exelon) stated in its Environmental Report (ER) that no new information existed for the issues that would invalidate the GEIS conclusions (Exelon 2003a). The staff has not identified any significant new information during its independent review of the Quad Cities ER (Exelon 2003a), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS. For all of the issues, the staff concluded in the GEIS that the impacts are SMALL, and additional plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

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

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section
SURFACE WATER QUALITY, HYDROLOGY, AND USE (FOR ALL PLANTS)	
Altered current patterns at intake and discharge structures	4.2.1.2.1; 4.3.2.2; 4.4.2
Temperature effects on sediment transport capacity	4.2.1.2.3; 4.4.2.2
Scouring caused by discharged cooling water	4.2.1.2.3; 4.4.2.2
Eutrophication	4.2.1.2.3; 4.4.2.2
Discharge of chlorine or other biocides	4.2.1.2.4; 4.4.2.2
Discharge of sanitary wastes and minor chemical spills	4.2.1.2.4; 4.4.2.2
Discharge of other metals in waste water	4.2.1.2.4; 4.3.2.2; 4.4.2.2
Water use conflicts (plants with once-through cooling systems)	4.2.1.3
AQUATIC ECOLOGY (FOR ALL PLANTS)	
Accumulation of contaminants in sediments or biota	4.2.1.2.4; 4.3.3; 4.4.3; 4.4.2.2
Entrainment of phytoplankton and zooplankton	4.2.2.1.1; 4.3.3; 4.4.3

Table 4-1 (contd)

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section
Cold shock	4.2.2.1.5; 4.3.3; 4.4.3
Thermal plume barrier to migrating fish	4.2.2.1.6; 4.4.3
Distribution of aquatic organisms	4.2.2.1.6; 4.4.3
Premature emergence of aquatic insects	4.2.2.1.7; 4.4.3
Gas supersaturation (gas bubble disease)	4.2.2.1.8; 4.4.3
Low dissolved oxygen in the discharge	4.2.2.1.9; 4.3.3; 4.4.3
Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses	4.2.2.1.10; 4.4.3
Stimulation of nuisance organisms (e.g., shipworms)	4.2.2.1.11; 4.4.3
HUMAN HEALTH	
Microbiological organisms (occupational health)	4.3.6
Noise	4.3.7

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

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

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

The staff has not identified any new and significant information during its independent review of the Quad Cities ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of altered current patterns at intake and discharge structures during the renewal term beyond those discussed in the GEIS.

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

3
4 These effects have not been found to be a problem at operating nuclear power
5 plants and are not expected to be a problem during the license renewal term.
6

7 The staff has not identified any new and significant information during its independent
8 review of the Quad Cities ER, the staff's site visit, the scoping process, or its evaluation of
9 other available information. Therefore, the staff concludes that there are no impacts of
10 temperature effects on sediment transport capacity during the renewal term beyond those
11 discussed in the GEIS.
12

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

15
16 Scouring has not been found to be a problem at most operating nuclear power
17 plants and has caused only localized effects at a few plants. It is not expected to
18 be a problem during the license renewal term.
19

20 The staff has not identified any new and significant information during its independent
21 review of the Quad Cities ER, the staff's site visit, the scoping process, or its evaluation of
22 other available information. Therefore, the staff concludes that there are no impacts of
23 scouring caused by discharged cooling water during the renewal term beyond those
24 discussed in the GEIS.
25

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

27
28 Eutrophication has not been found to be a problem at operating nuclear power
29 plants and is not expected to be a problem during the license renewal term.
30

31 The staff has not identified any new and significant information during its independent
32 review of the Quad Cities ER; the staff's site visit; the scoping process; or its evaluation of
33 other available information, including plant monitoring data and technical reports.
34 Therefore, the staff concludes that there are no impacts of eutrophication during the
35 renewal term beyond those discussed in the GEIS.
36

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

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

The staff has not identified any new and significant information during its independent review of the Quad Cities ER; the staff's site visit; the scoping process; or its evaluation of other available information, including the National Pollutant Discharge Elimination System (NPDES) permit for Quad Cities, Discharge Monitoring Reports (DMRs), or discussion with the NPDES compliance office. Therefore, the staff concludes that there are no impacts of discharge of chlorine or other biocides during the renewal term beyond those discussed in the GEIS.

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

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

The staff has not identified any new and significant information during its independent review of the Quad Cities ER; the staff's site visit; the scoping process; or its evaluation of other available information, including the NPDES permit for Quad Cities, DMRs, or discussion with the NPDES compliance office. Therefore, the staff concludes that there are no impacts of discharges of sanitary wastes and minor chemical spills during the renewal term beyond those discussed in the GEIS.

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

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

The staff has not identified any new and significant information during its independent review of the Quad Cities ER; the staff's site visit; the scoping process; or its evaluation of other available information, including the NPDES permit for Quad Cities, DMRs, or discussion with the NPDES compliance office. Therefore, the staff concludes that there are

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no impacts of discharges of other metals in waste water during the renewal term beyond those discussed in the GEIS.

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

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

The staff has not identified any new and significant information during its independent review of the Quad Cities ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of water-use conflicts associated with the once-through cooling system during the renewal term beyond those discussed in the GEIS.

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

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

The staff has not identified any new and significant information during its independent review of the Quad Cities ER, the staff's site visit, the scoping process, or its evaluation of available information. Therefore, the staff concludes that there are no impacts of accumulation of contaminants in sediments or biota during the renewal term beyond those discussed in the GEIS.

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

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

The staff has not identified any new and significant information during its independent review of the Quad Cities ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of entrainment of phytoplankton and zooplankton during the renewal term beyond those discussed in the GEIS.

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

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

The staff has not identified any new and significant information during its independent review of the Quad Cities ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of cold shock during the renewal term beyond those discussed in the GEIS.

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

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

The staff has not identified any new and significant information during its independent review of the Quad Cities ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of thermal plume barriers to migrating fish during the renewal term beyond those discussed in the GEIS.

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

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

The staff has not identified any new and significant information during its independent review of the Quad Cities ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts on the distribution of aquatic organisms during the renewal term beyond those discussed in the GEIS.

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

3
4 Premature emergence has been found to be a localized effect at some operating
5 nuclear power plants but has not been a problem at Quad Cities and is not
6 expected to be a problem during the license renewal term.
7

8 The staff has not identified any new and significant information during its independent
9 review of the Quad Cities ER, the site visit, the scoping process, or its evaluation of other
10 available information. Therefore, the staff concludes that there are no impacts of premature
11 emergence of aquatic insects during the renewal term beyond those discussed in the GEIS.
12

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

15
16 Gas supersaturation was a concern at a small number of operating nuclear
17 power plants with once-through cooling systems but has been satisfactorily
18 mitigated. It has not been found to be a problem at operating nuclear power
19 plants with cooling towers or cooling ponds and is not expected to be a problem
20 during the license renewal term.
21

22 The staff has not identified any new and significant information during its independent
23 review of the Quad Cities ER, the staff's site visit, the scoping process, or its evaluation of
24 other available information. Therefore, the staff concludes that there are no impacts of gas
25 supersaturation during the renewal term beyond those discussed in the GEIS.
26

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

29
30 Low dissolved oxygen has been a concern at one nuclear power plant with a
31 once-through cooling system but has been effectively mitigated. It has not been
32 found to be a problem at operating nuclear power plants with cooling towers or
33 cooling ponds and is not expected to be a problem during the license renewal
34 term.
35

36 The staff has not identified any new and significant information during its independent
37 review of the Quad Cities ER, the staff's site visit, the scoping process, or its evaluation of
38 other available information. Therefore, the staff concludes that there are no impacts of low
39 dissolved oxygen during the renewal term beyond those discussed in the GEIS.
40

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

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

The staff has not identified any new and significant information during its independent review of the Quad Cities ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of losses from predation, parasitism, and disease among organisms exposed to sublethal stresses during the renewal term beyond those discussed in the GEIS.

- Stimulation of nuisance organisms (e.g., shipworms). Based on information in the GEIS, the Commission found that

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

The staff has not identified any new and significant information during its independent review of the Quad Cities ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of stimulation of nuisance organisms during the renewal term beyond those discussed in the GEIS.

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

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

The staff has not identified any new and significant information during its independent review of the Quad Cities ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of microbiological organisms during the renewal term beyond those discussed in the GEIS.

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

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

The staff has not identified any new and significant information during its independent review of the Quad Cities ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of noise during the renewal term beyond those discussed in the GEIS.

The Category 2 issues related to cooling system operation during the renewal term that are applicable to Quad Cities Units 1 and 2 are discussed in the section that follows and are listed in Table 4-2.

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

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section	10 CFR 51.53(c)(3)(II) Subparagraph	SEIS Section
AQUATIC ECOLOGY			
(FOR PLANTS WITH ONCE-THROUGH AND COOLING POND HEAT-DISSIPATION SYSTEMS)			
Entrainment of fish and shellfish in early life stages	4.2.2.1.2; 4.4.3	B	4.1.1
Impingement of fish and shellfish	4.2.2.1.3; 4.4.3	B	4.1.2
Heat shock	4.2.2.1.4; 4.4.3	B	4.1.3
HUMAN HEALTH			
Microbiological organisms (public health)(plants using lakes or canals, or cooling towers or cooling ponds that discharge to a small river)	4.3.6	G	4.1.4

4.1.1 Entrainment of Fish and Shellfish in Early Life Stages

For plants with once-through cooling systems, entrainment of fish and shellfish in early life stages into cooling-water systems associated with nuclear power plants is considered a Category 2 issue, requiring a site-specific assessment before license renewal. To perform this evaluation, the staff reviewed the Quad Cities Units 1 and 2 ER (Exelon 2003a); visited the

1 Quad Cities site; and reviewed the applicant's State of Illinois NPDES Permit IL0005037, issued
2 on May 26, 2000, and in force until May 31, 2005 (IEPA 2000).
3

4 Section 316(b) of the Clean Water Act (CWA) requires that any standard established pursuant
5 to Sections 301 or 306 of the CWA shall require that the location, design, construction, and
6 capacity of cooling-water-intake structures reflect the best technology available for minimizing
7 adverse environmental impacts (33 USC 1326). Entrainment of fish and shellfish into the
8 cooling system is a potential adverse environmental impact that can be minimized by the best
9 technology available.
10

11 The fish community of Pool 14 has been monitored yearly by the applicant since 1971 to detect
12 any potential impacts of Quad Cities Units 1 and 2 operation. There are no indications that
13 entrainment has had a destabilizing impact on fish populations (Exelon 2003a). Naturally
14 occurring environmental perturbations (e.g., droughts, floods, and severe winters), the
15 modification of the river to accommodate barge navigation, and land use within the watershed
16 have had the greatest influences on fish populations (Section 2.2.5).
17

18 In Pool 14, the ichthyoplankton drift typically runs from mid-April through late July. There is
19 minimal to no difference in density between day versus night collections nor in depth within the
20 water column (LaJeone and Monzingo 2000). Freshwater drum dominate the drift, comprising
21 over 80 percent of the eggs and 57 percent of the larvae. Other common species include
22 emerald shiner and common carp. Lesser contributions come from sunfishes, gizzard shad,
23 and buffaloes (LaJeone and Monzingo 2000).
24

25 Under a very conservative scenario of total mortality of all entrained ichthyoplankton, projected
26 entrainment losses could be as high as 5.4 percent during the peak periods of the occurrence of
27 fish eggs and larvae in the water column (La Jeone and Monzingo 2000). However, as long as
28 discharge temperatures do not exceed 37.8 °C (100 °F), some entrainment survival does occur
29 (LaJeone and Monzingo 2000). Lawler Matusky Skelly Engineers (LMS) estimated that with
30 100 percent entrainment, mortality would impact 0.1 to 0.7 percent of total larvae that pass the
31 plant (LMS 1985). However, after applying entrainment survival data to freshwater drum,
32 common carp, and buffalo species, the entrainment losses of these species were from 0.0006
33 to 0.10 percent, 0.0000 to 0.0055 percent, and 0.000 to 0.004 percent, respectively. These
34 projections of cropping are not considered to adversely affect the fish community of Pool 14
35 (LaJeone and Monzinga 2000).
36

37 The staff reviewed the available information provided by Exelon in the Quad Cities Units 1 and
38 2 ER (Exelon 2003a) related to the CWA 316(b) permitting process. Based on the results of
39 past entrainment studies and the operating history of Quad Cities Units 1 and 2's intake
40 structure, the staff concludes that the potential impacts of entrainment of fish and shellfish in

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the early life stages into the cooling water intake system are SMALL, and further mitigation measures are not warranted.

4.1.2 Impingement of Fish and Shellfish

For plants with once-through cooling systems, impingement of fish and shellfish on debris screens of cooling-water system intakes is considered a Category 2 issue, requiring a site-specific assessment before license renewal. To perform this evaluation, the staff reviewed the Quad Cities Units 1 and 2 ER (Exelon 2003a); visited the Quad Cities site; and reviewed the applicant's State of Illinois NPDES Permit IL0005037, issued on May 26, 2000, and in force until May 31, 2005 (IEPA 2000).

Section 316(b) of the CWA states that any standard established pursuant to Section 301 or 306 of the CWA requires that the location, design, construction, and capacity of cooling-water-intake structures reflect the best technology available for minimizing adverse environmental impacts (33 USC 1326). Impingement of fish and shellfish on the debris screens of the cooling system is a potential adverse environmental impact that can be minimized by the use of best technology available.

Commonwealth Edison submitted a supplemental CWA Section 316(b) Demonstration in 1981 that evaluated impingement at Quad Cities Units 1 and 2; and concluded that losses due to impingement were minimal. This demonstration was approved by both the Iowa Department of Environmental Quality and the Illinois Environmental Protection Agency (IEPA) in 1981. From 1972 to 1983, the Quad Cities station operated in a closed-cycle or partial closed-cycle mode. Included in an agreement to allow the return of open-cycle operation was a commitment to construct and operate a fish production facility to mitigate potential impingement/entrainment impacts (LaJeone and Monzingo 2000).

The current NPDES permit requires Exelon to monitor fish impingement once weekly. Each year's data is tabulated and compared to historical fish impingement data. The results are submitted to the IEPA. The IEPA then evaluates the impingement data as part of the NPDES renewal process which occurs every five years.

At the low river flow of 453 m³/s (16,000 ft³/s), mean intake velocity with all pumps operating is about 0.5 m/s (1.5 cfs) at the traveling screens. Intake velocity measurements taken at the entrance to the intake forebay averaged less than 0.3 m/s (1.0 cfs) at a river flow of 850 m³/s (30,000 cfs). At average river flows of 1,530 m³/s (54,000 cfs), intake velocities are lower. When ambient river water temperature falls below 4.4 °C (40 °F) in the late autumn, cooling water requirements for the station can be reduced by one half. This is accomplished by opening the ice-melt recirculation line and by idling one condenser circulating water pump from

each unit. During this period, current velocities at the forebay entrance and traveling screens are also reduced by about 50 percent (LaJeone and Monzingo 2000).

Eighty fish species have been identified from impingement samples (Bowzer and Lippincott 2000). Gizzard shad and freshwater drum dominate the impinged species, accounting for 90 percent of the numbers and biomass of all fish impinged. Far lower contributions are made by bluegill, white bass, and channel catfish at 5 percent, 1.9 percent, and 1.7 percent by number, respectively (LaJeone and Monzingo 2000). Generally, impingement increases during the autumn and remains high throughout the winter and spring. The greatest numbers are impinged during the winter months, with fewest during the May to August period. Gizzard shad impingement peaks in January and February, coincident with stresses of freezing or near-freezing water temperatures. Freshwater drum numbers peak in March or April. Impingement is primarily comprised of young-of-year or yearlings (LaJeone and Monzingo 2000). Annual impingement estimates have ranged from 59,000 fish in 1981 to 2,989,000 fish in 1989; with weight of fish impinged ranging from 1200 kg (2650 lb) in 1981 to 153,700 kg (338,850 lb) in 1989 (Bowzer and Lippincott 2000).

Fish impingement at the Quad Cities site, though relatively high, does not adversely impact the fish community because the vast majority of fish impinged by the site during winter are dead or moribund upon their arrival in the intake forebay (LaJeone and Monzingo 2000). There have been no measurable changes to the fish community of Pool 14 related to the Quad Cities Units 1 and 2, and no indications that impingement has had a destabilizing impact on fish populations (LaJeone and Monzingo 2000). Naturally occurring environmental perturbations (e.g., droughts, floods, and severe winters), the modification of the river to accommodate barge navigation, and land use within the watershed have had the greatest influences on fish populations (Section 2.2.5). Because the Quad Cities site operates as a "base load" facility, there is only minor variation in cooling water usage between years. Therefore, wide annual fluctuations in the numbers of fish impinged are indicative of actual changes in fish abundance in the pool, as well as a measure of seasonal and hydrologic effects on fish survival (Bowzer and Lippincott 2000).

The staff has reviewed the available information. Based on the results of past impingement studies and the operating history of the Quad Cities Units 1 and 2 intake structure, the staff concludes that the potential impacts of impingement of fish and shellfish are SMALL, and further mitigation measures are not warranted.

4.1.3 Heat Shock

For plants with once-through cooling systems, the effects of heat shock are listed as a Category 2 issue and require plant-specific evaluation before license renewal. The NRC made

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1 impacts on fish and shellfish resources resulting from heat shock a Category 2 issue because
2 of continuing concerns about thermal-discharge effects and the possible need to modify thermal
3 discharges in the future in response to changing environmental conditions (NRC 1996).
4 Information to be considered includes (1) the type of cooling system (whether once-through or
5 cooling pond) and (2) evidence of a CWA Section 316(a) variance or equivalent state
6 documentation. To perform this evaluation, the staff reviewed the Quad Cities Units 1 and 2
7 ER (Exelon 2003a); visited the Quad Cities site; and reviewed the applicant's State of Illinois
8 NPDES Permit IL0005037, issued on May 26, 2000, and in force until May 31, 2005
9 (IEPA 2000).

10
11 Quad Cities Units 1 and 2 have a once-through heat dissipation system. Commonwealth
12 Edison submitted a supplemental CWA Section 316(a) Demonstration in 1981 that evaluated
13 thermal discharges at Quad Cities plant. This demonstration was approved by both the Iowa
14 Department of Environmental Quality and the Illinois EPA in 1981 (Exelon 2003a). Quad Cities
15 Units 1 and 2 have been able to operate at full power in the open-cycle mode while still meeting
16 state water temperature standards under most river flow conditions. The site utilizes river water
17 at the rate of 61,000 L/s (970,000 gpm) and condenser cooling water is warmed a maximum of
18 15.6 °C (28 °F) above ambient before being discharged to the river. Heated condenser water
19 is completely mixed with river water and meets the 2.8 °C (5 °F) criterion within 152 m (500 ft)
20 downstream of the diffuser pipes (LaJeone and Monzingo 2000). Under low flow conditions,
21 power levels sometimes have to be reduced to ensure that the NPDES permit temperature
22 limits are not exceeded. Under normal circumstances, Quad Cities Units 1 and 2 meet state
23 water quality (temperature) standards. Exelon has consistently operated Quad Cities Units 1
24 and 2 in compliance with the thermal-discharge limits established for the plant by the IEPA.
25 Therefore, no formal CWA Section 316(a) variance in accordance with 40 CFR 125 has been
26 needed or sought by the facility.

27
28 Thermal discharges related to the operation of Quad Cities Units 1 and 2 affect a relatively
29 small area of the Mississippi River. The required thermal mixing zone does not exceed 10.5 ha
30 (26 acres). This is only about 0.25 percent of the area of Pool 14 (4165 ha [10,292 acres]).
31 Furthermore, it extends no more than 152 m (500 ft) downstream of the point of discharge.
32 Section 2.2.5 discusses the major changes and modifications to the Upper Mississippi River
33 that have had an effect on aquatic resources. Thermal discharges have not been implicated as
34 having caused any adverse impacts on fish or shellfish. A major mussel bed, which is one of
35 the Essential Habitat Areas for the endangered clam, the Higgins' eye pearlymussel (*Lampsilis*
36 *higginsii*), is located at River Miles 505.5 through 503.0 (Section 2.2.5). This mussel bed is
37 over 1.6 km (1.0 mi) downstream of the Quad Cities site and mixing zone. Therefore, this
38 mussel bed is not affected by thermal discharges.

39
40 The staff has reviewed the available information, and on the basis of the conditions of the
41 NPDES permit and the operating history of the Quad Cities Units 1 and 2 discharge, concludes

1 that the potential impacts of discharged heated water from the cooling-water-intake system to
2 aquatic biota are SMALL, and further mitigation measures are not warranted.

3 4 **4.1.4 Microbiological Organisms (Public Health)**

5
6 The effects of microbiological organisms on human health are listed as a Category 2 issue and
7 require plant-specific evaluation before license renewal. The annual flow of the Mississippi
8 River near the Quad Cities site is $4.5 \times 10^{10} \text{ m}^3$ ($1.6 \times 10^{12} \text{ ft}^3$) per year, which is less than the
9 $8.9 \times 10^{10} \text{ m}^3$ ($3.15 \times 10^{12} \text{ ft}^3$) per year threshold value in 10 CFR 51.53(c)(3)(ii)(G). Thus, the
10 effects of its discharge on microbiological organisms must be addressed for Quad Cities Units 1
11 and 2.

12
13 The Category 2 designation is based on the magnitude of the potential public-health impacts
14 associated with thermal enhancement of the enteric pathogens (*Salmonella* sp. and
15 *Shigella* sp.), the *Pseudomonas aeruginosa* bacterium, thermophilic fungi, a number of
16 *Legionella* sp. bacteria species, and pathogenic strains of the free-living amoebae (*Naegleria*
17 *fowleri* and *Acanthamoeba* sp.) (NRC 1999). Generally, Quad Cities Units 1 and 2 discharge
18 temperatures do not exceed 44.2 °C (111.6 °F). In July and August, 2001, daily temperatures
19 in the discharge canal ranged from 32.1 to 43.3 °C (89.7 to 110 °F) below those known to be
20 conducive to the growth and survival of thermophilic pathogens (Exelon 2003a). Based on
21 these average daily temperatures in the discharge canal, coupled with the dilution provided by
22 the Mississippi River, the thermophilic microorganisms are not expected to cause any
23 appreciable public health risk (Mudgett 2002). The State of Iowa Department of Public Health
24 also concurs that there is no significant threat to the public from thermophilic microorganisms
25 attributable to operation of Quad Cities Unit 1 and 2 (Barton 2002). Disinfection of the Quad
26 Cities Units 1 and 2 sewage treatment plant effluent and NPDES permit requirements to
27 monitor fecal coliforms in this effluent further reduces the potential for the heated discharge to
28 be a seed source or inoculant for pathogenic microorganisms (Exelon 2003a).

29
30 The staff independently reviewed the Quad Cities Units 1 and 2 ER (Exelon 2003a); visited the
31 Quad Cities site; and reviewed the applicant's State of Illinois NPDES Permit IL0005037, issued
32 on May 26, 2000, and effective until May 31, 2005 (IEPA 2000). Based on its review of this
33 information, coupled with the fact that Quad Cities Units 1 and 2 operations and cooling
34 systems are not expected to change significantly over the license renewal term, the staff
35 concludes that the potential impacts to public health from microbiological organisms resulting
36 from the Quad Cities Units 1 and 2 cooling-water discharges are SMALL, and further mitigation
37 is not warranted.

4.2 Transmission Line

The Final Environmental Statement for Quad Cities Units 1 and 2 (AEC 1972) describes four transmission lines that connect Quad Cities Units 1 and 2 with the transmission system – two lines to the Nelson substation, one line to the Davenport substation near Davenport, Iowa, and one line to Barstow substation near Rock Island, Illinois. Environmental impacts of the lines to the Davenport and Barstow substations were not evaluated in the FES because the lines were planned before Quad Cities, and the lines would have been built even if Quad Cities Units 1 and 2 had not been built. Changes to lines connecting Quad Cities Units 1 and 2 to the transmission system are described in the applicant's ER (Exelon 2003a). The changes include addition of a fifth line from Quad Cities to the Rock Creek substation, which is approximately 8 km (5 mi) north. The scope of this review includes the full length of all five lines.

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1 that are applicable to transmission lines from Quad Cities Units 1 and 2 are listed in Table 4-3. Exelon stated in its ER that it is not aware of any new and significant information associated with the renewal of the

Quad Cities Units 1 and 2 OLs. The staff has not identified any new and significant information during its independent review of the ER (Exelon 2003a), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS. For all of those issues, the staff concluded in the GEIS that the impacts are SMALL, and additional plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

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

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

1 A brief description of the staff's review and GEIS conclusions, as codified in Table B-1 of the
2 GEIS, for each of these issues follows:
3

- 4 • Power line right-of-way management (cutting and herbicide application). Based on
5 information in the GEIS, the Commission found that
6

7 The impacts of right-of-way maintenance on wildlife are expected to be of small
8 significance at all sites.
9

10 The staff has not identified any new and significant information during its independent
11 review of the Exelon ER, the staff's site visit, the scoping process, consultation with the
12 FWS, or its evaluation of other information. Therefore, the staff concludes that there are no
13 impacts of power line right-of-way management during the renewal term beyond those
14 discussed in the GEIS.
15

- 16 • Bird collision with power lines. Based on information in the GEIS, the Commission found
17 that
18

19 Impacts are expected to be of small significance at all sites.
20

21 During an independent review of the Exelon ER, the staff's site visit, the scoping process,
22 consultation with the FWS, and the staff's evaluation of other information, the staff has not
23 identified any significant new information. Therefore, the staff concludes that there are no
24 impacts of bird collisions with power lines during the renewal term beyond those discussed
25 in the GEIS.
26

- 27 • Impacts of electromagnetic fields on flora and fauna (plants, agricultural crops, honeybees,
28 wildlife, livestock). Based on information in the GEIS, the Commission found that
29

30 No significant impacts of electromagnetic fields on terrestrial flora and fauna
31 have been identified. Such effects are not expected to be a problem during the
32 license renewal term.
33

34 The staff has not identified any new and significant information during its independent
35 review of the Exelon ER, the staff's site visit, the scoping process, or its evaluation of other
36 information. Therefore, the staff concludes that there are no impacts of electromagnetic
37 fields on flora and fauna during the renewal term beyond those discussed in the GEIS.
38
39

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- 1 • Floodplains and wetlands on power line right of way. Based on information in the GEIS, the
2 Commission found that

3
4 Periodic vegetation control is necessary in forested wetlands underneath power
5 lines and can be achieved with minimal damage to the wetland. No significant
6 impact is expected at any nuclear power plant during the license renewal term.
7

8 The staff has not identified any new and significant information during its independent
9 review of the Exelon ER, the staff's site visit, the scoping process, consultation with the
10 FWS, or its evaluation of other information. Therefore, the staff concludes that there are no
11 impacts of power-line right-of-way on floodplains and wetlands during the renewal term
12 beyond those discussed in the GEIS.
13

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

16
17 Production of ozone and oxides of nitrogen is insignificant and does not
18 contribute measurably to ambient levels of these gases.
19

20 The staff has not identified any new and significant information during its independent
21 review of the Exelon ER, the staff's site visit, the scoping process, or its evaluation of other
22 information. Therefore, the staff concludes that there are no air quality impacts of
23 transmission lines during the renewal term beyond those discussed in the GEIS.
24

- 25 • Onsite land use. Based on information in the GEIS, the Commission found that

26
27 Projected onsite land use changes required during... the renewal period would
28 be a small fraction of any nuclear power plant site and would involve land that is
29 controlled by the applicant.
30

31 The staff has not identified any new and significant information during its independent
32 review of the Exelon ER, the staff's site visit, the scoping process, or its evaluation of other
33 information. Therefore, the staff concludes that there are no onsite land use impacts during
34 the renewal term beyond those discussed in the GEIS.
35

- 36 • Power line right of way (land use). Based on information in the GEIS, the Commission
37 found that

38
39 Ongoing use of power line right of ways would continue with no change in
40 restrictions. The effects of these restrictions are of small significance.
41

The staff has not identified any new and significant information during its independent review of the Exelon ER, the staff's site visit, the scoping process, or its evaluation of other information. Therefore, the staff concludes that there are no impacts of power line right of way on land use during the renewal term beyond those discussed in the GEIS.

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

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

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

4.2.1 Electromagnetic Fields, Acute Effects (Electric Shock)

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

The five lines that are within the scope of this review were examined by the applicant to identify the configuration where the potential for current-induced shock would be the greatest. The electric field strength and induced current were calculated for a large tractor-trailer truck parked beneath the line for each limiting configuration (Exelon 2003a; Exelon 2003b) using the AC/DCLINE computer code produced by the Electric Power Research Institute (EPRI 1992).

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1 Calculated induced currents exceeded the NESC 5-mA induced current standard at only one
2 location on the five lines within the scope of this review. The maximum calculated induced
3 current on the North Nelson line was 6.0 mA at a location where the line crosses a county road.
4 However, since large truck traffic on the road is very infrequent, it is considered unlikely that a
5 large truck would park under the line.
6

7 The staff concludes that the impact of the potential for electric shock is MODERATE on the
8 segment of the north Nelson line where calculated induced currents exceed 5 mA.
9 Consideration of mitigation is warranted in the vicinity of this line segment. By letter dated
10 September 22, 2003, the NRC staff informed Exelon Energy Delivery (who owns, operates, and
11 maintains the portion of the transmission system to which this finding applies) of its findings
12 (NRC 2003c). The impacts of the potential for electric shock are SMALL on the remaining
13 portion of the north Nelson line, the south Nelson line, the Barstow line, the Rock Creek line,
14 and the Davenport line where the induced currents are calculated to be 5 mA or less. No
15 additional mitigation is warranted on these lines and line segments.
16

17 4.2.2 Electromagnetic Fields, Chronic Effects

18
19 In the GEIS, the chronic effects of 60-Hz electromagnetic fields from power lines were not
20 designated as Category 1 or 2, and will not be until a scientific consensus is reached on the
21 health implications of these fields.
22

23 The potential for chronic effects from these fields continues to be studied and is not known at
24 this time. The National Institute of Environmental Health Sciences (NIEHS) directs related
25 research through the U.S. Department of Energy (DOE). A recent report (NIEHS 1999)
26 contains the following conclusion:
27

28 The NIEHS concludes that ELF-EMF [extremely low frequency-electromagnetic field]
29 exposure cannot be recognized as entirely safe because of weak scientific evidence that
30 exposure may pose a leukemia hazard. In our opinion, this finding is insufficient to
31 warrant aggressive regulatory concern. However, because virtually everyone in the
32 United States uses electricity and therefore is routinely exposed to ELF-EMF, passive
33 regulatory action is warranted such as a continued emphasis on educating both the
34 public and the regulated community on means aimed at reducing exposures. The
35 NIEHS does not believe that other cancers or non-cancer health outcomes provide
36 sufficient evidence of a risk to currently warrant concern.
37

38 This statement is not sufficient to cause the staff to change its position with respect to the
39 chronic effects of electromagnetic fields. The staff considers the GEIS finding of "not
40 applicable" still appropriate and will continue to follow developments on this issue.
41

4.3 Radiological Impacts of Normal Operations

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1 that are applicable to Quad Cities Units 1 and 2 in regard to radiological impacts are listed in Table 4-5. Exelon stated in the Quad Cities ER (Exelon 2003a) that it is not aware of any new and significant information associated with the renewal of the Quad Cities Units 1 and 2 OLS. The staff has not identified any significant new information during its independent review. Therefore, the staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS (NRC 1996, 1999). For all of those issues, the staff concluded in the GEIS that the impacts are SMALL and additional plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

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

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

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

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

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

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

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

Environmental Impacts of Operation

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

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

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

4.4 Socioeconomic Impacts of Plant Operations During the License Renewal Period

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

The staff has not identified any significant new information during its independent review of the Exelon ER, the staff's site visit, the scoping process, or its evaluation of other information. Therefore, the staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS (NRC 1996, 1999). For these issues, the staff concluded in the GEIS that the impacts are SMALL and additional plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

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

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

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

- 3
4 • Public services: public safety, social services, and tourism and recreation. Based on
5 information in the GEIS, the Commission found that

6
7 Impacts to public safety, social services, and tourism and recreation are
8 expected to be of small significance at all sites.

9
10 The staff has not identified any new and significant information during its independent
11 review of the Exelon ER, the staff's site visit, the scoping process, or its evaluation of other
12 available information. Therefore, the staff concludes that there are no impacts on public
13 safety, social services, and tourism and recreation during the renewal term beyond those
14 discussed in the GEIS.

- 15
16 • Public services: education (license renewal term). Based on information in the GEIS, the
17 Commission found that

18
19 Only impacts of small significance are expected.

20
21 The staff has not identified any new and significant information during its independent
22 review of the Exelon ER, the staff's site visit, the scoping process, or its evaluation of other
23 available information. Therefore, the staff concludes that there are no impacts on education
24 during the renewal term beyond those discussed in the GEIS.

- 25
26 • Aesthetic impacts (license renewal term). Based on information in the GEIS, the
27 Commission found that

28
29 No significant impacts are expected during the license renewal term.

30
31 The staff has not identified any new and significant information during its independent
32 review of the Exelon ER, the staff's site visit, the scoping process, or its evaluation of other
33 available information. Therefore, the staff concludes that there are no aesthetic impacts
34 during the renewal term beyond those discussed in the GEIS.

- 35
36 • Aesthetic impacts of transmission lines (license renewal term). Based on information in the
37 GEIS, the Commission found that

38
39 No significant impacts are expected during the license renewal term.
40

Environmental Impacts of Operation

The staff has not identified any new and significant information during its independent review of the Exelon ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no aesthetic impacts of transmission lines during the renewal term beyond those discussed in the GEIS.

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

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

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section	10 CFR 51.53(c)(3)(ii) Subparagraph	SEIS Section
SOCIOECONOMICS			
Housing impacts	4.7.1	I	4.4.1
Public services: public utilities	4.7.3.5	I	4.4.2
Offsite land use (license renewal term)	4.7.4	I	4.4.3
Public services, transportation	4.7.3.2	J	4.4.4
Historic and archaeological resources	4.7.7	K	4.4.5
Environmental justice	Not addressed ^(a)	Not addressed ^(a)	4.4.6
(a) Guidance related to environmental justice was not in place at the time the GEIS and the associated revision to 10 CFR Part 51 were prepared. Therefore, environmental justice must be addressed in the licensee's environmental report and the staff's environmental impact statement.			

4.4.1 Housing Impacts During Operations

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

Data from the U.S. Bureau of the Census (USBC) 2000 Census of Population indicates that approximately 283,000 persons live within 32 km (20 mi) of the Quad Cities site. Within this radius, the population density is 86 persons/km² (224 persons/mi²). Thus, the Quad Cities site falls into Category 4 of the GEIS sparseness classification (greater than or equal to

1 46 persons/km² [120 persons/mi²] within 32km [20 mi] NRC 1996). In addition, there are five
2 communities with populations exceeding 25,000 within 32 km (20 mi) of the Quad Cities site.

3
4 An analysis of data from the 2000 Census indicates that approximately 657,000 persons reside
5 within 80 km (50 mi) of the Quad Cities site, for a population density of 32 persons/km²
6 (83 persons/mi²) in this radius. The Census 2000 data show that one city, Davenport, Iowa,
7 has a population of 98,359, which places the Quad Cities region in Category 2 proximity
8 classification (no city with 100,000 or more persons and between 20 and 73 persons/km² [50
9 and 190 persons/mi²] within 80 km [50 mi]). However, Davenport grew at 3.2 percent over the
10 1990–2000 decade and within the next few years, it is possible that the Quad Cities region will
11 be in the Category 3 proximity classification (one or more cities with 100,000 or more persons
12 and less than 73 persons/km² [190 persons/mi²] within 80 km [50 mi]).

13
14 Currently, the Quad Cities region is classified in sparseness Category 4 and proximity Category
15 2, resulting in classification of the Quad Cities region as a medium-population area according to
16 the GEIS Sparseness and Proximity Matrix (NRC 1996). When the Davenport population
17 exceeds 100,000, the region will be considered a high-population area. Therefore, the Quad
18 Cities site is in a regional population context in which SMALL housing and employment impacts
19 from license renewal would be expected.

20
21 In 10 CFR Part 51, Subpart A, Appendix B, Table B-1, NRC concluded that impacts on housing
22 availability are expected to be of small significance at plants located in a medium-population
23 area where growth-control measures are not in effect. The Quad Cities site is located in a
24 medium-population area, and although Rock Island, Whiteside, and Scott counties and their
25 municipal governments attempt to direct growth within the established growth boundaries
26 without sprawl, growth-control measures are not in effect. Based on the NRC criteria, Exelon
27 expects housing impacts to be SMALL during continued operations (Exelon 2003a).

28
29 SMALL impacts result when no discernible change in housing availability occurs, changes in
30 rental rates and housing values are similar to those occurring statewide, and no housing
31 construction or conversion is required to meet new demand (NRC 1996). The GEIS assumes
32 that no more than a total additional staff of 60 permanent workers might be needed at each unit
33 during the license renewal period to perform routine maintenance and other activities. Although
34 Exelon expects to perform these routine activities during scheduled outages, they assumed
35 they would not add more than 60 total employees to their permanent staff during license
36 renewal (Exelon 2003a). This addition of 60 permanent workers, plus 139 indirect jobs (Exelon
37 2003a), would result in an increased demand for a total of 199 housing units around the Quad
38 Cities site (153 housing units for Rock Island, Whiteside, and Scott counties).^(a) The demand

(a) This assumes 77 percent of the new hires reside in the three counties (See Section 2.2.8.1).

Environmental Impacts of Operation

1 for the existing housing units could be met with the construction of new housing or use of
2 existing, unoccupied housing. In an area that has a population of more than 368,000, this
3 demand would not create a discernible change in housing availability, change in rental rates or
4 housing values, or spur much new construction or conversion. As a result, Exelon concludes
5 that the impacts would be SMALL and mitigation measures would not be necessary (Exelon
6 2003a).^(a)

7
8 The staff reviewed the available information relative to housing impacts and Exelon's
9 conclusions. Based on this review, the staff concludes that the impact on housing during the
10 license renewal period would be SMALL, and further mitigation is not warranted.

11 12 **4.4.2 Public Services: Public Utility Impacts During Operations**

13
14 An analysis of impacts on the public water supply system considered both plant demand and
15 plant-related population growth. Section 2.2.2 describes the Quad Cities Units 1 and 2
16 permitted withdrawal rate and actual use of water. The plant is not connected to a municipal
17 water system because it uses groundwater from its own wells. Exelon plans no refurbishment
18 in conjunction with this license renewal, so plant demand will not change beyond current
19 demands (Exelon 2003a).

20
21 To estimate the potential increase in demand for water resulting from new employment, it was
22 assumed that there might be an increase of up to 60 permanent employees during license
23 renewal, which might result in 199 direct and indirect new jobs, that, given the average
24 household size, would result in a net overall population increase of approximately 516 persons
25 and 199 households as a result of those jobs. These were distributed according to the current
26 distribution of Quad Cities employees across the three most affected counties, Rock Island and
27 Whiteside counties in Illinois and Scott County in Iowa and compared with the water service
28 capacities of the larger water service companies in these counties (Exelon 2003a). Table 4-8
29 shows the results of these estimates. The staff finds that the impact of increased water use on
30 area water systems is SMALL and that further mitigation is not warranted.

31 32 **4.4.3 Offsite Land Use During Operations**

33
34 Offsite land use during the license renewal term is a Category 2 issue (10 CFR 51, Subpart A,
35 Appendix B, Table B-1). Table B-1 of 10 CFR 51 Subpart A, Appendix B notes that "significant
36 changes in land use may be associated with population and tax revenue changes resulting from
37 license renewal."

(a) Exelon's estimate of 153 housing units is likely to be an "upper bound" estimate. Most of the
potentially new jobs would most likely be filled by existing area residents, thus creating no, or
little, net demand for housing.

Table 4-8. Water Supply and Estimated Potential Additional Consumption from Direct and Indirect New Employment During Renewal Term

County	Estimated Number of Persons	Consumption (Based on 80 Gallons/day)	Water Supplier Capacity	Additional Consumption Capacity
Rock Island	122	9760	53 MGD	0.02%
Whiteside	165	13200	16.5 MGD	0.08%
Scott	118	9440	32 MGD	0.03%

Source: Exelon 2003a

Section 3.7.5 and 4.7.4 of the GEIS define the magnitude of land-use changes as **SMALL** if little new development and minimal changes to an area's land-use pattern result. **MODERATE** change results if considerable new development and some changes to the land-use pattern occur. The magnitude of change is **LARGE** if large-scale new development and major changes in the land-use pattern occur.

Exelon has identified a maximum of 60 additional employees during the license renewal term plus an additional 139 indirect jobs (total 199) in the surrounding community (Exelon 2003a). Using this upper-bound employment assumption, the staff calculated that there could be an increase in total population within the two states of 517 people during the license renewal term.

Section 3.7.5 of the GEIS (NRC 1996) states that if plant-related population growth is less than 5 percent of the study area's total population, offsite land-use changes would be small, especially if the study area has established patterns of residential and commercial development, a population density of at least 23 persons/km² (60 persons/mi²), and at least one urban area with a population of 100,000 or more within 80 km (50 mi). Population growth related to Quad Cities license renewal will be less than 5 percent of the area's 2000 total population of 654,509; the area has established patterns of residential and commercial development, a population density of well over 32 persons/km² (83 persons/mi²), and the conjoined urban area (Quad Cities Metropolitan Statistical Area composed of Davenport and Bettendorf, Iowa, and Rock Island, Moline, and East Moline, Illinois) with a population of 359,062 in 2000 within the 80-km (50-mi) radius. Consequently, the staff concludes that population changes resulting from license renewal are likely to result in **SMALL** offsite land-use impacts.

Tax revenue can affect land use because it enables local jurisdictions to be able to provide the public services (e.g., public facilities and utilities) necessary to support development.

Environmental Impacts of Operation

1 Section 4.7.4.1 of the GEIS states that the assessment of tax-driven, land-use impacts during
2 the license renewal term should consider (1) the size of the plant's payments relative to the
3 community's total revenues, (2) the nature of the community's existing land-use pattern, and
4 (3) the extent to which the community already has public services in place to support and guide
5 development. If the plant's tax payments are projected to be small relative to the community's
6 total revenue, tax-driven, land-use changes during the plant's license renewal term would be
7 SMALL, especially where the community has pre-established patterns of development and has
8 provided adequate public services to support and guide development. Section 4.7.2.1 of the
9 GEIS states that if tax payments by the plant owner are less than 10 percent of the taxing
10 jurisdiction's revenue, the significance level would be SMALL. If the plant's tax payments are
11 projected to be medium to large relative to the community's total revenue, new tax-driven, land-
12 use changes would be MODERATE.

13
14 Annual property taxes from Quad Cities Units 1 and 2 accounted for approximately 2.7 percent
15 of Rock Island County's total levee extension and approximately 2.8 percent of the county's
16 total collections available for distribution for the years 1997 to 2000. However, the local
17 Cordova taxing districts for the township, library, school district, road and bridge district, and fire
18 department derive significant revenue (31 to 73 percent of their total revenue from all sources)
19 from the plant (Rock Island County Board of Review 2002).

20
21 Negotiations are underway between Exelon and Rock Island County for a graduated reduction
22 in payments to minimize the financial disruption to county and local operations caused by a
23 change in the methods of plant value assessment due to the deregulation of the utility industry
24 in the State of Illinois (Exelon 2003a). The local taxing districts that rely on the plant for a large
25 portion of their revenue will be adversely affected to a significant degree by the decline in tax
26 receipts. However, this decline is not related to the proposed license renewal for Quad Cities
27 Units 1 and 2.

28
29 Since no major refurbishment activities are planned at the Quad Cities site during the license
30 renewal term, no new incremental sources of plant-related tax payments are expected that
31 could influence land use in Rock Island County by fostering considerable growth. Therefore,
32 the staff concludes that tax-related land use impacts caused during the plant's license term
33 renewal are SMALL.

34
35 Rock Island County utilizes four major tools in an effort to manage growth and sprawl
36 throughout the county. Strong farmland preservation policies in Rock Island County dictate that
37 settlement is to occur mainly in existing municipalities rather than in rural unincorporated areas
38 (Bi-State 2002). Similarly, Scott County, Iowa and Whiteside County, Illinois, also seek to guide
39 their counties' development. Therefore, any possible population growth emanating from plant
40 property taxes or employment during the plant's license renewal term are likely to be channeled

to county-targeted growth locations where utilities, facilities, and services can accommodate growth and thus the impacts of these changes would be SMALL.

Based on the information presented above, the staff concludes that offsite land-use impacts are likely to be SMALL and additional mitigation is not warranted.

4.4.4 Public Services: Transportation Impacts During Operations

Currently, Quad Cities employs approximately 850 staff and 130 contract/matrixed workers. The upper-bound potential increase in permanent staff during the license renewal term is 60 additional workers, or approximately 6 percent of the current permanent and contract workforce of approximately 980 employees. The State of Illinois Department of Transportation does not make level-of-service (LOS) determinations in rural, non-metropolitan areas such as the Quad Cities site, unless it is deemed necessary, and therefore, none of the roads in the vicinity of the site has had a LOS determination.

The staff reviewed Exelon's assumptions and resulting conclusions. The staff concludes that any impact of Quad Cities employees on transportation service degradation is likely to be SMALL and does not require further mitigation.

4.4.5 Historic and Archaeological Resources

The National Historic Preservation Act (NHPA), as amended through 1992, requires Federal agencies to take into account the potential effects of their undertakings on historic properties. The historic-review process mandated by Section 106 of the NHPA is outlined in regulations issued by the Advisory Council on Historic Preservation in 36 CFR Part 800, as amended through 2001. Renewal of an OL for a nuclear power plant is an undertaking that could possibly affect either known or potential historic properties that may be located at the plant. Therefore, in accordance with the provisions of NHPA, the NRC is required to make a reasonable effort to identify historic properties in the areas of potential effects. If no historic properties are present or affected, the NRC is required to notify the State Historic Preservation Office before proceeding. If it is determined that historic properties are present, the NRC is required to assess and resolve possible adverse effects of the undertaking. In general, lands within the boundaries of a nuclear-plant site fall into one of the following categories:

- (1) Areas with No Potential for archaeological resources. These areas include lands where past disturbances related to the construction of the power station and appurtenant facilities have taken place to such an extent that once-extant cultural resources are no longer present. No further archaeological investigations would be recommended for these areas.

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- (2) Areas with Low Potential for archaeological resources. Lands within the plant site that fall into this category are those that are relatively undisturbed but that possess characteristics that would normally indicate a low possibility for most types of cultural resources to occur. For the most part, these lands have a degree of slope greater than 15 percent. For most of these areas, further archaeological work would not be necessary, although there could be smaller areas within the larger zone where specific ground conditions could require investigation.
- (3) Areas with Moderate-to-High Potential for archaeological resources. These areas are classified as those that are relatively undisturbed by past activities and have a likelihood for prehistoric and historic archaeological sites, according to local models of prehistoric and historic land use and settlement patterning. Archaeological investigation would be recommended prior to undertaking any ground-disturbing activities in these areas.

The Quad Cities site is an area of moderate-to-high potential. There are no known historic resources at the Quad Cities site. However, there are reports of archaeological resources on the Quad Cities site (Bareis 1972a, 1972b). A prehistoric Woodland-period archaeological site associated with Quad Cities property was recorded by archaeologists in 1933. In 1972, archaeologists found some areas of archaeological interest in a reconnaissance during construction of a spray canal.

The Quad Cities property has not been investigated by professional archaeologists at a level that would conclusively determine the current presence or absence of archaeological sites, or define the significance of any such resources that may exist on these lands. The Quad Cities license renewal application for continued operations does not include proposals for future land-disturbing activities or structural modifications beyond routine maintenance at the plant nor does it guarantee against such disturbances.

Exelon initiated communication with the Iowa and Illinois state historic preservation offices by letters dated April and January of 2002 (Jury 2002a, 2002b). The letters express Exelon's desire to assess the effects of the license renewal on historic properties, as required by the Nuclear Regulatory Commission of applicants for operating license renewal. The letters specifically include within the purview of the undertaking the Quad Cities site itself and five related transmission lines built to connect Quad Cities to the regional transmission system. The applicant notes in its letters that it does not expect the operation of Quad Cities, including maintenance of the identified transmission lines, through the license renewal term to adversely affect cultural or historical resources. The applicant further notes in the letters that "No major structural modifications have been identified for the purposes of supporting license renewal. Any maintenance activities necessary to support license renewal would be limited to previously disturbed areas. No additional land disturbance is anticipated in support of license renewal." Finally, a request is made in the letters for state concurrence with a determination that

1 operations at Quad Cities during the period of the license renewal would have "...no effect on
2 any historic or archeological properties."

3
4 Both the Illinois and Iowa historic preservation offices responded to the applicant's letters,
5 concurring that the operation and management of the Quad Cities Units 1 and 2 would not
6 affect historic properties. The Illinois Historic Preservation Agency wrote on February 7, 2002,
7 that it had reviewed the undertaking in accordance with regulations to implement Section 106 of
8 the National Historic Preservation Act. Illinois authorities agreed that no historic properties are
9 affected by the undertaking as described by the applicant (Haaker 2002). The Iowa State
10 Historic Preservation Office wrote on June 24, 2002, that it had reviewed the information
11 submitted by the applicant. Iowa authorities agreed that they "could concur with a
12 determination of no historic properties affected" if the project occurred as described by the
13 applicant and if the Nuclear Regulatory Commission petitioned for the state's views in
14 accordance with regulations to implement Section 106 of the National Historic Preservation Act
15 (Jones 2002).

16
17 The Nuclear Regulatory Commission has forwarded letters to the state historic preservation
18 offices in Iowa and Illinois. The letters include a request for confirmation of their previous
19 conclusion that no historic properties are affected by the decision to renew the Quad Cities
20 license (NRC 2003a and 2003b).

21
22 The staff reviewed the applicant's assumptions and resulting conclusions as they relate to
23 historical and archaeological resources and determined that archaeological resources have
24 been found on the Quad Cities site. The setting of the Quad Cities site adjacent to the
25 Mississippi River, combined with the reports of archaeological finds on and adjacent to the
26 station, indicate a high potential for discovery of significant resources. These considerations
27 require adequate plans to protect archaeological sites from inadvertent disturbance or
28 destruction. The staff further finds that procedures currently in place are not protective of
29 archaeological resources that may be present at the Quad Cities site. However, the applicant
30 has committed to modify existing procedures to include the following criteria:

- 31
- 32 • Contact the Illinois Historic Preservation Agency for guidance on requirements for an
33 archaeological survey when any undertaking would disturb sediments at the station at
34 depths below previous disturbance, or below the present surface in previously undisturbed
35 areas. [Note: previous disturbance is defined by the documented disturbance area and
36 depth for projects previously reviewed by the NRC and determined to be not significant.
37 Areas or sediments that extend beyond these boundaries are previously undisturbed.]
 - 38 • Once guidance is received from the Illinois Historic Preservation Agency, adhere to that
39 guidance.
- 40

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Based on this commitment by the applicant, the staff's preliminary determination is the impact of license renewal on historical and archaeological resources is SMALL and additional mitigation is not warranted.

4.4.6 Environmental Justice

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

For the purpose of the staff's review, a minority population is defined to exist if the percentage of minorities within the census block groups^(b) in each state within the 80 km (50 mi) potentially affected by the renewal of Quad Cities Units 1 and 2 operating licenses exceeds the corresponding percentage of minorities in the state of which it is a part by 20 percentage points, or if the corresponding percentage of minorities within the census block group is at least 50 percent. A low-income population is defined to exist if the percentage of low-income population within a census block group exceeds the corresponding percentage of low-income population in the state of which it is a part by 20 percentage points, or if the corresponding percentage of low-income population within a census block group is at least 50 percent. For census block groups within Rock Island and Whiteside counties, for example, the percentage of minority and low-income populations is compared to the percentage of minority and low-income populations in Illinois. For block groups in Scott County, the percentage of minority and low-income populations is compared with the percentage of minority and low-income populations in Iowa.

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

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

1 Exelon used U.S. Bureau of the Census 2000 data for the minority portion of the Environmental
2 Justice calculations and Census 1990 data for the low-income portion of the Environmental
3 Justice calculations, the most current data available at the time of publication of the ER (Exelon
4 2003a). This discussion of minority and low-income status relies on Census 2000 data, which
5 now includes both population and economic data. Geographic Information System (GIS)
6 software was used to analyze Census 2000 population data. The census data used are from
7 Geolytics, Inc. (Geolytics, 2000).
8

9 Figure 4-1 shows the location of census block groups identified as having minority status,
10 according to the above criteria. Figure 4-2 shows the location of census block groups identified
11 as low-income status, according to NRC criteria.
12

13 The closest minority-status block groups to the Quad Cities site are in the East Moline/Moline
14 area, approximately 24 km (15 mi) south of the plant. The low-income block groups nearest the
15 plant are in the vicinity of Clinton, Iowa, about 14 km (9 mi) north of the Quad Cities site; the
16 next nearest block groups to the plant are in the East Moline area about 24 km (15 mi) south of
17 the plant. With the locations of minority and low-income populations identified, the staff
18 proceeded to evaluate whether any of the environmental impacts of the proposed action could
19 affect these populations in a disproportionately high and adverse manner. Based on staff
20 guidance (NRC 2001), air, land, and water resources within 80 km (50 mi) of the Quad Cities
21 site were examined. Within that area, of the potential environmental impacts that could affect
22 human populations, all of these were considered SMALL for the general population.

23 The pathways through which the environmental impacts associated with the Quad Cities
24 license renewal can affect human populations are discussed in each associated section. The
25 staff then evaluated whether minority and low-income populations could be disproportionately
26 affected by these impacts. The staff found no unusual resource dependencies or practices,
27 such as subsistence agriculture, hunting, or fishing through which the populations could be
28 disproportionately affected. In addition, the staff did not identify any location-dependent
29 disproportionate impacts affecting these minority and low-income populations. The staff
30 concludes that offsite impacts from Quad Cities to minority and low-income populations would
31 be SMALL and no additional mitigation actions are warranted.
32

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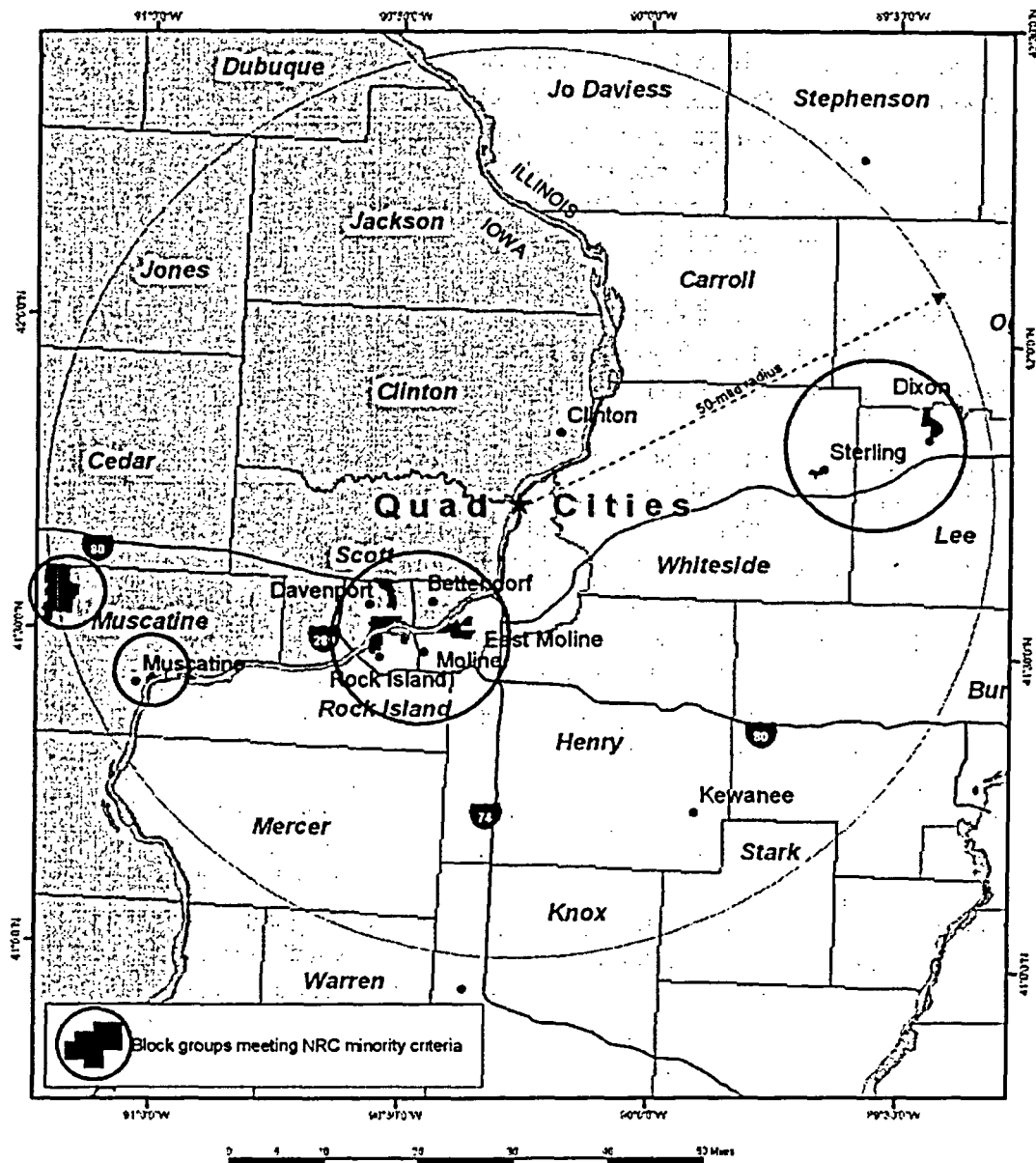
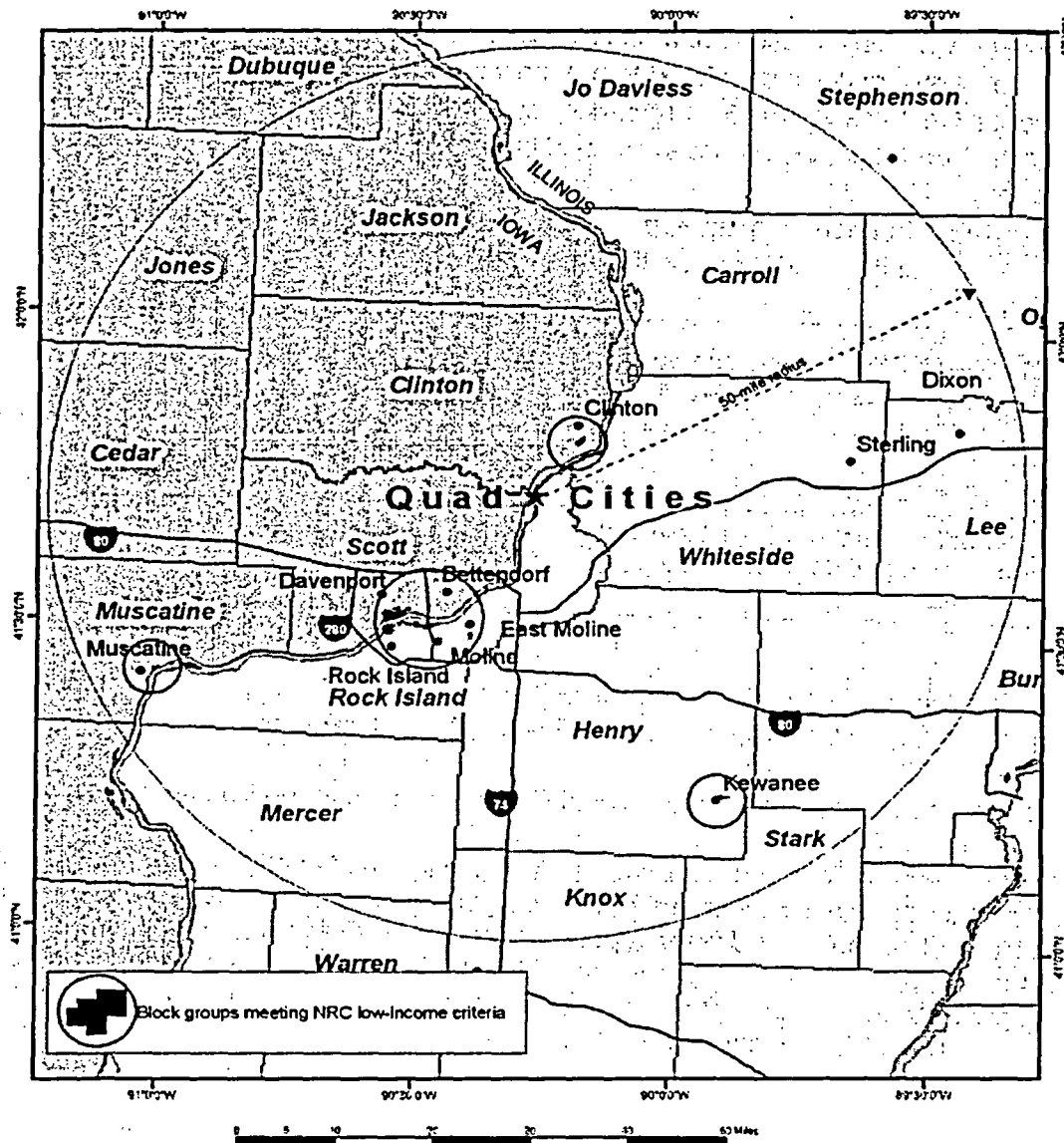


Figure 4-1. Geographic Distribution of Minority Populations (shown in shaded areas) Within 80 km (50 mi) of Quad Cities Based on 2000 Census Block Group Data



1 **Figure 4-2** Geographic Distribution of Low-Income Populations (shown in shade areas)
 2 Within 80 km (50 mi) of Quad Cities Based on 1990 Census Block Group Data

4.5 Groundwater Use and Quality

There are no Category 1 issues related to groundwater use and quality for Quad Cities Units 1 and 2. The Category 2 issues related to groundwater use conflicts during the renewal term that are described in 10 CFR Part 51, Subpart A, Appendix B, Table B-1 and applicable to Quad Cities Units 1 and 2 are discussed in the section that follows and are listed in Table 4-9.

Table 4-9. Category 2 Issue Applicable to Groundwater Use Conflicts of the Quad Cities Units 1 and 2 During the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section	10 CFR 51.53(c)(3)(ii) Subparagraph	SEIS Section
AQUATIC ECOLOGY			
(FOR PLANTS WITH ONCE-THROUGH AND COOLING POND HEAT-DISSIPATION SYSTEMS)			
Groundwater use conflicts (potable and service water, and dewatering; plants that use >100 gpm)	4.8.1.1; 4.8.1.2	C	4.5

For plants using greater than 100 gallons per minute (gpm) of groundwater, the potential use conflict is a Category 2 issue, requiring a site-specific assessment prior to license renewal.

The staff independently reviewed the Quad Cities ER (Exelon 2003a) and visited the site.

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

Quad Cities groundwater use has averaged 45 L/s (717 gpm) over the last 10 years and, therefore, the issue of groundwater use conflicts does apply. In the winter of 1997, groundwater was used to heat the water in the fish-rearing facility while the plant was shut down. During this period, groundwater use from Well 7 was six times normal use. Without this period of high use, the 10-year average yield for the site is approximately 31.9 L/s (505 gpm).

The Quad Cities site is located in the Meredosia Channel, an ancient channel of the Mississippi River. The Meredosia Channel has been filled over many thousands of years with unconsolidated sediments ranging in depth from approximately 15 to 91 m (50 to 300 ft)

(Blume 1966). Water for industrial and home use in the region comes from both wells and the Mississippi River.

Groundwater resources in the region are developed from three aquifer systems. These consist of the alluvial aquifer, the shallow Silurian dolomite aquifer, and the artesian Cambrian-Ordovician aquifer. Some wells within a few miles of the station pump at rates up to 44.2 L/s (700 gpm). These are in the upper alluvial aquifer at depths of 6 to 30 m (20 to 100 ft) below ground surface (AEC 1972). Groundwater in the area is encountered at depths from approximately 5 to 6 m (17 to 21 ft). The groundwater gradient in this aquifer is relatively flat and generally flows to the Mississippi River, except during periods of high river flow (Blume 1966).

During periods of pumping, groundwater levels in site wells are monitored by Exelon to determine whether drawdown is taking place that might impact offsite groundwater users. Due to extensive reservoir of groundwater associated with the Meredosia Channel, it is unlikely that Quad Cities operation would result in noticeable changes in the groundwater levels and Exelon has not observed a lowering of water levels in site wells. Therefore, groundwater use conflict impacts would be SMALL, if any, and mitigation measures would not be warranted.

4.6 Threatened or Endangered Species

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

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

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

This issue requires consultation with appropriate agencies to determine whether threatened or endangered species are present and whether they would be adversely affected by the continued operation of the nuclear power plant during the license renewal term. The presence of threatened or endangered species in the vicinity of the Quad Cities site is discussed in Sections 2.2.5 and 2.2.6. On January 11, 2002, Exelon corresponded with the FWS and requested information on the potential impacts of relicensing on threatened and endangered species (Jury 2002c). The FWS indicated that they had no objection to the relicensing action

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on February 12, 2002 (Millar 2002). On March 12, 2003, the NRC independently contacted the FWS to request information on threatened and endangered species and the impacts of relicensing (NRC 2003c). In response, on June 6, 2003, the FWS provided additional information regarding federally listed species that have been observed or may occur in the vicinity of the Quad Cities site and its associated transmission lines (Nelson 2003). On August 12, 2003, the NRC requested additional information from the FWS for an expanded scope of the transmission lines under review for re-licensing (NRC 2003d). The FWS responded on September 15, 2003, with the requested information (FWS 2003b). This information has been received by the staff and is included in its assessment.

4.6.1 Aquatic Species

As described in Section 2.2.5, the Higgins' eye pearlymussel (*Lampsilis higginsii*) is the only Federally listed (endangered) aquatic species in the vicinity of the Quad Cities site. As discussed in Section 2.2.5, an Essential Habitat Area for the Higgins' eye pearlymussel is located 1.6 to 4.0 km (1.0 to 2.5 mi) downstream from the Quad Cities site. The presence of the Higgins' eye pearlymussel in this area suggests that past operation of Quad Cities Units 1 and 2 has not adversely affected the species. In addition, Quad Cities Units 1 and 2's cooling-water intake and discharge are closely monitored under the NPDES program, and permit limits are reviewed on a regular basis by state regulatory agencies to ensure the protection of aquatic biota (Exelon 2003a).

There are no plans to conduct refurbishment or construction at Quad Cities Units 1 and 2. Therefore, the staff has preliminarily concluded that continued operation of the plant under license renewal is not likely to adversely affect the Higgins' eye pearlymussel. Thus, it is the staff's preliminary findings that the impact on threatened or endangered aquatic species from an additional 20 years of operation of Quad Cities Units 1 and 2 would be SMALL, and additional mitigation is not warranted. The staff's findings will be documented in a biological assessment and forwarded to the FWS for their concurrence.

4.6.2 Terrestrial Species

Federally listed threatened and endangered terrestrial species that have the potential to occur on or in the vicinity of the Quad Cities site or the transmission lines associated with Quad Cities Units 1 and 2 are described in Section 2.2.6. These species include the Indiana bat, Iowa Pleistocene snail, bald eagle, western prairie fringed orchid, eastern prairie fringed orchid and the prairie bush clover.

All species presented in Table 2-3 could occur in counties within which Quad Cities Units 1 and 2 are located or which are traversed by transmission lines associated with Quad Cities Units 1 and 2. These listed species are associated with upland woodlands, prairie, algific (i.e., cold

1 producing) talus slopes, riparian and open water habitats. Although most of the transmission
2 lines transverse agricultural areas, some natural habitats are crossed (e.g., the Upper
3 Mississippi River NWFR). However, the bald eagle is the only Federally listed species that has
4 been observed or documented to occur along the transmission lines. One other Federally listed
5 species, the Iowa Pleistocene snail, is known to occur on north-facing slopes of driftless areas
6 (i.e., areas with little or no glacial deposits) in Clinton County, Iowa, occupying algific talus
7 slopes at the outlet of underground ice caves along limestone bluffs (Nelson 2003). This highly
8 restricted habitat is not likely to be found at the site or along the transmission lines. No
9 documented occurrences of other Federally listed species in Table 2-3 have been noted along
10 these transmission lines, within their ROWs, or in the vicinity of Quad Cities Units 1 and 2.

11
12 Bald eagles visit the open water and riparian habitats on or near Quad Cities Units 1 and 2, as
13 well as its Davenport and Rock Creek transmission lines, during winter migration and use this
14 area for summer nesting. Foraging bald eagles may be attracted to the open water areas in the
15 Mississippi River caused by the plant's thermal discharge during the winter months when the
16 river is icing over (Nelson 2003). Approximately one to two bald eagles per year have been
17 observed by FWS to collide with the Rock Creek transmission line, in the segment that crosses
18 the Mississippi River, with subsequent mortality.^(a) However, relative to the numbers of bald
19 eagles in the area, this impact is observed to be of small significance.^(a)

20
21 Although no management actions for bald eagle nesting and breeding areas (i.e., those actions
22 recommended by the Management Guidelines and Breeding Areas of the Northern States
23 Recovery Plan for the Bald Eagle) have been needed along the Quad Cities transmission lines,
24 it is expected that Exelon and its vegetation management contractors would implement such
25 actions upon identification of a nest. Vegetation management staff would coordinate and work
26 closely with the Rock Island U.S. FWS, the Upper Mississippi NWFR's Savanna District,
27 IL DNR, and IA DNR, to identify needed management actions and implement them to protect
28 the bald eagle and its habitat. Additionally, it is expected that raptor incident reporting for any
29 incidences of bald eagle injury or mortality along these transmission lines would be carried out
30 by Exelon and its vegetation management contractors. Currently, no bald eagle incident
31 reports have been necessary due to no observed injuries or mortalities in the area of Quad
32 Cities and its transmission lines by Exelon nor its contractors.

33
34 The NRC assessed the impacts of transmission lines on avian populations in its GEIS on the
35 effects of nuclear power plant license renewal (NRC 1996). In the GEIS, the NRC concluded
36 that mortality resulting from bird collisions with transmission lines associated with license
37 renewal and an additional 20 years of operation would be of small significance. This conclusion
38 was based on: (1) no indication in the existing literature that collision mortality is high enough to

(a) Personal communication with E. Britton, District Manager, Savanna District, Upper Mississippi
National Wildlife and Fish Refuge, May 8, 2003.

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1 result in population-level effects and, (2) the lack of known instances where nuclear power plant
2 lines affect large numbers of individuals in local areas.

3
4 Although undeveloped areas of the Quad Cities site have not been surveyed for Federally listed
5 species, these areas are not affected by ongoing plant operations and no refurbishment
6 activities that could disturb these areas are planned. In addition, maintenance activities
7 occurring along the transmission lines are limited by using a vegetation management strategy
8 that minimizes the need for cutting, mowing, and the application of herbicides (Cunningham
9 2003; Exelon 2003c; Exelon 2003d).

10
11 Based on the staff's review of the applicant's environmental report and the staff's independent
12 analysis, the staff has preliminarily concluded that continued operation of the plant during the
13 license renewal term is not likely to adversely affect the bald eagle and will have no effect on
14 other listed or proposed endangered or threatened species within the immediate vicinity of
15 Quad Cities site and its associated transmission lines. The applicant currently plans no
16 refurbishment activities. The staff expects that Best Management Practices (BMPs) for
17 protecting Federally listed species and their habitats, while carrying out vegetation management
18 activities, will be implemented by Exelon and its contractors at the end of consultation. Based
19 on this expectation, it is the staff's preliminary finding that the impact on threatened or
20 endangered species of an additional 20 years of operation of Quad Cities Units 1 and 2, and
21 associated transmission lines, would be SMALL and further mitigation is not warranted. The
22 staff's findings will be documented in a biological assessment forwarded to the FWS for their
23 concurrence.
24

25 **4.7 Evaluation of Potential New and Significant Information** 26 **on Impacts of Operation During the Renewal Term**

27
28 The staff has not identified new and significant information on environmental issues listed in 10
29 CFR Part 51, Subpart A, Appendix B, Table B-1, related to operation during the renewal term.
30 The staff reviewed the discussion of environmental impacts associated with operation during
31 the renewal term in the GEIS and had conducted its own independent review, including public
32 scoping meetings, to identify issues with new and significant information. Processes for
33 identification and evaluation of new information are described in Section 1.2.2, License
34 Evaluation Process.
35

4.8 Cumulative Impacts of Operations During the Renewal Term

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

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

4.8.1 Cumulative Impacts Resulting from Operation of the Plant Cooling System

For the purposes of this analysis, the geographic area considered for cumulative impacts resulting from operation of the Quad Cities Units 1 and 2 cooling system is the Upper Mississippi River,^(a) particularly within Pool 14. As discussed in Section 4.1, the staff found no new and significant information indicating that the conclusions regarding any of the cooling system-related Category 1 issues as related to Quad Cities are inconsistent with the conclusions in the GEIS (NRC 1996). Additionally, the staff determined that none of the cooling system-related Category 2 issues were likely to have greater than a SMALL impact on local water quality and aquatic resources.

(a) The Upper Mississippi River is the 1667-km (1036-mi) reach from St. Anthony Falls in Minnesota to the mouth of the Ohio River at Cairo, Illinois.

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1 The cumulative effects of past actions have resulted in the existing conditions on local water
2 quality and aquatic resources. Section 2.2.5 discusses the major changes and modifications
3 within the Upper Mississippi River that have had the greatest effects on aquatic resources.
4 These include agriculture, forestry, natural resource utilization (e.g., pearl button industry and
5 commercial and recreational fishing), river modifications, and industrial, municipal, and
6 residential developments. The 29 navigation dams constructed to create the 2.7-m (9-ft)
7 navigation channel between St. Louis, Missouri and Minneapolis, Minnesota have created
8 broad, shallow impoundments within the Upper Mississippi River. Dredging is routinely required
9 in some reaches to maintain the navigation channel (Fremling and Dratzkowski 2000). Dams
10 and levees have caused increased sedimentation within the river. Some reaches of the river
11 are polluted from past industrial and agricultural discharges (USGS 1999).

12
13 The lock and dam system has increased the water surface per linear mile of river, which has
14 increased total photosynthesis of the river. This has resulted in an increase in pounds of fish
15 per linear mile than existed before river impoundment. However, there have been general
16 decreases in floodplain forests, submerged aquatic plants, freshwater mussels, fingernail
17 clams, other bottom-dwelling invertebrates, and some fish species (Fremling and Dratzkowski
18 2000). Also, movement of many fish species throughout the Upper Mississippi River has been
19 impeded by the dams (USGS 1999). As the quantity and quality of backwater habitat has
20 become increasingly scarce and degraded due to sedimentation, riverine fish species have
21 increased in abundance while lacustrine species have decreased (Bowzer and Lippincott 2000).
22 However, there is little evidence to suggest that there has been a substantial net loss of fish
23 species in the Upper Mississippi River since the 1800s (USGS 1999).

24
25 Non-native species (e.g., common carp, grass carp, purple loosestrife, Eurasian milfoil, and
26 zebra mussel) are also adversely impacting native species. The zebra mussel has been
27 particularly devastating to native freshwater mussels (Fremling and Dratzkowski 2000); and the
28 common carp now comprises most of the commercial harvest and is the dominant species in
29 the Upper Mississippi River (USGS 1999).

30
31 Management and protection of fish and wildlife resources are provided, in part, by the three
32 National Wildlife Refuges contained within the Upper Mississippi River: Upper Mississippi River
33 National Wildlife and Fish Refuge, Trempealeau National Wildlife Refuge, and the Mark Twain
34 National Wildlife Refuge (Fremling and Dratzkowski 2000).

35
36 The staff concludes that the SMALL impacts of Quad Cities Units 1 and 2 cooling system
37 operations, including entrainment and impingement of fish and shellfish, heat shock, or any of
38 the cooling system-related Category 1 issues are not contributing to an overall decline in water
39 quality or the status of the fishery or other aquatic resources. The annual planting of walleye
40 and hybrid striped bass by Quad Cities has contributed to an increase in gamefish resources
41 within Pool 14, with lesser increases within several downstream pools (LaJeune and Monzingo
42 2000).

1 Future contributions to cumulative impacts to aquatic resources within the Upper Mississippi
2 River would generally occur from those actions that currently cause impacts (e.g., maintenance
3 of the navigation channel and associated barging, human habitation, urban and industrial
4 development, agriculture, commercial and recreational fisheries, and spread of non-native
5 species). Proposed increases in commercial traffic within the river may increase the rate of
6 sedimentation (Fremling and Drazkowski 2000). The quality of the aquatic resources within the
7 Upper Mississippi River will continue to decline unless inputs of sediments, nutrients, and toxic
8 substances are reduced or eliminated (Fremling and Drazkowski 2000). It is predicted that
9 without active management (e.g., habitat rehabilitation), the navigation pools within the Upper
10 Mississippi River will continue to progress toward shallow, more uniform conditions. This will
11 lead to poorer water and substrate quality, reduction of submerged aquatic plant and benthic
12 invertebrate populations, and less diverse fish communities (USGS 1999).

13
14 There is a potential for severe impacts to aquatic resources from large oil or chemical spills
15 within the Upper Mississippi River, but the risk of such spills is relatively small. However, a
16 major oil spill did occur in the Mississippi River in 1963 (UMRCC 1993). The probability of
17 smaller spills is higher, but the impacts from such spills would probably be small, temporary,
18 and additive and unlikely to severely affect aquatic resources; especially if spill response
19 activities are undertaken when such events occur.

20
21 The non-native round goby (*Neogobius melanostomus*), which is currently common in the
22 Upper Illinois Waterway, may be a future threat to the Upper Mississippi River. It is an
23 aggressive and highly territorial species that can displace native species and eat their eggs. It
24 also has a high reproductive potential and tolerates extreme water-quality conditions (USGS
25 1999). Five species of Asian carp now occur in the United States. As mentioned, the common
26 carp is a dominant species within the Upper Mississippi River. The grass carp
27 (*Ctenopharyngodon idella*), silver carp (*Hypophthalmichthys molitrix*) and bighead carp (*H.*
28 *nobilis*) have also become established within the Upper Mississippi River during the past 20
29 years (Chick 2002). These mostly occur in the southern Illinois area (e.g., Pool 26) (Koel et al.
30 2000), although the grass carp has been collected in Pool 14 (Bowzer and Lippincott 2000).
31 These species can impact native species by destroying habitat, reducing water quality, and by
32 consuming aquatic vegetation (grass carp) or planktonic organisms (silver and bighead carp)
33 (USGS 2003). The silver and bighead carp have the potential to adversely affect every species
34 of fish within the Upper Mississippi River (Chick 2002). The black carp (*Mylopharyngodon*
35 *piceus*) primarily occurs in aquaculture ponds in Arkansas and Mississippi (Koel et al. 2000).
36 However, it has been collected in the Mississippi River, but is not believed to have established
37 reproducing populations as yet (USGS 2003). This species feeds almost exclusively on
38 mussels and snails, therefore, if it becomes established within the Upper Mississippi River it
39 could further threaten freshwater mussels (USGS 2003).
40

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The staff, while preparing this assessment, assumed that other industrial, commercial, or public installations could be located in the general vicinity of the Quad Cities site prior to the end of Quad Cities Units 1 and 2 operations. The intake of water from, and the discharge of water to, the Upper Mississippi River from these facilities would be regulated by the IEPA, the Wastewater Section of the Iowa Water Quality Bureau, or other agencies; just as the Quad Cities Units 1 and 2 is presently regulated by the IEPA. The intake and discharge limits for each installation are set considering the overall or cumulative impact of all of the other regulated activities in the area. Compliance with the Clean Water Act and NPDES permits minimizes the cumulative effects on aquatic resources. Continued operation of Quad Cities Units 1 and 2 will require renewed discharge permits from the IEPA which will address changing requirements so that cumulative water quality objectives are served. Therefore, the staff concludes that the potential cumulative impacts contributed by the continued operation of Quad Cities Units 1 and 2 will be SMALL, and that no additional mitigation measures are warranted.

4.8.2 Cumulative Impacts Resulting from Continued Operation of the Transmission Lines

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

As described in Section 4.2, the staff found no new and significant information indicating that the conclusions regarding any of the transmission line-related Category 1 issues as related to Quad Cities are inconsistent with the conclusions within the GEIS. The staff anticipates that Exelon and its contractors will follow BMPs for ROW vegetation management over all of its transmission line corridors that are protective of wildlife and habitat resources, including floodplains and wetlands. There are no State or Federally regulated wetlands at the Quad Cities site or within the transmission line right-of-way connecting Quad Cities to the power grid. Therefore, continued operation and maintenance of these ROWs are not likely to contribute to a regional decline in wetland or floodplain resources. Using BMPs for vegetation management ensures minimal disturbance to wildlife and may improve the habitat within the transmission line corridors relative to many of the surrounding land uses.

Based on the expectation that BMPs for protecting Federally listed species and their habitats while carrying out vegetation management activities along transmission lines will be implemented by Exelon and its contractors at the end of consultation, it is the staff's preliminary

determination that the cumulative impacts of the continued operation of the Quad Cities transmission lines will be SMALL, and that no additional mitigation is warranted.

4.8.3 Cumulative Radiological Impacts

The radiological dose limits for protection of the public and workers have been developed by EPA and NRC to address the cumulative impact of acute and long-term exposure to radiation and radioactive material. As described in Section 2.2.7, the public and occupational doses resulting from operation of Quad Cities are within regulatory limits, and as described in Section 4.3, the impacts of these doses are SMALL. For the purposes of this analysis, the areas within an 80-km (50-mi) radius of the Quad Cities site was included (Figure 2-1). EPA regulation 40 CFR 190 limits the dose to members of the public from all sources in the nuclear fuel cycle in the United States, including all the nuclear power plants, fuel fabrication facilities, waste disposal facilities, and transport of fuel and waste. In addition, the radiological environmental monitoring program conducted by Exelon in the vicinity of Quad Cities measures radiation and radioactive material from all sources, including Quad Cities; therefore, the monitoring program measures cumulative radiological impacts. The NRC and the States of Illinois and Iowa would regulate any reasonably foreseeable future actions in the vicinity of Quad Cities that could contribute to cumulative radiological impacts.

Therefore, the staff determined that the cumulative radiological impacts of continued operation of Quad Cities will be SMALL, and that no additional mitigation is warranted.

4.8.4 Cumulative Sociological Impacts

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

The continued operation of Quad Cities is not likely to add to any cumulative socioeconomic impacts beyond those already evaluated in Section 4.4. In other words, the impacts of issues such as transportation or offsite land use are likely to be non-detectable beyond the regions previously evaluated and will quickly decrease with increasing distance from the site. The staff determined that the impacts on housing, public utilities, public services, and environmental justice would be SMALL. The staff determined that the impact on off-site land use is SMALL.

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1 because, as no refurbishment actions are planned at Quad Cities, no new incremental sources
2 of plant-related tax payments are expected that could influence land use by fostering
3 considerable growth. There are no reasonably foreseeable scenarios that would alter these
4 conclusions regarding cumulative impacts.

5
6 Related to historic resources, no archaeological or historical architectural surveys have been
7 completed for Quad Cities. There are no indications that standing buildings and structures at
8 Quad Cities carry any historical value, however, there are reports of archaeological finds on or
9 in the vicinity of Quad Cities. These reports and the location of the plant on an alluvial terrace
10 of the Mississippi River translate to a high potential for the discovery of archaeological remains
11 during any future ground disturbance that might occur over the period of extended operation
12 under NRC license. The licensee recognizes the potential that archaeological remains may be
13 present in undisturbed areas and at undisturbed depths at Quad Cities, and, given that
14 recognition, management procedures employed by Exelon should protect against damage to
15 important archaeological sites. The NRC staff has concluded that with the company procedure
16 requiring additional archaeological review in the event of activities in areas not previously
17 disturbed, and with a commitment of the licensee to contact the Illinois Historic Preservation
18 Agency for direction on level of effort necessary for archaeological survey in such project areas,
19 the impacts of license renewal would be SMALL. Under these circumstances there is no
20 reason to believe that the continued operation and maintenance of the Quad Cities site would
21 impact any significant archaeological resources without consideration of those resources, and
22 therefore the contribution to a cumulative impact on historic resources is considered SMALL.

23 24 4.8.5 Cumulative Impacts on Groundwater Use and Quality

25
26 The Quad Cities site is located in the Meredosia Channel, an ancient channel of the Mississippi
27 River. The Meredosia Channel has been filled over many thousands of years with
28 unconsolidated sediments ranging in depth from approximately 15 to 91 m (50 to 300 ft) (Blume
29 1966). It is expected that these waters communicate strongly with the present channel. The
30 groundwater gradient in this aquifer is relatively flat and generally flows towards the river,
31 except during periods of high river flow (Blume 1966).

32
33 There are groundwater withdrawals at Quad Cities, and Exelon imports no other potable water
34 from local utilities for plant use. The impact of current water usage has been determined in
35 Section 4.5 to be SMALL. Based on the fact that Exelon has determined that the long term
36 water table levels have not dropped, the Quad Cities site is not causing a detectable change in
37 the regional groundwater usage, nor has the regional water table dropped, and therefore the
38 cumulative impact is SMALL and no mitigation measures are warranted.

4.8.6 Cumulative Impacts on Threatened or Endangered Species

The geographic area considered in the analysis of potential cumulative impacts to threatened or endangered species includes Clinton and Scott Counties, Iowa; Lee, Rock Island, and Whiteside Counties, Illinois; and the waters of the Upper Mississippi River, particularly within Pool 14. As discussed in Sections 2.2.5 and 2.2.6, there are several threatened or endangered species that occur within this area. The staff's preliminary findings presented in Section 4.6 are that continued operation of Quad Cities Units 1 and 2 would have a SMALL effect on these species. The staff's findings will be documented in a biological assessment, and forwarded to the FWS for their concurrence. No critical habitat, as designated by the Endangered Species Act, occurs in the area affected by the Quad Cities site; therefore, cumulative impacts on critical habitats are not addressed.

4.8.6.1 Aquatic Species

The only Federally protected aquatic species that occurs in the area of the Quad Cities site is the endangered Higgins' eye pearlymussel (*Lampsilis higginsii*). As mentioned in Section 2.2.5, past actions that have adversely affected the freshwater mussels (including the Higgins' eye pearlymussel) within the Upper Mississippi River have included the pearl button and cultured pearl industries, siltation, chemicals, establishment and maintenance of the navigation channel, commercial and recreational navigation, and introduced species (particularly the zebra mussel). Channel navigation maintenance activities are now routinely coordinated with the FWS and state natural resource agencies in order to minimize or avoid impacting riverine habitat. Nevertheless, in its Biological Opinion for the operation and maintenance of the navigation channel on the Upper Mississippi River (FWS 2000), the FWS determined that the project (continuation of current operation and maintenance activities for another 50 years) would jeopardize the continued existence of the Higgins' eye pearlymussel. The major adverse effect would be associated with continuing upstream transport of zebra mussels by barge traffic. Currently, there are no effective ways to control established populations of zebra mussels at the scale required to eliminate their threat to the Higgins' eye pearlymussel (FWS 2003a). The reintroductions of the endangered mussel into rivers from which it has been extirpated have been conducted since 2000, but it is too early to determine the success of these reintroductions (FWS 2003a).

Maintenance activities (e.g., dredging, disposal, clearing and snagging, channel revetments) may affect individuals or populations of the Higgins' eye pearlymussel at a local scale. However, through the Section 7 process of the Endangered Species Act, impacts to the mussel from these activities would be avoided or minimized (FWS 2000). Similarly, permit requirements under Section 401 and 404 of the Clean Water Act and Section 7 consultation would avoid or

Environmental Impacts of Operation

1 minimize future impacts to the Higgins' eye pearlymussel from barge fleet and port facility
2 developments. Permit requirements and Section 7 consultation would also be required for
3 other developments (e.g., power plants) within the Upper Mississippi River. Therefore, potential
4 impacts to the Higgins' eye pearlymussel from these types of future developments would be
5 small to negligible. For example, MidAmerican Energy relocated a portion of a mussel bed that
6 was located within the proposed outfall area for a 500-megawatt generating facility near
7 Cordova, Illinois. This effort was successful in relocating mussels, including Higgins' eye
8 pearlymussels, allowing the plant to be conducted without adversely impacting the species
9 (MidAmerican Energy Holdings Company 2001). However, other residential, industrial, and
10 recreational activities not requiring Section 7 consultation or water quality permits would be
11 likely to increase in the future, and may alter habitat conditions for the Higgins' eye
12 pearlymussel (FWS 2000).

13
14 As discussed in Section 4.8.1, there is the potential for other non-native species to become
15 established within the Upper Mississippi River in the future. One non-native mussel that could
16 impact the Higgins' eye pearlymussel in the same manner as the zebra mussel is the quagga
17 mussel (*Dreissena bugensis*). This species is already established in the lower Great Lakes and
18 has been found in the Upper Mississippi River near St. Louis, Missouri (FWS 2000). If the
19 black carp becomes established in the Upper Mississippi River, it could pose a threat to the
20 Higgins eye pearlymussel because it feeds upon mussels (Chick 2002).

21
22 There are only 10 Essential Habitat Areas for the Higgins' eye pearlymussel within the entire
23 Upper Mississippi River watershed (one in the Wisconsin River, three in the St. Croix River, and
24 six in the Mississippi River) (FWS 2003a). Only two of these Essential Habitat Areas, both
25 located in Wisconsin, are located within the 3-m (9-ft) navigation channel (FWS 2000). One of
26 the Essential Habitat Areas is located 1.6 to 4.0 km (1.0 to 2.5 mi) downstream from the Quad
27 Cities site at Cordova, Illinois. The presence of the Higgins' eye pearlymussel in this area
28 suggests that the operation of Quad Cities Units 1 and 2 has not adversely affected the
29 species. Walleye (which are annually released as part of the fish production operation at the
30 Quad Cities site) is one of several suitable host species for Higgins' eye pearlymussel glochidia
31 (FWS 2003a). Thus, the release of walleye may have a small benefit to the mussels that occur
32 downstream from the Quad Cities site. However, the Essential Habitat Area at Cordova, Illinois
33 (as well as the two in Wisconsin that occur within the navigation channel) has become severely
34 infested with zebra mussels (FWS 2003a).

4.8.6.2 Terrestrial Species

35
36
37 Six Federally-listed terrestrial species may occur in the area of the Quad Cities site and its
38 associated transmission lines (Table 2-3). However, five of these species, the Indiana bat,
39 Iowa Pleistocene snail, western and eastern prairie fringed orchids, and the prairie bush-clover,
40 have not been reported from the Quad Cities site or its associated transmission lines. The
41

staff, as a result, determined in Section 4.6 that continued operation of Quad Cities would have no effect on any of these five species. Therefore, the continued operation of Quad Cities will not contribute to a regional cumulative impact on these five federally listed species, regardless of whether or not other actions occur that could have adverse impacts.

The only federally-listed species known to occur near the Quad Cities site and its associated transmission lines is the bald eagle. As mentioned in Section 2.2.6, the increases in the bald eagle population prompted downlisting from Federally-endangered to Federally-threatened status in 1995 and the species is currently proposed for delisting (64 FR 36453 [FWS 1999]). Past actions that have adversely affected the bald eagle include the widespread use of DDT and other organochlorine pesticides shortly after World War II for mosquito control. Eagles ingested DDT contaminated fish which caused thinning of the shells of their eggs, which in turn resulted in nesting failures. The use of DDT was banned in 1972 by the U.S. Environmental Protection Agency, marking the first major step in the bald eagle recovery. Other past actions adversely impacting the bald eagle include the construction of impoundments and water level regulation (i.e., altering habitats and species composition), extensive logging and agricultural conversion, urban development, dredging, channel structures and revetments, tow traffic, development of fleeting areas and port facilities, human disturbance (especially during critical nesting periods, March through May for this region) and recreational activities (FWS 2000b).

Prior to the first Europeans arriving on the North American continent, it is estimated that 250,000-500,000 bald eagles were extant in 45 of the 48 contiguous states. The breeding range of the bald eagle was greatly impacted and diminished during the 1800-1900's, with present day breeding primarily occurring in northern California, Alaska, Oregon, Washington, Minnesota, Wisconsin, Michigan, Maine, the Chesapeake Bay area, Florida, the tri-state corner of Idaho, Montana, and Wyoming, and in parts of Canada (FWS 2000a). The lowest estimated nesting pairs for the lower 48 contiguous states occurred in 1963 with 487 counted. Recovery efforts across the states have resulted in this number rising to approximately 6,000 nesting pairs in 1998 and with close to 7,000 young produced (FWS 2000b). The proposal for delisting occurred on July 6, 1999 (64 FR 36453 [FWS 1999]). Specifically, the recovery goal for the northern states recovery region, within which the Quad Cities site and its associated transmission lines occur, is to re-establish a self-sustaining population and to have 1200 occupied breeding areas by the year 2000. This goal was achieved and exceeded with over 2,000 occupied territories in the northern state region in 1998 (FWS 2000b).

The Upper Mississippi River System represents an area of significant winter use for the bald eagle, especially in areas where the river is not frozen over and adequate perch sites are available. These areas provide important and stable feeding areas during periods where high caloric intake is needed (FWS 2000b). As discussed in section 2.2.6, the open water areas in

Environmental Impacts of Operation

1 the Mississippi River created by the warm water discharges from Quad Cities represent a
2 feeding area for the bald eagle and the forest bottomlands within the vicinity offer suitable
3 perching sites. It is not surprising that the bald eagle has a known and successful (i.e., in
4 producing young) nesting site upstream of the site, while many bald eagles have been noted
5 and documented to use areas near and in the vicinity of Quad Cities and its transmission lines
6 during winter. The FWS notes that high use areas, during winter, within this northern states
7 region include those areas with heated effluent discharged by power plants (FWS 2000b;
8 Nelson 2003). Furthermore, it is noted by the FWS (2000b) that during most winters, much
9 open water exists for bald eagle use in the region and such habitat is not limiting for this
10 species.

11
12 Three habitat components for winter bald eagle management exist and include 1) feeding,
13 2) daytime perching, and 3) night roost areas. The preferred perching areas are trees within 30
14 m (100 ft) of the shore (FWS 2000b). The Quad Cities site and some of its transmission lines
15 offer excellent feeding and daytime perching sites (i.e., Rock Island and Davenport
16 transmission lines in particular). Removal or disturbance of roost sites could adversely affect
17 bald eagles, causing them to abandon the use of their wintering areas; protection of these sites
18 is therefore important (FWS 2000b). The staff expects that Exelon and its vegetation
19 management contractors will work with the FWS and State agencies to ensure that any
20 maintenance operations for the transmission lines minimize any adverse impacts on the bald
21 eagle (Cunningham 2003; Exelon 2003c; Exelon 2003d).^(a)

22
23 The staff determined in Section 4.6 that continued operation of Quad Cities is not likely to
24 adversely affect the bald eagle. Maintenance activities (e.g., dredging, disposal, clearing and
25 snagging, channel structures/revetments) may affect the bald eagle locally. However, through
26 the Section 7 process of the Endangered Species Act, impacts to the bald eagle from these
27 activities would be avoided or minimized (FWS 2000b). In addition, the geographic area under
28 this review is largely rural and agricultural with not much opportunity for further timber clearing
29 and agricultural conversion (i.e., it is already predominantly converted to agricultural use).
30 Further urban development would, in all likelihood, impact agricultural areas, as natural areas
31 are protected within the Upper Mississippi River NWFR and the Princeton Wildlife Management
32 Area in the vicinity of Quad Cities Station. Human disturbance, as a consequence, is minimized
33 by their management strategies. Quad Cities is not planning any refurbishment activities in the
34 future and is not aware of other activities in the vicinity of the Quad Cities facility that would
35 contribute to the cumulative impact on the bald eagle.

36
37 Based on the expectation that Exelon and its contractors will implement BMPs for vegetation
38 management and the staff's finding that there will be no adverse impacts on threatened or

(a) Personal communication between Ed Britton, District Manager, Savanna District, Upper Mississippi River NWFR, May 8, 2003.

1 endangered species during the period of extended operations, the staff has preliminarily
2 determined that the cumulative impacts to threatened or endangered species due to continued
3 operation of the Quad Cities site and associated transmission lines would be SMALL, and that
4 additional mitigation measures would not be warranted.

6 **4.8.7 Conclusions Regarding Cumulative Impacts**

8 The staff considered the potential impacts resulting from operation of Quad Cities Units 1 and 2
9 during the license renewal term and other past, present, and future actions in the Quad Cities
10 area.

12 For each impact area, the staff's preliminary determination is that the potential cumulative
13 impacts resulting from operation during the license renewal term are SMALL, and additional
14 mitigation is not warranted.

16 **4.9 Summary of Impacts of Operations During the Renewal 17 Term**

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

26 Plant-specific environmental evaluations were conducted for 13 Category 2 issues applicable to
27 Quad Cities operation during the renewal term and for environmental justice and chronic effects
28 of electromagnetic fields. For 12 issues and environmental justice, the staff concluded that the
29 potential environmental impact of renewal term operations of Quad Cities would be of SMALL
30 significance in the context of the standards set forth in the GEIS and that additional mitigation
31 would not be warranted. In addition, the staff determined that a consensus has not been
32 reached by appropriate Federal health agencies regarding chronic adverse effects from
33 electromagnetic fields. Therefore, no evaluation of this issue is required.

35 For one issue, the staff's preliminary conclusion is that the potential environmental impact of
36 renewal term operations of Quad Cities Units 1 and 2 is greater than SMALL. The staff
37 concludes that the impact of the potential for electric shock is MODERATE on the portions of
38 the north Nelson line where calculated induced currents exceed 5 mA. For this issue,
39 consideration of further mitigation by the transmission line owner, ComEd, is recommended.

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5.0 Environmental Impacts of Postulated Accidents

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

- (1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristic.
- (2) Single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective off-site radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal).
- (3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation.

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

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

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

5.1 Postulated Plant Accidents

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

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

Postulated Accidents

5.1.1 Design-Basis Accidents

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

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

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

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

and, therefore, under the provisions of 10 CFR 54.30, is not subject to review under license renewal. This issue, applicable to Quad Cities Units 1 and 2, is listed in Table 5-1.

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

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

Based on information in the GEIS, the Commission found that

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

Exelon Generation Company, LLC (Exelon) stated in its Environmental Report (ER) that it is not aware of any new and significant information associated with the renewal of the Quad Cities Units 1 and 2 OLs (Exelon 2003a). The staff has not identified any significant new information during its independent review of the Quad Cities ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of design basis accidents during the renewal term beyond those discussed in the GEIS.

5.1.2 Severe Accidents

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

Based on information in the GEIS, the Commission found that

The probability weighted consequences of atmospheric releases, fallout onto open bodies of water, releases to ground water, and societal and economic impacts from severe accidents are small for all plants. However, alternatives to mitigate severe accidents must be considered for all plants that have not considered such alternatives.

Postulated Accidents

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

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

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

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

5.2 Severe Accident Mitigation Alternatives (SAMAs)

10 CFR 51.53(c)(3)(ii)(L) requires that license renewal (LR) applicants consider alternatives to mitigate severe accidents if the staff has not previously evaluated SAMAs for the applicant's plant in an environmental impact statement (EIS) or related supplement or in an environmental assessment. The purpose of this consideration is to ensure that plant changes (i.e., hardware, procedures, and training) with the potential for improving severe-accident safety performance are identified and evaluated. SAMAs have not been previously considered for Quad Cities Units 1 and 2; therefore, the remainder of Chapter 5 addresses those alternatives.

5.2.1 Introduction

This section presents a summary of the SAMA evaluation for Quad Cities conducted by Exelon and described in the ER (Exelon 2003a) and of the NRC staff review of that evaluation. The details of the review are described in the NRC staff evaluation that was prepared by the staff with contract assistance from Information Systems Laboratories, Inc. The entire evaluation is presented in Appendix G.

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

4
5 The second step was the examination of the major risk contributors to identify areas where
6 plant improvements might have the greatest chance to reduce risk. Then, possible ways of
7 reducing those risks were identified. Common ways of reducing risk are changes to
8 components, systems, procedures, and training. Exelon identified 280 potential SAMAs. Using
9 a set of screening criteria, the number of SAMAs requiring further consideration was reduced to
10 54. Preliminary cost estimates were made for these 54 SAMAs, and any SAMAs costing more
11 than the maximum attainable benefit (discussed in Section 5.2.3) were removed from further
12 consideration.

13
14 In the third step, the benefits and costs for the remaining 15 candidate SAMAs were estimated.
15 Estimates were made of how much each proposed SAMA could reduce risk. Those estimates
16 were developed in terms of dollars in accordance with NRC guidance for performing regulatory
17 analyses (NRC 1997). The costs of implementing the proposed SAMAs were also estimated.

18
19 Finally in the fourth step, the costs and benefits of each of the 15 final SAMAs were compared
20 to determine whether the SAMA was cost-beneficial, meaning the benefits of the SAMA were
21 greater than the costs (a positive cost-benefit). In the final analysis, Exelon concluded that
22 none of these 280 SAMAs were cost-beneficial for Quad Cities. However, the staff concluded
23 that four SAMAs are cost-beneficial and that two additional SAMAs may be cost-beneficial.

24
25 Each of these four steps is discussed in more detail in the sections that follow and in
26 Appendix G.

27 28 **5.2.2 Estimate of Risk**

29
30 Exelon submitted an assessment of SAMAs for Quad Cities as part of the ER (Exelon 2003a).
31 This assessment was based on the most recent Quad Cities Probabilistic Risk Assessment
32 (PRA) (including the Level 1 and 2 analyses), a plant-specific offsite consequence analysis
33 performed using the MELCOR Accident Consequence Code System (MACCS2) (essentially a
34 Level 3 PRA model), and insights from the Quad Cities Individual Plant Examination (IPE)
35 (Exelon 1993) and Individual Plant Examination of External Events (IPEEE) (Exelon 1997). The
36 SAMA analysis is based on the most recent PRA model available at the time of the ER, referred
37 to as the 2002B model (or Update Revision 02B). The baseline core damage frequency (CDF)
38 for Quad Cities is approximately 2.2×10^{-6} per year, based on internally-initiated events. Exelon
39 did not include the contribution to CDF from external events in these estimates even though the
40 risk from external events is significantly higher for Quad Cities than the risk from internal
41 events. Although the scope of the Quad Cities PRA does not include external events, Exelon

Postulated Accidents

concluded that the existing IPEEE and fire evaluations had adequately identified potential plant improvements to address external events. The breakdown of CDF by initiating event/accident class is summarized in Table 5-3. Loss of the 125 V DC buses, loss of offsite power, transients

Table 5-3. Quad Cities Units 1 and 2 Core Damage Frequency

Initiating Event/Accident Class	Frequency (CDF) (per Year)	Percent Contribution to the CDF
Loss of 125 V DC Buses 1 and 2	7.6×10^{-7}	35
Loss of offsite power (LOOP) ^a (dual-unit and single-unit)	4.2×10^{-7}	19
Transients	3.2×10^{-7}	15
Loss of service water	3.0×10^{-7}	14
Loss-of-coolant accident (LOCA)	1.5×10^{-7}	7
Loss of instrument air	6.8×10^{-8}	3
Manual shutdown	6.6×10^{-8}	3
Others	6.0×10^{-8}	3
Interfacing systems LOCA (ISLOCA)	2.3×10^{-8}	1
Total CDF (from internal events)	2.2×10^{-6}	100

^a Includes station blackout

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

Containment Release Mode	Population Dose (Person-Rem ^a per Year)	Percent Contribution to Dose
Early containment failure	0.93	56
Late containment failure	0.67	40
Containment bypass	0.07	4
No containment failure	~0	~0
Total Population Dose	1.67	100

^a One person-rem equals 0.01 person-Sv.

(such as turbine trip, loss of turbine building closed-cooling water, and loss of condenser vacuum), and loss of service water are the dominant contributors to the CDF.

Exelon estimated the dose from all postulated accidents to the population within 80 km (50 mi) of the Quad Cities site to be approximately 0.0167 person-Sv (1.67 person-rem). The breakdown of the population dose by containment release mode is summarized in Table 5-4. Early and late containment failures dominate the population dose.

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

5.2.3 Potential Plant Improvements

Once the most risk significant parts of the plant design and operation were identified, Exelon searched for ways to reduce those risks. To identify potential plant improvements, Exelon reviewed improvements identified in the Quad Cities IPE and IPEEE and subsequent PRA revision processes, SAMA analyses submitted for other nuclear power plants, and NRC and industry documents discussing potential plant improvements. Exelon identified 280 potential risk-reducing improvements to plant components, systems, procedures, and training (SAMAs).

All but 54 of these SAMAs were removed from further consideration because: (1) the SAMA was not applicable at Quad Cities due to design differences, (2) the SAMA had already been implemented at Quad Cities, (3) the SAMA was sufficiently similar to other SAMAs and was combined with another SAMA, or (4) the SAMA would not provide a significant safety benefit or has implementation costs greater than any possible risk benefit. A preliminary cost estimate was prepared for each of the remaining 54 SAMAs.

The preliminary cost estimate of each of the 54 remaining SAMAs was compared to the maximum attainable benefit (MAB) of \$110,000. The MAB is the dollar value of the benefit that would be achieved if the plant risk and population dose from postulated accidents could be reduced to zero. If the cost of a SAMA exceeded the MAB, it could not be cost-beneficial because no single SAMA could eliminate all the risk. Using this comparison, all but 15 of the candidate SAMAs were removed from further consideration. The ER only identified 14 candidate SAMAs for further examination because of an error. This error was identified and corrected in Exelon's response to an NRC staff request for additional information (RAI) (Exelon 2003b).

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

5.2.4 Evaluation of Risk Reduction and Costs of Improvements

Exelon evaluated the risk reduction potential of the remaining 15 SAMAs. Bounding calculations were made for most of these SAMAs; bounding calculations overestimate the benefit and are conservative. The benefits (the estimated dollar value of these risk reductions) were developed by calculating and adding the averted public exposure, offsite property damage, occupational exposure, and onsite costs associated with each SAMA (Exelon 2003a).

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

The staff reviewed the cost estimates and concluded that the cost ranges provided by Exelon were reasonable and appropriate for use in the SAMA evaluation. However, the staff concluded that the cost estimates at the lower end of the cost ranges provided by Exelon were more appropriate than the values used by Exelon in the cost-benefit comparisons for two SAMAs. These two SAMAs are SAMA 6, develop procedures for locally starting equipment during a 125 V DC bus failure; and SAMA 8, develop procedures to control feedwater flow without 125 V DC power. These conclusions contributed to the staff's conclusions regarding cost-beneficial SAMAs (see Section 5.2.5).

5.2.5 Cost-Benefit Comparison

Based on the more detailed evaluations of potential risk reduction and cost discussed above, Exelon determined that none of the 15 remaining SAMAs were cost-beneficial. In response to the staff's RAIs (NRC 2003), Exelon evaluated the level of uncertainty in the calculations. Since the Quad Cities PRA did not include uncertainty analyses, Exelon used information from the uncertainty analyses performed for the LaSalle plant (another Exelon boiling water reactor plant) to estimate 95th percentile values of the CDF for Quad Cities. Use of these 95th percentile CDF values increased the estimated benefits of the SAMAs by approximately a factor of five. Exelon revisited the set of SAMAs screened out in the first part of the evaluation using the 95th percentile CDF values to account for the potential impact of external events and uncertainties. Exelon identified two additional SAMAs that could be cost-beneficial using the 95th percentile values of the CDF. However, all 17 SAMAs were found by Exelon to have implementation costs greater than their averted cost-risk (benefit), and thus, were eliminated from further consideration. Therefore, Exelon's final conclusion was that there were no cost-beneficial SAMAs (Exelon 2003b).

The staff reviewed Exelon's calculation methods and logic arguments in the final cost-benefit comparisons and concluded that Exelon's original benefit estimates should be increased by a factor of 10 to fully account for the potential impact of uncertainties and external events, especially fires. As a result, the staff concluded that four SAMAs were cost-beneficial: SAMA 6, develop procedures for locally starting equipment during a 125 V DC bus failure; SAMA 8, develop procedures to control feedwater flow without 125 V DC power; SAMA 10, develop procedures to terminate reactor depressurization at a high enough pressure to keep the reactor core isolation cooling system operable; and SAMA 14, develop procedures to control containment venting within a narrow band of pressure. The staff concluded that two additional SAMAs could be cost-beneficial if a more detailed evaluation of the external events benefits or the uncertainties were performed: SAMA 1, develop procedures to provide alternate safe shutdown makeup pump room cooling; and SAMA 2, develop procedures to use the fire protection system as a source of water for the drywell spray system. The numbered SAMAs (1 through 17) are the 17 SAMAs that were included in the final cost-benefit analysis after Exelon increased the benefit estimates by a factor of five in response to staff RAIs.

5.2.6 Conclusions

The staff reviewed the Exelon SAMA analysis and concluded that the methods used and the implementation of those methods were sound. The treatment of SAMA benefits and costs, the generally large negative net benefits, and the inherently small baseline risks support the general conclusion that the SAMA evaluations performed by Exelon are reasonable and sufficient for the license renewal submittal. However, the staff concluded that four SAMAs were cost-beneficial: SAMA 6, develop procedures for locally starting equipment during a 125 V DC bus failure; SAMA 8, develop procedures to control feedwater flow without 125 V DC power; SAMA 10, develop procedures to terminate reactor depressurization at a high enough pressure to keep the reactor core isolation cooling system operable; and SAMA 14, develop procedures to control containment venting within a narrow band of pressure. The staff concluded that two additional SAMAs could be cost-beneficial if a more detailed evaluation of the external events benefits or the uncertainties were performed: SAMA 1, develop procedures to provide alternate safe shutdown makeup pump room cooling; and SAMA 2, develop procedures to use the fire protection system as a source of water for the drywell spray system. However, none of the six SAMAs relate to adequately managing the effects of aging during the period of extended operation. Therefore, they need not be implemented as part of license renewal pursuant to 10 CFR Part 54.

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

5.3 References

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

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

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

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

Commonwealth Edison Company (Exelon). 1993. Letter from Martin J. Vonk (ComEd) to Thomas E. Murley, U. S. NRC. "Quad Cities Nuclear Power Station Units 1 and 2 Individual Plant Examination Submittal," December 13, 1993.

Commonwealth Edison Company (Exelon). 1997. Letter from E. S. Kraft (ComEd) to Nuclear Regulatory Commission Document Control Desk. Subject: Quad Cities Nuclear Power Station Units 1 and 2 Final Report — Individual Plant Examination of External Events (IPEEE) Generic Letter 88-20, Supplement 4, February 17, 1997.

Exelon Generation Company, LLC (Exelon). 2003a. *Applicant's Environmental Report—Operating License Renewal Stage, Quad Cities Nuclear Power Station Units 1 and 2*. Exelon Generation Company, LLC, Warrenville, Illinois. January 2003.

Exelon Generation Company, LLC (Exelon). 2003b. Letter from Jeffrey A. Benjamin, Exelon, to USNRC. Subject: Quad Cities Nuclear Power Station, Units 1 and 2, Facility Operating License Nos. DPR-29 and DPR-30, NRC Docket Nos. 50-254 and 50-265, Response to Request for Additional Information – License Renewal Environmental Report for Quad Cities Nuclear Power Station, Units 1 and 2, July 17, 2003.

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

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

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

5
6 U.S. Nuclear Regulatory Commission (NRC). 2003. Letter from Louis L. Wheeler, U.S. NRC to
7 John Skolds, Exelon. Subject: Request for Additional Information (RAI) Related to the Staff's
8 Review of the License Renewal Environmental Report for the Quad Cities Nuclear Power
9 Station, Unit 1 and 2 (TAC Nos. MB6845 and MB6846), May 23, 2003.

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

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

- (1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristics.
- (2) A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective off-site radiological impacts from the fuel cycle and from high-level waste [HLW] and spent fuel disposal).
- (3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation.

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

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

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

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

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

6.1 The Uranium Fuel Cycle

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

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

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section
URANIUM FUEL CYCLE AND WASTE MANAGEMENT	
Off-site radiological impacts (individual effects from other than the disposal of spent fuel and high level waste)	6.1; 6.2.1; 6.2.2.1; 6.2.2.3; 6.2.3; 6.2.4; 6.6
Off-site radiological impacts (collective effects)	6.1; 6.2.2.1; 6.2.3; 6.2.4; 6.6
Off-site radiological impacts (spent fuel and high level waste disposal)	6.1; 6.2.2.1; 6.2.3; 6.2.4; 6.6
Nonradiological impacts of the uranium fuel cycle	6.1; 6.2.2.6; 6.2.2.7; 6.2.2.8; 6.2.2.9; 6.2.3; 6.2.4; 6.6
Low-level waste storage and disposal	6.1; 6.2.2.2; 6.4.2; 6.4.3; 6.4.3.1; 6.4.3.2; 6.4.3.3; 6.4.4; 6.4.4.1; 6.4.4.2; 6.4.4.3; 6.4.4.4; 6.4.4.5; 6.4.4.5.1; 6.4.4.5.2; 6.4.4.5.3; 6.4.4.5.4; 6.4.4.6; 6.6
Mixed waste storage and disposal	6.4.5.1; 6.4.5.2; 6.4.5.3; 6.4.5.4; 6.4.5.5; 6.4.5.6; 6.4.5.6.1; 6.4.5.6.2; 6.4.5.6.3; 6.4.5.6.4; 6.6
On-site spent fuel	6.1; 6.4.6; 6.4.6.1; 6.4.6.2; 6.4.6.3; 6.4.6.4; 6.4.6.5; 6.4.6.6; 6.4.6.7; 6.6
Nonradiological waste	6.1; 6.5; 6.5.1; 6.5.2; 6.5.3; 6.6
Transportation	6.1; 6.3.1; 6.3.2.3; 6.3.3; 6.3.4; 6.6; Addendum 1

Exelon Generation Company, LLC (Exelon) stated in its Environmental Report (ER) that it is not aware of any new and significant information associated with the renewal of the Quad Cities Units 1 and 2 operating license (Exelon 2003). The staff has not identified any significant new information during its independent review of the ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS. For these issues, the staff concluded in the GEIS that the impacts are SMALL except for the collective off-site radiological impacts from the fuel cycle and from HLW and spent fuel disposal, as discussed below, and that additional plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

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

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

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

The staff has not identified any new and significant information during its independent review of the Quad Cities ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no off-site radiological impacts of the uranium fuel cycle during the renewal term beyond those discussed in the GEIS.

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

The 100 year environmental dose commitment to the U.S. population from the fuel cycle, high level waste and spent fuel disposal excepted, is calculated to be about 14,800 person rem [148 person Sv], or 12 cancer fatalities, for each additional 20-year power reactor operating term. Much of this, especially the contribution of radon releases from mines and tailing piles, consists of tiny doses summed over large populations. This same dose calculation can theoretically be extended to include many tiny doses over additional thousands of years as well as doses outside the U.S. The result of such a calculation would be thousands of cancer fatalities from the fuel cycle, but this result assumes that even tiny doses have some statistical adverse health effect which will not ever be

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1 mitigated (for example no cancer cure in the next thousand years), and that
2 these doses projected over thousands of years are meaningful. However, these
3 assumptions are questionable. In particular, science cannot rule out the
4 possibility that there will be no cancer fatalities from these tiny doses. For
5 perspective, the doses are very small fractions of regulatory limits and even
6 smaller fractions of natural background exposure to the same populations.
7

8 Nevertheless, despite all the uncertainty, some judgement as to the regulatory
9 NEPA [National Environmental Policy Act] implications of these matters should
10 be made and it makes no sense to repeat the same judgement in every case.
11 Even taking the uncertainties into account, the Commission concludes that these
12 impacts are acceptable in that these impacts would not be sufficiently large to
13 require the NEPA conclusion, for any plant, that the option of extended operation
14 under 10 CFR Part 54 should be eliminated. Accordingly, while the Commission
15 has not assigned a single level of significance for the collective effects of the fuel
16 cycle, this issue is considered Category 1.
17

18 The staff has not identified any new and significant information during its independent
19 review of the Quad Cities ER, the staff's site visit, the scoping process, or its evaluation of
20 other available information. Therefore, the staff concludes that there are no off-site
21 radiological impacts (collective effects) from the uranium fuel cycle during the renewal term
22 beyond those discussed in the GEIS.
23

- 24 • Off-site radiological impacts (spent fuel and high level waste disposal). Based on
25 information in the GEIS, the Commission found that
26

27 For the high level waste and spent fuel disposal component of the fuel cycle,
28 there are no current regulatory limits for off-site releases of radionuclides for the
29 current candidate repository site. However, if we assume that limits are
30 developed along the lines of the 1995 National Academy of Sciences (NAS)
31 report, "Technical Bases for Yucca Mountain Standards," and that in accordance
32 with the Commission's Waste Confidence Decision, 10 CFR 51.23, a repository
33 can and likely will be developed at some site which will comply with such limits,
34 peak doses to virtually all individuals will be 100 millirem [1 mSv] per year or
35 less. However, while the Commission has reasonable confidence that these
36 assumptions will prove correct, there is considerable uncertainty since the limits
37 are yet to be developed, no repository application has been completed or
38 reviewed, and uncertainty is inherent in the models used to evaluate possible
39 pathways to the human environment. The NAS report indicated that 100 millirem
40 [1 mSv] per year should be considered as a starting point for limits for individual
41 doses, but notes that some measure of consensus exists among national and

1 international bodies that the limits should be a fraction of the 100 millirem [1
2 mSv] per year. The lifetime individual risk from 100 millirem [1 mSv] annual dose
3 limit is about 3×10^{-3} .

4
5 Estimating cumulative doses to populations over thousands of years is more
6 problematic. The likelihood and consequences of events that could seriously
7 compromise the integrity of a deep geologic repository were evaluated by the
8 Department of Energy in the "Final Environmental Impact Statement:
9 Management of Commercially Generated Radioactive Waste," October 1980
10 [DOE 1980]. The evaluation estimated the 70-year whole-body dose
11 commitment to the maximum individual and to the regional population resulting
12 from several modes of breaching a reference repository in the year of closure,
13 after 1,000 years, after 100,000 years, and after 100,000,000 years.
14 Subsequently, the NRC and other federal agencies have expended considerable
15 effort to develop models for the design and for the licensing of a HLW repository,
16 especially for the candidate repository at Yucca Mountain. More meaningful
17 estimates of doses to population may be possible in the future as more is
18 understood about the performance of the proposed Yucca Mountain repository.
19 Such estimates would involve very great uncertainty, especially with respect to
20 cumulative population doses over thousands of years. The standard proposed
21 by the NAS is a limit on maximum individual dose. The relationship of potential
22 new regulatory requirements, based on the NAS report, and cumulative
23 population impacts has not been determined, although the report articulates the
24 view that protection of individuals will adequately protect the population for a
25 repository at Yucca Mountain. However, EPA's generic repository standards in
26 40 CFR part 191 generally provide an indication of the order of magnitude of
27 cumulative risk to population that could result from the licensing of a Yucca
28 Mountain repository, assuming the ultimate standards will be within the range of
29 standards now under consideration. The standards in 40 CFR part 191 protect
30 the population by imposing "containment requirements" that limit the cumulative
31 amount of radioactive material released over 10,000 years. Reporting
32 performance standards that will be required by EPA are expected to result in
33 releases and associated health consequences in the range between 10 and
34 100 premature cancer deaths with an upper limit of 1,000 premature cancer
35 deaths world-wide for a 100,000 metric tonne (MT) repository.

36
37 Nevertheless, despite all the uncertainty, some judgement as to the regulatory
38 NEPA implications of these matters should be made and it makes no sense to
39 repeat the same judgement in every case. Even taking the uncertainties into
40 account, the Commission concludes that these impacts are acceptable in that
41 these impacts would not be sufficiently large to require the NEPA conclusion, for

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any plant, that the option of extended operation under 10 CFR part 54 should be eliminated. Accordingly, while the Commission has not assigned a single level of significance for the impacts of spent fuel and HLW disposal, this issue is considered Category 1.

Since the GEIS was originally issued in 1996, the U.S. Environmental Protection Agency (EPA) published radiation-protection standards for Yucca Mountain, Nevada, in 40 CFR Part 197, "Public Health and Environmental Radiation Protection Standards for Yucca Mountain, Nevada," on June 13, 2001 (66 FR 32132 [EPA 2001]). The Energy Policy Act of 1992 (42 USC 10101 et seq.) directs that the NRC adopt these standards into its regulations for reviewing and licensing the repository. The NRC published its regulations at 10 CFR Part 63 on November 2, 2001 (66 FR 55792 [NRC 2001]). These standards include the following: (1) 0.15-mSv/yr (15-mrem/yr) dose limit for members of the public during the storage period prior to repository closure; (2) 0.15-mSv/yr (15-mrem/yr) dose limit for the reasonably maximally exposed individual for 10,000 years following disposal; (3) 0.15-mSv/yr (15-mrem/yr) dose limit for the reasonably maximally exposed individual as a result of a human intrusion at or before 10,000 years after disposal; and (4) a groundwater-protection standard that states for 10,000 years of undisturbed performance after disposal, radioactivity in a representative volume of groundwater will not exceed (a) 0.19 Bq/L (5 pCi/L) (radium-226 and radium-228), (b) 0.56 Bq/L (15 pCi/L) (gross alpha activity), and (c) 0.04 mSv/yr (4 mrem/yr) to the whole body or any organ (from combined beta- and photon-emitting radionuclides).

On February 15, 2002, subsequent to the receipt of a recommendation by Secretary Abraham, U.S. Department of Energy, the President recommended the Yucca Mountain site for the development of a repository for the geologic disposal of spent nuclear fuel and high-level nuclear waste. The U.S. Congress approved this recommendation on July 9, 2002. This development does not represent new and significant information with respect to the off-site radiological impacts related to spent fuel and HLW disposal during the renewal term.

The staff has not identified any new and significant information during its independent review of the Quad Cities ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no off-site radiological impacts related to spent fuel and HLW disposal during the renewal term beyond those discussed in the GEIS.

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

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

The staff has not identified any new and significant information during its independent review of the Quad Cities ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no nonradiological impacts of the uranium fuel cycle during the renewal term beyond those discussed in the GEIS.

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

The comprehensive regulatory controls that are in place and the low public doses being achieved at reactors ensure that the radiological impacts to the environment will remain small during the term of a renewed license. The maximum additional on-site land that may be required for low-level waste storage during the term of a renewed license and associated impacts will be small. Nonradiological impacts on air and water will be negligible. The radiological and nonradiological environmental impacts of long-term disposal of low-level waste from any individual plant at licensed sites are small. In addition, the Commission concludes that there is reasonable assurance that sufficient low-level waste disposal capacity will be made available when needed for facilities to be decommissioned consistent with NRC decommissioning requirements.

The staff has not identified any new and significant information during its independent review of the Quad Cities ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of low-level waste storage and disposal associated with the renewal term beyond those discussed in the GEIS.

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

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

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disposal capacity will be made available when needed for facilities to be decommissioned consistent with NRC decommissioning requirements.

The staff has not identified any new and significant information during its independent review of the Quad Cities ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of mixed-waste storage and disposal associated with the renewal term beyond those discussed in the GEIS.

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

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

The staff has not identified any new and significant information during its independent review of the Quad Cities ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of onsite spent fuel associated with license renewal beyond those discussed in the GEIS.

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

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

The staff has not identified any new and significant information during its independent review of the Quad Cities ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no nonradiological waste impacts during the renewal term beyond those discussed in the GEIS.

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

The impacts of transporting spent fuel enriched up to 5 percent uranium-235 with average burnup for the peak rod to current levels approved by NRC up to 62,000 MWd/MTU and the cumulative impacts of transporting HLW to a single repository, such as Yucca Mountain, Nevada are found to be consistent with the impact values contained in 10 CFR 51.52(c), Summary Table S-4 –

1 Environmental Impact of Transportation of Fuel and Waste to and from One
2 Light-Water-Cooled Nuclear Power Reactor. If fuel enrichment or burnup
3 conditions are not met, the applicant must submit an assessment of the
4 implications for the environmental impact values reported in § 51.52.
5

6 Quad Cities meets the fuel-enrichment and burnup conditions set forth in Addendum 1 to
7 the GEIS. The staff has not identified any new and significant information during its
8 independent review of the Quad Cities ER, the staff's site visit, the scoping process, or its
9 evaluation of other available information. Therefore, the staff concludes that there are no
10 impacts of transportation associated with license renewal beyond those discussed in the
11 GEIS.
12

13 There are no Category 2 issues for the uranium fuel cycle and solid-waste management.
14

15 6.2 References

16
17 10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy*, Part 51, "Environmental
18 Protection Regulations for Domestic Licensing and Related Regulatory Functions."
19

20 10 CFR Part 54. Code of Federal Regulations, Title 10, *Energy*, Part 54, "Requirements for
21 Renewal of Operating Licenses for Nuclear Power Plants."
22

23 10 CFR Part 63. Code of Federal Regulations, Title 10, *Energy*, Part 63, "Disposal of High-
24 Level Radioactive Wastes in a Geologic Repository at Yucca Mountain, Nevada."
25

26 40 CFR Part 191. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 191,
27 "Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear
28 Fuel, High-Level and Transuranic Radioactive Waste."
29

30 40 CFR Part 197. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 197,
31 "Public Health and Environmental Radiation Protection Standards for Management and
32 Disposal for Yucca Mountain, Nevada."
33

34 Energy Policy Act of 1992. 42 USC 10101, et seq.
35

36 Exelon Generation Company, LLC (Exelon). 2003. *Applicant's Environmental*
37 *Report—Operating License Renewal Stage, Quad Cities Nuclear Power Station Units 1 and 2.*
38 *Cordova, Illinois.*
39

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

3 National Environmental Policy Act of 1969 (NEPA), as amended. 42 USC 4321, et seq.
4

5 U.S. Department of Energy (DOE). 1980. *Final Environmental Impact Statement:*
6 *Management of Commercially Generated Radioactive Waste*. DOE/EIS-0046F,
7 Washington, D.C.
8

9 U.S. Environmental Protection Agency (EPA). 2001. "Public Health and Environmental
10 Radiation Protection Standards for Yucca Mountain, Nevada." *Federal Register*. Vol. 66,
11 No. 114, pp. 32132–32135. June 13, 2001.
12

13 U.S. Nuclear Regulatory Commission (NRC). 1996. *Generic Environmental Impact Statement*
14 *for License Renewal of Nuclear Plants*. NUREG-1437, Volumes 1 and 2, Washington, D.C.
15

16 U.S. Nuclear Regulatory Commission (NRC). 1999. *Generic Environmental Impact Statement*
17 *for License Renewal of Nuclear Plants, Main Report*, "Section 6.3 – Transportation, Table 9.1,
18 Summary of findings on NEPA issues for license renewal of nuclear power plants, Final
19 Report." NUREG-1437, Volume 1, Addendum 1, Washington, D.C.
20

21 U.S. Nuclear Regulatory Commission (NRC). 2001. "Disposal of High-Level Radioactive
22 Wastes in a Geologic Repository at Yucca Mountain, Nevada." *Federal Register*. Vol. 66,
23 No. 213., pp. 55792–55815. November 2, 2001.

7.0 Environmental Impacts of Decommissioning

Environmental issues from the activities associated with the decommissioning of any power reactors are evaluated in the *Generic Environmental Impact Statement for Decommissioning of Nuclear Facilities*, NUREG-0586, Supplement 1 (NRC 2002). The staff's evaluation of the environmental effects of decommissioning in Supplement 1 resulted in a range of impacts for each environmental issue. These results may be used by licensees as a starting point for a plant-specific evaluation of the decommissioning impacts at their facilities.

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

- (1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristics.
- (2) A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective off-site radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal).
- (3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation.

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

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

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

7.1 Decommissioning

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

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

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

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

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

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

The staff has not identified any new and significant information during its independent review of the Exelon ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no radiation

1 doses associated with decommissioning following the license renewal term beyond
2 those discussed in the GEIS.

- 3
4 • Waste management. Based on information in the GEIS, the Commission found that

5
6 Decommissioning at the end of a 20-year license renewal period would generate no
7 more solid wastes than at the end of the current license term. No increase in the
8 quantities of Class C or greater than Class C wastes would be expected.

9
10 The staff has not identified any new and significant information during its independent
11 review of the Exelon ER, the staff's site visit, the scoping process, or its evaluation of other
12 available information. Therefore, the staff concludes that there are no impacts of solid
13 waste associated with decommissioning following the license renewal term beyond those
14 discussed in the GEIS.

- 15
16 • Air quality. Based on information in the GEIS, the Commission found that

17
18 Air quality impacts of decommissioning are expected to be negligible either at the
19 end of the current operating term or at the end of the license renewal term.

20
21 The staff has not identified any new and significant information during its independent
22 review of the Exelon ER, the staff's site visit, the scoping process, or its evaluation of other
23 available information. Therefore, the staff concludes that there are no air quality impacts
24 associated with decommissioning following the license renewal term beyond those
25 discussed in the GEIS.

- 26
27 • Water quality. Based on information in the GEIS, the Commission found that

28
29 The potential for significant water quality impacts from erosion or spills is no
30 greater whether decommissioning occurs after a 20-year license renewal period or
31 after the original 40-year operation period, and measures are readily available to
32 avoid such impacts.

33
34 The staff has not identified any new and significant information during its independent
35 review of the Exelon ER, the staff's site visit, the scoping process, or its evaluation of other
36 available information. Therefore, the staff concludes that there are no water quality impacts
37 associated with decommissioning following the license renewal term beyond those
38 discussed in the GEIS.
39

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- Ecological resources. Based on information in the GEIS, the Commission found that Decommissioning after either the initial operating period or after a 20-year license renewal period is not expected to have any direct ecological impacts.

The staff has not identified any new and significant information during its independent review of the Exelon ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts on ecological resources associated with decommissioning following the license renewal term beyond those discussed in the GEIS.

- Socioeconomic impacts. Based on information in the GEIS, the Commission found that Decommissioning would have some short-term socioeconomic impacts. The impacts would not be increased by delaying decommissioning until the end of a 20-year relicense period, but they might be decreased by population and economic growth.

The staff has not identified any new and significant information during its independent review of the Exelon ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no socioeconomic impacts associated with decommissioning following the license renewal term beyond those discussed in the GEIS.

7.2 References

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

Exelon Generation Company (Exelon). 2003. *Applicant's Environmental Report – Operating License Renewal Stage Quad Cities Nuclear Power Station Units 1 and 2*. Warrenville, Illinois.

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

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

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

8.0 Environmental Impacts of Alternatives to Operating-License Renewal

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

SMALL – Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.

MODERATE – Environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.

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

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

8.1 No-Action Alternative

The NRC's regulations implementing the National Environmental Policy Act (NEPA) specify that the no-action alternative be discussed in an NRC environmental impact statement (EIS) (10 CFR Part 51, Subpart A, Appendix A(4)). For license renewal, the no-action alternative refers to a scenario in which the NRC would not renew the OLs for Quad Cities Units 1 and 2

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

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1 and the Exelon Generation Company (Exelon) would then decommission Quad Cities Units 1
2 and 2 when plant operations cease.

3
4 The no-action alternative is a conceptual alternative resulting in a net reduction in electricity
5 generation; there would be no replacement power, and therefore no environmental impacts
6 from replacement power. In actual practice, the power lost by not renewing the OLs for Quad
7 Cities Units 1 and 2 would likely be replaced by (1) demand-side management (DSM) and
8 energy conservation, (2) electricity generated from other sources, either by Exelon or by
9 another generator, or (3) some combination of these alternatives. Any replacement power
10 would produce environmental impacts in addition to those discussed under the no-action
11 alternative. Environmental impacts of these other sources are discussed in Section 8.

12
13 Exelon will be required to comply with NRC decommissioning requirements whether or not the
14 OLs are renewed and therefore must comply under the no-action alternative. If the OLs for
15 Quad Cities Units 1 and 2 are renewed, decommissioning activities would be postponed for up
16 to an additional 20 years. If the OLs are not renewed, Exelon would conduct decommissioning
17 activities according to the requirements in 10 CFR 50.82.

18
19 The environmental impacts associated with decommissioning under both license renewal and
20 the no-action alternative would be bounded by the discussion of impacts in Chapter 7 of the
21 GEIS, Chapter 7 of this supplemental environmental impact statement (SEIS), and NUREG-
22 0586, Supplement 1 *Generic Environmental Impact Statement on Decommissioning of Nuclear*
23 *Facilities, Supplement 1 Regarding the Decommissioning of Nuclear Power Reactors*, dated
24 November 2002 (NRC 2002). The impacts of decommissioning after 60 years of operation are
25 not expected to be significantly different from those occurring after 40 years of operation.

26
27 The environmental impacts associated with the no-action alternative are summarized in Table
28 8-1. Implementation of the no-action alternative would also have certain positive impacts in that
29 adverse environmental impacts associated with the current operation of Quad Cities Units 1
30 and 2, for example, any adverse ecological impacts, would be eliminated.

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

Impact Category	Impact	Comment
Land Use	SMALL	Impacts would be expected to be temporary.
Ecology	SMALL	Impacts on ecology would be expected to be temporary and largely mitigated by using best management practices.
Water Quality	SMALL	Water use would decrease. Water quality unlikely to be adversely affected.
Air Quality	SMALL	Greatest impact would likely to be from fugitive dust; impact could be mitigated by good management practices.
Waste	SMALL	Low-level radioactive waste would be disposed of in licensed facilities. A permanent disposal facility for high-level waste is currently not available.
Human Health	SMALL	Radiological doses to workers and members of the public would be expected to be within regulatory limits and comparable to, or lower than, doses from operating plants. Occupational injuries would be possible, but injury rates at nuclear power plants are below the U.S. average industrial rate.
Socioeconomic	SMALL	Proximity to the Quad Cities metropolitan area would mitigate any impacts on employment. Small impacts on local tax revenue.
Aesthetics	SMALL	Positive impact from eventual removal of buildings and structures. Some noise impact during decommissioning operations.
Historic and Archaeological Resources	SMALL	Any impacts primarily confined to land use during plant operations. No impact on other lands on site.
Environmental Justice	SMALL	Impacts on minority and low-income communities would be similar to those experienced by the population as a whole.

- **Land Use.** Temporary changes in onsite land use for portions of the site could occur during decommissioning. Temporary changes may include addition or expansion of staging and laydown areas or construction of temporary buildings and parking areas. No offsite land use changes are expected as a result of decommissioning.^(a) The impacts of the no-action alternative on land use are considered SMALL.

(a) The Rock Island County Land Use Plan designates the site area as industrial, which will have implications for the future use of the site. (Rock Island County Land Use Plan, 1998).

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- 1 • Ecology. Impacts on aquatic ecology at the Quad Cities site could result from removal of
2 in-water pipes and structures or the filling of the intake and discharge canals. Negative
3 impacts to aquatic ecology would likely be short-term and could be mitigated. The aquatic
4 environment is expected to recover naturally. In the long term, decommissioning of Quad
5 Cities Units 1 and 2 would shut down the open-cycle cooling system, with beneficial effects
6 for aquatic biology. However, this no action alternative would result in the loss of the warm
7 water effluent and, during winter, this area may no longer offer open water habitat to
8 support bald eagle feeding with which bald eagles have been noted to use at the Quad
9 Cities site.^(a) Also, impacts on terrestrial ecology could occur as a result of land disturbance
10 for additional laydown yards, stockpiles, and support facilities. Land disturbance is
11 expected to be minimal and result in relatively short-term impacts that can be mitigated
12 using best management practices. The land is expected to recover naturally. The impacts
13 of the no-action alternative on ecology are considered SMALL.
14
- 15 • Water Use and Quality. The existing plant uses open-cycle cooling with essentially no
16 evaporative losses, so the cooling system is not a consumptive water user. Therefore,
17 cessation of plant operations will reduce the cooling water need (but will not reduce the
18 cooling water consumptive use) and the condenser heat load sent to the river would be
19 eliminated. As plant staff size decreases, the demand for potable water is expected also to
20 decrease. Overall, the impacts of the no-action alternative on water use and quality are
21 considered SMALL.
22
- 23 • Air Quality. Decommissioning activities that can adversely affect air quality include
24 dismantlement of systems and equipment, demolition of buildings and structures, and the
25 operation of internal combustion engines. The most likely adverse impact would be the
26 generation of fugitive dust. Best management practices, such as seeding and wetting,
27 could be used to minimize the generation of fugitive dust. Overall, the impacts of the no-
28 action alternative on air quality are considered SMALL.
29
- 30 • Waste. Decommissioning activities would result in the generation of radioactive and
31 nonradioactive waste. The volume of low-level radioactive waste could vary greatly
32 depending on the option chosen for decommissioning, and the waste treatment and volume
33 reduction procedures used. Low-level radioactive waste must be disposed of in a facility
34 licensed by the NRC or a state with authority delegated by the NRC. Recent advances in
35 volume reduction and waste processing have significantly reduced waste volumes.
36
37

(a) Personal communication with E. Britton, District Manager, Savanna District, Upper Mississippi National Wildlife and Fish Refuge, May 8, 2003.

A permanent repository for high-level waste (HLW) is not currently available. The NRC has made a generic determination that, if necessary, spent fuel generated in any reactor can be stored safely and without significant environmental impacts for at least 30 years beyond the licensed life for operation (which may include the term of a revised or renewed license) of that reactor in its spent fuel pool or at either onsite or offsite independent spent fuel storage installations [10 CFR 51.23(a)]. Overall, the impacts of the no-action alternative on waste are considered SMALL.

- Socioeconomic. If Quad Cities Units 1 and 2 cease operation, there will be a decrease in employment and possibly tax revenues associated with the closure. These impacts would be most concentrated in Rock Island and Whiteside counties, Illinois, and Scott County, Iowa, with smaller impacts in adjoining counties. There would be some adverse impacts on local housing values and the local economy in Rock Island County, and adjoining counties to a lesser extent, under the no-action alternative.

The tax revenue losses that might result from closure of Quad Cities Units 1 and 2 would occur in Rock Island County and its taxing bodies at the township. Annual property taxes from Quad Cities Units 1 and 2 accounted for approximately 2.7 percent of Rock Island County's total levee extension and approximately 2.8 percent of the county's total collections available for the distribution for the years 1997 to 2000. However, the local Cordova taxing districts for the township, library, school district, road and bridge district, and fire department derive significant revenue (31 to 73 percent of their total revenue from all sources) from the plant (Rock Island County Board of Review 2002). Exelon plans to negotiate a graduated reduction in payments to minimize the financial disruption to county and local operations caused by a change in the methods of plant value assessment due to the deregulation of the utility industry in the State of Illinois (Exelon 2003). The local taxing districts that rely on the plant for a large portion of their revenue will be adversely affected to a significant degree by the decline in tax receipts.

The no-action alternative would result in the loss of plant payrolls 20 years earlier than if the OLs were renewed. Quad Cities Units 1 and 2 currently support approximately 850 permanent employees and approximately 130 contract workers (Exelon 2003). Approximately 77 percent of employees who work at the Quad Cities site live in Rock Island and Whiteside counties, Illinois, or in Scott County, Iowa (Exelon 2003). Therefore, primary employment impacts would be concentrated in these counties. However, the proximity to the Quad Cities metropolitan area would mitigate much of the employment impact. Most secondary employment impacts and impacts on population would also be concentrated in Rock Island, Whiteside, and Scott counties. Exelon employees working at the Quad Cities site currently contribute time and money toward community involvement, including schools, churches, charities, and other civic activities. It is likely that with a reduced presence in the

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community following decommissioning, Exelon's community involvement efforts in the region would be lessened.

Overall, the staff concluded that the socioeconomic impacts associated with the no-action alternative are considered SMALL.

Overall, the no-action alternative would have SMALL socioeconomic impacts.

- Human Health. Radiological doses to occupational workers during decommissioning activities are estimated to average approximately 5 percent of the dose limits in 10 CFR Part 20, and to be similar to, or lower than, the doses received from operating nuclear power plants. Occupational injuries to workers engaged in decommissioning activities are possible. Overall, the impacts of the no-action alternative on human health are considered SMALL.
- Aesthetics. Decommissioning would result in the eventual dismantlement of buildings and structures at the site resulting in a positive aesthetic impact. Noise would be generated during decommissioning operations that may be detectable offsite, however the impact is unlikely to be of significance, and noise would cease altogether following decommissioning. Overall, the impacts of the no-action alternative on aesthetics are considered SMALL.
- Historic and Archaeological Resources. Use of land resources at Quad Cities would be reduced following plant closure. Reduced use of the property will reduce the likelihood of adversely impacting historic and archaeological resources. The amount of undisturbed land needed to support the decommissioning process will be relatively small. The staff concluded in NRC (2002) that decommissioning activities conducted within the operational areas of a nuclear power plant are not expected to have a detectable effect on important cultural resources because these areas have been impacted during the operating life of the plant. Minimal disturbance of land outside the licensee's operational area for decommissioning activities is expected. Historic and archaeological resources on undisturbed portions of the site should not be adversely affected. Following decommissioning, the site would likely be retained by Exelon for other corporate purposes. Eventual sale or transfer of the site, however, could result in adverse impacts to cultural resources if the land-use pattern changes dramatically. Notwithstanding this possibility, the impacts of the no-action alternative and decommissioning on historic and archaeological resources are considered SMALL.
- Environmental Justice. Current operations at the Quad Cities site have no disproportionate impacts on the minority and low-income populations of the surrounding counties, and no environmental pathways have been identified that would cause disproportionate impacts. Closure of Quad Cities Units 1 and 2 would result in decreased employment opportunities in

Rock Island County, Whiteside County, and Scott County, and somewhat reduced tax revenues in Rock Island County, with possible small, negative and disproportionate impacts on minority or low-income populations. Because the Quad Cities site is located in the Quad Cities metropolitan area, the impacts of closure on minority and low-income populations would be offset by other local employment opportunities. Overall, the impacts of the no-action alternative on minority and low-income populations are considered SMALL.

8.2 Alternative Energy Sources

This section discusses the environmental impacts associated with alternative sources of electricity to replace the electricity generated by Quad Cities Units 1 and 2, assuming that the OLs for Units 1 and 2 are not renewed. According to Exelon, the capacity of Quad Cities Units 1 and 2 is approximately 1860 megawatts electric (MW(e)), based on a capacity of 930 MW(e) for each unit. (Exelon 2003).^(a)

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

- coal-fired generation at the Quad Cities site and at an alternate site (Section 8.2.1)
- natural-gas-fired generation at the Quad Cities site and at an alternate site (Section 8.2.2)
- nuclear generation at the Quad Cities site and at an alternate site (Section 8.2.3)

The alternative of purchasing power from other sources to replace power generated at Quad Cities Units 1 and 2 is discussed in Section 8.2.4. Other power-generation alternatives and conservation alternatives considered by the staff and found not to be reasonable replacements for the full production at Quad Cities Units 1 and 2 are discussed in Section 8.2.5.

Section 8.2.6 discusses the environmental impacts of a combination of generation and conservation alternatives.

Each year, the EIA, a component of the U.S. DOE, issues an Annual Energy Outlook. The *Annual Energy Outlook 2002 with Projections to 2020* was issued in December 2001 (DOE/EIA

(a) The Department of Energy's (DOE's) Energy Information Administration (EIA) estimates the peak summer capacity of Quad Cities Units 1 and 2 to be 1537 MW(e) (DOE/EIA 2003c). For the remainder of this section, the staff considered the total capacity of Quad Cities Units 1 and 2 to be 1860 MW(e).

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2001a). In this report, the EIA projects that combined-cycle^(a) or combustion-turbine technology fueled by natural gas is likely to account for approximately 88 percent of new electricity-generating capacity through the year 2020 (DOE/EIA 2001a). Both technologies are designed primarily to supply peak and intermediate capacity, but combined-cycle technology can also be used to meet base-load^(b) requirements. Coal-fired plants are projected by the EIA to account for approximately 9 percent of new capacity during this period. Coal-fired plants are generally used to meet base-load requirements. Renewable energy sources, primarily wind, geothermal, and municipal solid-waste units, are projected by the EIA to account for the remaining 3 percent of capacity additions.

The EIA projects that oil-fired plants will account for very little new generation capacity in the United States through the year 2020 because of higher fuel costs and lower efficiencies (DOE/EIA 2001a). The EIA's projections are based on the assumption that providers of new generating capacity will seek to minimize cost while meeting applicable environmental requirements. Combined-cycle plants are projected by the EIA to have the lowest generation cost in 2005 and 2020, followed by coal-fired plants and then wind generation (DOE/EIA 2001a).

The EIA also projects that new nuclear power plants will not account for any new generation capacity in the United States through the year 2020 because natural-gas- and coal-fired plants are projected to be more economical (DOE/EIA 2001a). In spite of this projection, since 1997, the NRC has certified three new standard designs for nuclear power plants under the procedures in 10 CFR Part 52 Subpart B. Therefore, a new, nuclear plant alternative for replacing power generated by Quad Cities 1 and 2 is considered in Section 8.2.3. The submission to the NRC of these three applications for certification indicates continuing interest in the possibility of licensing new nuclear power plants. The NRC has established a new organization to prepare for and manage future reactor and site licensing applications.

Note that this section discusses the impacts of alternative generation technologies. It does not address the impacts of decommissioning. Further, it does not consider the impacts to the Quad Cities site of building alternative generation elsewhere, when such options are addressed. The no-action alternative discussed in Section 8.1, covers the impacts at the Quad Cities site of shutting down Quad Cities Units 1 and 2.

(a) In the combined-cycle unit, hot combustion gases in a combustion turbine rotate the turbine to generate electricity. Waste combustion heat from the combustion turbine is routed through a heat-recovery boiler to make steam to generate additional electricity.

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

8.2.1 Coal-Fired Generation

The environmental impacts of the coal-fired alternative are examined in this section for the Quad Cities site and an alternate site. Unless otherwise indicated, the assumptions and numerical values used in this section are from the Exelon environmental report (ER; Exelon 2003). The staff reviewed this information and compared it to environmental impact information in the GEIS, as well as other relevant information and sources where appropriate. Although the OL renewal period is only 20 years, the impact of operating the coal-fired alternative for 40 years is considered (as a reasonable projection of the operating life of a coal-fired plant). The staff assumed that Quad Cities Units 1 and 2 would remain in operation while the coal-fired alternative was constructed.

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

The staff assumes construction of three 550-megawatts electric (MW[e]) units, for a combined capacity of 1650 MW(e), as potential replacements for Quad Cities Units 1 and 2, which is consistent with Exelon's ER (Exelon 2003)^(a). Exelon chose this size to be consistent with the natural-gas-fired alternative, which was chosen to match "standard" sizes for new combined-cycle facilities. The assumption of 1650 MW(e) understates the environmental impacts of replacing the 1860 MW(e) from Quad Cities Units 1 and 2. The remaining capacity would be made up from other sources. As a rough estimate, if a coal-fired plant of exactly 1860 MW(e) were to be built, any impacts, for example, quantities of air pollutants, in this section might simply be adjusted upward accordingly. However, given these adjustments, the staff has determined that the differences in impacts between 1650 MW(e) and 1860 MW(e) of coal-fired generation would not be significant and would not change the impact levels.

Exelon assumes the coal-fired alternative would use tangentially-fired, dry-bottom combustors with an associated heat rate^(b) of 10,200 Btu/kWh (a thermodynamic efficiency of approximately

(a) The coal-fired units would have a rating of 583 gross MW(e) and 550 net MW(e). The difference between "gross" and "net" is the electricity consumed on site.

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

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30 percent) and a capacity factor^(a) of 0.85 (Exelon 2003). According to Exelon, the coal-fired plant would consume approximately 6.3 million MT (6.9 million tons) per year of pulverized bituminous coal with an ash content of approximately 6.9 percent (Exelon 2003). For emissions control, the facility would be outfitted with low nitrogen oxide (NO_x) burners, overfire air and selective catalytic reduction for NO_x control; fabric filters for control of particulates; and a wet scrubber using lime for sulfur oxide (SO₂) control.

The coal-fired alternative would require converting a significant quantity of land to industrial use for the power plant, coal storage, landfill disposal of ash, spent catalytic reduction catalyst (used for control of NO_x emissions), and scrubber sludge. Exelon believes that the Quad Cities site is adequate to support these requirements. The Quad Cities site consists of approximately 327 ha (817 ac) (Exelon 2003). The GEIS asserts that approximately 700 ha (1700 ac) would be required to build a 1000 MW(e) coal-fired power plant at a greenfield site (NRC 1996). Locating a coal-fired power plant at an existing nuclear site would significantly lower this land requirement and would allow the new facility to take advantage of existing infrastructure at the Quad Cities site, including switchyard, offices, intake and discharge, and transmission rights-of-way. Exelon estimates that the coal-fired alternative would require approximately 75 ha (180 ac) for waste disposal and approximately 120 ha (300 ac) for the powerblock and coal-storage area. To use the Quad Cities site, Exelon would likely need to acquire additional adjacent acreage, some of which had recently been divested.

Two coal-and-lime delivery options are most appropriate for the Quad Cities site: barge and rail. The Quad Cities site location lends itself to coal delivery by barge, which is a common practice along the Mississippi River waterway. The barge alternative would require construction of a barge offloading facility on Pool 14 and a conveyor system to the station coal yard. These new facilities would result in greater construction impacts than upgrading the existing rail line (Exelon 2003). The alternative would trade barge traffic impacts for rail traffic impacts. The staff agrees with Exelon that such a tradeoff provides no obvious environmental benefit and the barge alternative is considered in this section. A coal slurry pipeline is another potential alternative for delivering coal. However, such a pipeline would need to cover a great distance to reach a suitable coal-mining area or the coal would need to be transported by alternative means (e.g., rail) to a site closer to the Quad Cities site for introduction into the pipeline. The coal slurry pipeline alternative for delivering coal is not further evaluated.

8.2.1.1 Closed-Cycle Cooling System

For purposes of this SEIS, the staff assumed a coal-fired plant at the Quad Cities site would use a closed-cycle cooling system. While the existing system is open-cycle, using water from

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

the Mississippi River, Exelon notes that the U.S. Environmental Protection Agency (EPA) has revised requirements that could affect the design of the cooling-water intake structures for new facilities (EPA 2001a) and has proposed requirements that could affect modifications at existing facilities (EPA 2002). For this reason, this section considers a closed-cycle system using cooling towers at both the Quad Cities site and an alternate site.

The overall impacts of the coal-fired generating system using a closed-cycle cooling system are discussed in the following sections and are summarized in Table 8-2. For completeness, the staff also considered the impacts of a fully open-cycle cooling system at the Quad Cities site. Additional impacts from the use of an open-cycle cooling system are considered in Section 8.2.1.2.

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

Impact Category	Quad Cities Site		Alternate Site	
	Impact	Comments	Impact	Comments
Land Use	MODERATE	Would use unused portion of Quad Cities site, and potentially, portions of neighboring land. Would require approximately 195 ha (480 ac) for power block, coal storage, and waste disposal. Would use any existing infrastructure (e.g., transmission lines). Additional land impacts for coal and limestone mining.	MODERATE to LARGE	Potentially 1150 ha (2800 ac) for new coal facility, including power block, infrastructure, coal storage, and waste disposal. Additional land impacts for coal and limestone mining. Total impact would depend on whether the alternate site is previously disturbed.
Ecology	MODERATE to LARGE	Would use undeveloped areas at Quad Cities site. There would be potential for significant habitat loss and fragmentation and reduced productivity and biological diversity.	MODERATE to LARGE	Impact would depend on whether site is previously developed. Factors to consider include location and ecology of site and transmission line route. There would be potential for habitat loss and fragmentation and reduced productivity and biological diversity.
Water Use and Quality	SMALL	Would use closed-cycle cooling system, reducing cooling water requirements while increasing evaporative, consumptive use and new heat rejection to the atmosphere and would continue very limited groundwater use.	SMALL to MODERATE	Impact would depend on volume of water withdrawal, the constituents of the discharge water, and the characteristics of surface water body or groundwater source.

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Table 8-2 (contd)

Impact Category	Quad Cities Site		Alternate Site	
	Impact	Comments	Impact	Comments
Air Quality	MODERATE	<p>Sulfur oxides</p> <ul style="list-style-type: none"> • 6000 MT/yr (6600 tons/yr). Actual impact would depend on emissions offsets. <p>Nitrogen oxides</p> <ul style="list-style-type: none"> • 1561 MT/yr (1721 tons/yr). Actual impact would depend on emissions offsets. <p>Particulates</p> <ul style="list-style-type: none"> • 216 MT/yr (238 tons/yr) particulates, 50 MT/yr (55 tons/yr) PM₁₀ <p>Carbon monoxide</p> <ul style="list-style-type: none"> • 1561 MT/yr (1721 tons/yr) <p>Other</p> <ul style="list-style-type: none"> • Some hazardous air pollutants, CO₂ emissions contribute to global warming 	MODERATE	Same emissions as Quad Cities site, although offsets for SO ₂ and NO _x would depend on location.
Waste	MODERATE	Total ash production would be 431,000 MT (475,000 tons) annually, but 87 percent of this ash would be recycled. Facility would also generate 311,000 MT (343,000 tons) of scrubber sludge.	MODERATE	Same impacts as for Quad Cities site.
Human Health	SMALL	Impacts are uncertain but are considered SMALL in the absence of more quantitative data.	SMALL	Same impacts as for Quad Cities site.

Table 8-2 (contd)

	Impact Category	Quad Cities Site		Alternate Site	
		Impact	Comments	Impact	Comments
1	Socioeconomics	SMALL to MODERATE	<p>During construction, impacts would be SMALL. Up to 2500 workers might be required at the peak of the 5-year construction period.</p> <p>During operation, employment would decrease from approximately 1000 permanent and contract workers to approximately 250. All employment impacts would be tempered by proximity to the Quad Cities metropolitan area. No impact on tax base.</p> <p>Transportation impacts during operation would be SMALL due to the smaller workforce. Transportation impacts associated with construction workers would be SMALL to MODERATE.</p>	SMALL to LARGE	<p>Construction impacts at alternate site would be similar to those at Quad Cities site, but would depend on whether new site is located near a major metropolitan area.</p> <p>Minimal impacts on local tax base.</p> <p>Transportation impacts would be similar to those at the Quad Cities site.</p>
2	Aesthetics	MODERATE	MODERATE aesthetic impact due to impact of plant buildings and structures, along with noise impacts from plant operation.	MODERATE to LARGE	Impact would be similar to those at the Quad Cities site, but would also include any aesthetic impacts from building a new transmission line(s). Impacts would depend on location.
3 4 5	Historic and Archaeological Resources	SMALL to MODERATE	Studies would likely be needed to identify, evaluate, and address mitigation of the potential cultural resource impacts from construction of a new plant on an undeveloped or developed site.	SMALL to MODERATE	Alternate location would necessitate cultural studies. Studies would likely be needed to identify, evaluate, and address mitigation of the potential cultural resource impacts from construction of a new plant on an undeveloped site.

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Table 8-2 (contd)

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

• Land Use

For siting a new facility at the Quad Cities site, the existing infrastructure would be used to the extent practicable, thus limiting the amount of new construction that would be required. Specifically, the staff assumed that the new coal-fired facility would use the switchyard, offices, and transmission rights-of-way. If the coal-fired facility is built at the existing Quad Cities site, Exelon estimates that construction of the power block and coal-storage area would impact approximately 120 ha (300 ac) of land and associated terrestrial habitat (Exelon 2003). Exelon further estimates that ash- and scrubber-waste disposal over a 40-year facility lifetime would require approximately 75 ha (180 ac) (Exelon 2003). In total, the facility is expected to require approximately 195 ha (480 acres) of land. The GEIS estimates 700 ha (1700 ac) for a 1000 MW(e), coal-fired greenfield, power plant, well above the estimates from Exelon for the 1650-MW(e) power plant. Much of the difference is due to the potential to use existing infrastructure at the Quad Cities site with neighboring land to support the coal-fired alternative.

The coal-fired alternative at the Quad Cities site would require construction of a barge offloading facility at Pool 14 and a conveyor system to the plant's coal yard, requiring the conversion of riverfront land to industrial use.

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

Regardless of whether the coal-fired alternative is built at the Quad Cities site or at an alternate site, additional land-use changes would occur offsite in an undetermined coal-mining area to supply coal for the plant. In the GEIS, the staff estimated that approximately 8900 ha (22,000 ac) would be affected for mining the coal and disposing the waste to support a 1000-MW(e) coal plant during its operational life (NRC 1996). Partially offsetting this offsite land use would be the elimination of the need for uranium mining to supply fuel for Quad Cities Units 1 and 2. In the GEIS, the staff estimated that approximately 400 ha (1000 ac) would be affected for mining the uranium and processing it during the operating life of a 1000-MW(e) nuclear power plant.

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

• Ecology

Locating a coal-fired plant at the Quad Cities site would alter ecological resources because of construction, and because of the need to convert currently unused land to industrial use for the plant, coal storage, and ash- and scrubber-sludge disposal. However, some of this land has been previously disturbed. Use of cooling towers would reduce operational impacts on the aquatic ecosystem. Impacts could include habitat degradation, fragmentation, or loss as a result of construction activities and conversion of land to industrial use. Ecological communities may experience reduced productivity and biological diversity from disturbing previously intact land. Construction of a barge offloading facility would affect terrestrial habitat along the river bluffs as well as aquatic habitat associated with construction, maintenance, and operation of the offloading facility. Overall, the impacts of the coal-fired alternative at the Quad Cities site are considered MODERATE to LARGE.

At an alternate site, the coal-fired alternative would introduce construction impacts and new incremental operational impacts. Even assuming siting at a previously disturbed area, the impacts may alter the ecology. Impacts could include habitat degradation, fragmentation or loss, reduced ecosystem productivity (i.e., including wildlife species), and a reduction in biological diversity. Construction and maintenance of transmission lines and a rail spur would have ecological impacts. Use of make-up cooling water from a nearby surface water body could have adverse aquatic resource impacts. Overall, the impacts of the coal-fired alternative at an alternate site are considered MODERATE to LARGE, depending on the degree to which the site has already been disturbed by industrial use.

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• Water Use and Quality

The coal-fired alternative at the existing site would use cooling towers and would therefore reduce the cooling-water needs from their existing levels. There would still be consumptive use of water due to evaporation from the cooling towers. At both the Quad Cities site and an alternate site, plant discharges would consist mostly of cooling-tower blowdown, characterized primarily by an increased temperature and increased concentration of dissolved solids relative to the receiving body of water and intermittent low concentrations of biocides (e.g., chlorine). Treated process waste streams and sanitary waste water would also be discharged. All discharges would likely be regulated through a national pollution discharge elimination system (NPDES) permit. Some erosion and sedimentation probably would occur during construction (NRC 1996). At the Quad Cities site, the five groundwater wells that supply limited, specific uses at the Quad Cities site would continue to be used. Use of groundwater for a coal-fired plant at an alternate site is a possibility. Overall, the impacts of the coal-fired alternative at the Quad Cities site are SMALL. The impacts of the coal-fired alternative at an alternate site are considered SMALL to MODERATE.

• Air Quality

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

The Quad Cities site is located in the Metropolitan Quad Cities Interstate Air Quality Control Region. All counties in this air quality control region are designated as being in attainment for all criteria pollutants (40 CFR 81.102, 40 CFR 81.316). All counties in Illinois within 50 miles of the Quad Cities site are designated as being in attainment for all criteria pollutants, as are all counties in Iowa (40 CFR 81.314, 40 CFR 81.316).

A new coal-fired generating plant located at the Quad Cities site would likely need a prevention of significant deterioration (PSD) permit and an operating permit under the Clean Air Act (CAA). The plant would need to comply with the new source performance standards for such plants set forth in 40 CFR Part 60 Subpart Da, which consists of 40 CFR Part 60.40a through 40 CFR Part 60.49a. Standards establish limits for particulate matter and opacity (40 CFR 60.42a), SO₂ (40 CFR 60.43a), and NO_x (40 CFR 60.44a).

Section 169A of the CAA (42 USC 7491) establishes a national goal of preventing future, and remedying existing, impairment of visibility or mandatory Class 1 Federal areas when impairment results from man-made air pollution. In addition, EPA issued a new regional haze rule in 1999 (64 FR 35714 [EPA 1999]). The rule specifies that for each mandatory

class I Federal area located within a state, the state must establish goals that provide for reasonable progress toward achieving natural visibility conditions. The reasonable-progress goals must provide for an improvement in visibility for the most-impaired days over the period of the implementation plan and ensure no degradation in visibility for the least-impaired days over the same period [40 CFR 1.308(d)(1)]. If a new coal-fired power station were located close to a mandatory class I Federal area, additional air pollution control requirements could be imposed. However, there are no mandatory class I Federal areas near the Quad Cities site. It is assumed that an alternate site would not be chosen near a mandatory class I Federal area.

The U.S. EPA has various regulatory requirements for visibility protection in 40 CFR Part 51, Subpart P, including a specific requirement for the review of any new major stationary source in an area designated as attainment or unclassified under the CAA. As noted above, the Quad Cities site is in a region that is either attainment or unclassified for all criteria pollutants.

Impacts and issues for particular pollutants follow. Unless otherwise stated, the impacts would be the same at the Quad Cities site or at an alternate site.

Sulfur oxides. A new coal-fired power plant would be subject to the requirements in Title IV of the CAA. Title IV was enacted to reduce emissions of SO₂ and NO_x, the two principal precursors of acid rain, by restricting emissions of these pollutants from power plants. Title IV caps aggregate annual power-plant SO₂ emissions and imposes controls on SO₂ emissions through a system of marketable allowances. The EPA issues one allowance for each ton of SO₂ that a unit is allowed to emit. New units do not receive allowances, but they are required to have allowances to cover their SO₂ emissions. Owners of new units must, therefore, purchase allowances from owners of other power plants or reduce SO₂ emissions at other power plants they own. Allowances can be banked for use in future years. Because Exelon has no fossil-fired power plants (Exelon 2003), it would need to purchase allowances from the open market to operate a coal-fired power plant at the Quad Cities site. Whether the coal-fired alternative results in an aggregate increase in SO₂ emissions will depend on whether the permits are purchased when there is a surplus of permits or when the market is constrained. In the latter case, the coal-fired alternative would result in no net increase in aggregate national SO₂ emissions. Regardless, the coal-fired power plant would result in a local increase in SO₂ emissions whether located at the Quad Cities site or an alternate site.

Exelon states in its ER that the alternative coal-fired power plant would minimize air emissions through a combination of boiler technology and post-combustion pollution removal. SO₂ would be removed using lime in a flue-gas desulfurization process (Exelon 2003). Exelon estimates that by using a wet-scrubber control technology, 95 percent of the

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stack emissions of SO₂ could be collected, so that total annual stack emissions, after scrubbing, would be approximately 6000 MT (6600 tons) of SO_x (Exelon 2003).

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

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

Section 407 of the CAA establishes technology-based limitations for NO_x emissions. The market-based allowance system used for SO₂ emissions is not used for NO_x emissions. A new coal-fired power plant would be subject to the new source performance standards for such plants at 40 CFR 60.44a(d)(1). This regulation, issued on September 16, 1998 (63 FR 49453 [EPA 1998]), limits the discharge of any gases that contain nitrogen oxides (expressed as NO₂) in excess of 200 ng/J of gross energy output (1.6 lb/MWh), based on a 30-day rolling average.

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

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

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

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

Hazardous air pollutants, including mercury. In December 2000, the EPA issued a regulatory finding on the emissions of hazardous air pollutants from electric utility steam-generating units (65 FR 79825 [EPA 2000b]). The EPA determined that coal- and oil-fired electric utility steam-generating units are significant emitters of hazardous air pollutants. Coal-fired power plants were found by the EPA to emit arsenic, beryllium, cadmium, chromium, dioxins, hydrogen chloride, hydrogen fluoride, lead, manganese, and mercury (65 FR 79825 [EPA 2000b]). The EPA concluded that mercury is the hazardous air pollutant of greatest concern. The EPA found that (1) there is a link between coal consumption and mercury emissions, (2) electric utility steam-generating units are the largest domestic source of mercury emissions, and (3) certain segments of the U.S. population (e.g., the developing fetus and subsistence fish-eating populations) are believed to be at potential risk of adverse health effects due to mercury exposures resulting from the consumption of contaminated fish (65 FR 79825 [EPA 2000b]). Accordingly, the EPA added coal- and oil-fired electric utility steam-generating units to the list of source categories under Section 112(c) of the CAA for which emission standards for hazardous air pollutants will be issued (65 FR 79825 [EPA 2000b]).

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

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

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

• Waste

Coal combustion generates waste in the form of ash, and equipment for controlling air pollution generates additional ash, spent selective catalytic reduction catalyst, and scrubber sludge. Assuming 99.9 percent ash removal, the three 550-MW(e) coal-fired units would generate approximately 431,000MT (475,000 tons) of this ash annually (Exelon 2003). According to Exelon, Illinois regulations encourage recycling of coal-combustion byproducts, and Exelon (then ComEd) historically recycled 87 percent of its coal ash (Exelon 2003). Assuming continuation of this waste mitigation measure, the coal-fired alternative would generate approximately 56,000 (62,000 tons) of ash per year for disposal (Exelon 2003). In addition, approximately 311,000 MT (343,000 tons) per year of scrubber sludge would be generated by SO_x-controlled equipment (Exelon 2003). This equipment would use approximately 116,000 tons of calcium oxide (lime) in the scrubbing process to control SO_x emissions.

The waste would be disposed of onsite, accounting for approximately 75 ha (180 ac) of land area over the 40-year plant life, assuming a waste depth of 30 feet (Exelon 2003). Waste impacts to groundwater and surface water could extend beyond the operating life of the plant if leachate and runoff from the waste storage area occurs. Disposal of the waste could noticeably affect land use and groundwater quality, but with appropriate management and monitoring, it would not destabilize any resources. After closure of the waste site and revegetation, the land could be available for other uses.

In May 2000, the EPA issued a "Notice of Regulatory Determination on Wastes From the Combustion of Fossil Fuels" (65 FR 32214 [EPA 2000a]). The EPA concluded that some form of national regulation is warranted to address coal-combustion waste products because (1) the composition of these wastes could present danger to human health and the

environment under certain conditions; (2) the EPA has identified 11 documented cases of proven damages to human health and the environment by improper management of these wastes in landfills and surface impoundments; (3) present disposal practices are such that in 1995, these wastes were being managed in 40 to 70 percent of landfills and surface impoundments without reasonable controls in place, particularly in the area of groundwater monitoring; and (4) the EPA identified gaps in the state oversight of coal-combustion wastes. Accordingly, the EPA announced its intention to issue regulations for the disposal of coal-combustion waste under Subtitle D of the Resource Conservation and Recovery Act.

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

- **Human Health**

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

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

Regulatory agencies, including the EPA and state agencies, set air-emission standards and requirements based on human-health impacts. These agencies also impose site-specific emission limits as needed to protect human health. The EPA has recently concluded that certain segments of the U.S. population (e.g., the developing fetus and subsistence fish-eating populations) are believed to be at potential risk of adverse health effects due to mercury exposures from sources such as coal-fired power plants. However, in the absence of more quantitative data, human-health impacts from radiological doses and inhaling toxins and particulates generated by burning coal are characterized as SMALL. This characterization holds for a coal-fired generation plant at the Quad Cities site and at an alternate site.

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• Socioeconomics

Construction of the coal-fired alternative would take approximately 5 years. The staff assumed that construction would take place while Quad Cities Units 1 and 2 continues operation and would be completed by the time Quad Cities Units 1 and 2 permanently cease operation. The GEIS estimates a peak workforce during construction of between 1200 and 2500 workers for a 1000-MW(e) power plant (NRC 1996). This workforce would likely be larger for the 1650-MW(e) coal-fired alternative.

If the facility were constructed at the Quad Cities site, these workers would be in addition to the 850 permanent employees and approximately 130 contract workers that currently work at the Quad Cities site. During construction of the new coal-fired plant, surrounding communities would experience demands on housing and public services that could have SMALL impacts. These impacts would be tempered because the Quad Cities site is part of the Quad Cities metropolitan area. After construction, the nearby communities would be impacted by the loss of the construction jobs.

Exelon estimates that the new coal-fired plant would have a workforce of approximately 250 (Exelon 2003). If the coal-fired alternative were constructed at the Quad Cities site and Quad Cities Units 1 and 2 were decommissioned, there would be a loss of 600 permanent, high-paying jobs (850 for Quad Cities Units 1 and 2 down to 250 for the coal-fired alternative), along with the loss of 130 contract workers, with a commensurate reduction in demand on socioeconomic resources and contribution to the regional economy. These impacts may be offset because the Quad Cities site is in the Quad Cities metropolitan area. The coal-fired alternative would provide a new tax base to offset the loss of tax base associated with decommissioning of Quad Cities Units 1 and 2. For all of these reasons, the appropriate characterization of non-transportation socioeconomic impacts for operating a coal-fired plant constructed at the Quad Cities site is considered SMALL.

The capital expenditures associated with the new plant would lead to an increase in assessed value and tax revenue that would probably be substantial for several of the taxing bodies associated with Cordova Township. Therefore, this alternative would probably have a positive impact in tax revenues. However, even though these new tax revenues would probably more than replace tax revenues lost upon the decommissioning of the current plant, they would not have more than a SMALL effect in terms of tax-related land use effects.

The impacts of a new coal-fired facility at an alternate site would depend on the socioeconomic characteristics of the new site. If the site were near a large urban center, as the Quad Cities site is, then the impacts would be small. On the other hand, in the GEIS, the staff stated that socioeconomic impacts at a rural site would be larger than at an urban

site, because more of the peak construction workforce would need to move into the area to work (NRC 1996). Alternate sites would therefore need to be analyzed on a case-by-case basis. Socioeconomic impacts from construction of the new site could range from SMALL to LARGE, depending on the characteristics of the surrounding regions. Impacts from operating the facility could range from SMALL to MODERATE, depending on the characteristics of the surrounding regions.

For transportation related to the commuting of plant-operating personnel, the impacts are considered SMALL. The maximum number of plant-operating personnel would be approximately 250 compared to the current permanent workforce of 850 and contract workforce of 130 (Exelon 2003). Therefore, traffic impacts associated with plant personnel commuting to a coal-fired plant would be expected to be SMALL compared to the current impacts from Quad Cities Units 1 and 2. This would hold for both the Quad Cities site and an alternate site.

During the 5-year construction period for the replacement coal-fired units, a large number of construction workers would be working at the site in addition to the workers currently at the Quad Cities site. The addition of these workers could place significant traffic loads on existing highways near either the Quad Cities site or an alternate site. Such impacts would be MODERATE.

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

- **Aesthetics**

The coal-fired power-plant units stand as high as 60 m (200 ft) tall. The exhaust stacks stand as high as 120 to 185 m (400 to 600 ft) tall. These structures would be visible offsite during daylight hours. Buildings and structures would also be visible at night because of outside lighting. Cooling towers would be required (up to 160 m [520 ft] high in the case of natural draft towers and up to 30 m [100 ft] high in the case of mechanical draft towers), and these towers and their associated plumes would also be visible offsite. The Federal Aviation Administration (FAA) generally requires that all structures exceeding an overall height of 61 m (200 ft) above ground level have markings and/or lighting so as not to impair aviation safety (FAA 2000). Visual impacts of buildings and structures could be mitigated by landscaping and color selection that is consistent with the environment. Visual impact at night could be mitigated by reduced use of lighting that meets FAA requirements, and appropriate use of shielding. There would also be impacts from the barge offloading facility

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on the river bluffs. At the Quad Cities site, visual aesthetic impacts are considered MODERATE.

At an alternate site, the aesthetic impacts could be mitigated if the plant were located in an industrial area adjacent to the other power plants. There would also be significant aesthetic impacts from a new transmission line and any rail line needed to deliver coal and lime. Overall, the visual aesthetic impacts associated with a replacement coal-fired power plant at an alternate site are considered MODERATE to LARGE and will depend on the exact location of the alternate site.

Coal-fired generation would introduce mechanical sources of noise that would be audible offsite. Sources contributing to total noise produced by plant operation are classified as continuous or intermittent. Continuous sources include the mechanical equipment associated with normal plant operations. Intermittent sources include the equipment related to coal handling, solid-waste disposal, transportation related to coal and lime/limestone delivery, use of outside loudspeakers, and the commuting of plant employees. Noise impacts associated with rail delivery of coal and lime/limestone at an alternate site would be most significant for residents living in the vicinity of the facility and along the rail route. Although noise from passing trains significantly raises noise levels near the rail corridor, the short duration of the noise reduces its impact. The noise impacts of a coal-fired plant at the Quad Cities site are considered to be MODERATE. At an alternate site, these noise impacts would be SMALL to LARGE, depending on the site. Aesthetic impacts at the plant site would be mitigated if the plant were located in an industrial area adjacent to other power plants or industrial facilities.

• Historic and Archaeological Resources

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

Before construction at the Quad Cities site or an alternate site, studies would likely be needed to identify, evaluate, and address mitigation of the potential impacts of new plant construction on cultural resources. The studies would likely be needed for all areas of potential disturbance at the proposed plant site and along associated corridors where new construction would occur (e.g., roads, transmission corridors, rail lines, or other rights-of-ways). Historic and archaeological resource impacts need to be evaluated on a site-specific basis. The impacts can generally be effectively managed, and as such, impacts would vary

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

- **Environmental Justice**

No environmental pathways or locations have been identified that would result in disproportionately high and adverse environmental impacts on minority and low-income populations if a replacement coal-fired plant were built at the Quad Cities site. Other impacts, such as impacts on housing availability and prices during construction, might occur, and this could disproportionately affect minority and low-income populations. Closure of Quad Cities Units 1 and 2 would result in a decrease in employment of approximately 850 permanent operating employees and 130 contract employees (same as in the no-action case), but this would be partially offset by construction and operation of the replacement power plant. Resulting economic conditions could reduce employment prospects for minority or low-income populations. However, the Quad Cities site is located near an active urban area with many employment possibilities. Overall, impacts would be SMALL and would depend on the ability of minority or low-income populations to commute to other jobs outside the area. The impacts around the alternate site would depend upon the site chosen and the nearby population distribution. These impacts could vary between SMALL and LARGE.

8.2.1.2 Open-Cycle Cooling System

The environmental impacts of constructing a coal-fired generation system at the Quad Cities site using the existing open-cycle cooling system are largely the same as the impacts for a coal-fired plant using a closed-cycle system. However, there are some environmental differences between the closed-cycle and once-through cooling systems. Table 8-3 summarizes the incremental differences.

8.2.2 Natural-Gas-Fired Generation

The environmental impacts of the natural-gas alternative are examined in this section. Unless otherwise indicated, the assumptions and numerical values used in this section are from the Exelon ER (Exelon 2003). The staff reviewed this information and compared it to environmental impact information in the GEIS, as well as other relevant information and sources when appropriate. Although the OL renewal period is only 20 years, the impact of operating the natural gas-fired alternative for 40 years is considered as a reasonable projection of the operating life of a natural gas-fired plant.

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Table 8-3. Summary of Environmental Impacts of Coal-Fired Generation at the Quad Cities Site Using Open-Cycle Cooling

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

The staff assumed that Quad Cities Units 1 and 2 would remain in operation while the natural-gas-fired alternative was constructed. Consistent with the Exelon ER (Exelon 2003), the staff assumed a combined-cycle^(a) natural-gas facility based on three 550-MW(e) combined-cycle units, for a total facility size of 1650 MW(e) (Exelon 2003).^(b) The 550-MW(e) units are a standard size, which would minimize the cost of the new facility. Any shortfall in capacity would be made up from other sources. This assumption understates the environmental impacts of replacing the 1860 MW(e) from Quad Cities Units 1 and 2. As a rough estimate, if a natural-gas-fired plant of exactly 1860 MW(e) were to be built, any numerical impacts in this section, for

(a) In a combined-cycle unit, hot combustion gases in a combustion turbine rotate the turbine to generate electricity. Waste-combustion heat from the combustion turbine is routed through a heat-recovery boiler to make steam to generate additional electricity.

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

example, quantities of air pollutants, might simply be adjusted upward accordingly. However, given these adjustments, the staff has determined that the differences in impacts between 1650 MW(e) and 1860 MW(e) of natural-gas-fired generation would not be significant and would not change the impact levels.

The staff assumed that Quad Cities Units 1 and 2 would remain in operation while the natural-gas-fired alternative was constructed. Consistent with the Exelon ER (Exelon 2003), the staff assumed a combined-cycle^(a) natural-gas facility based on three 550-MW(e) combined-cycle units, for a total facility size of 1650 MW(e) (Exelon 2003).^(b) The 550-MW(e) units are a standard size, which would minimize the cost of the new facility. Any shortfall in capacity would be made up from other sources. This assumption understates the environmental impacts of replacing the 1860 MW(e) from Quad Cities Units 1 and 2. As a rough estimate, if a natural-gas-fired plant of exactly 1860 MW(e) were to be built, any numerical impacts in this section, for example, quantities of air pollutants, might simply be adjusted upward accordingly. However, given these adjustments, the staff has determined that the differences in impacts between 1650 MW(e) and 1860 MW(e) of natural-gas-fired generation would not be significant and would not change the impact levels.

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

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

- Heat Rate: 6120 Btu/kWhr (Exelon 2003)
- Natural Gas Heating Value: 1021 Btu/ft³ (Exelon 2003)

(a) In a combined-cycle unit, hot combustion gases in a combustion turbine rotate the turbine to generate electricity. Waste-combustion heat from the combustion turbine is routed through a heat-recovery boiler to make steam to generate additional electricity.

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

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- Capacity Factor: 0.85 (Exelon 2003)

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

Operation of a new combined-cycle facility at the Quad Cities site would require a new gas line. Exelon estimated that at least six miles of 16-inch gas pipeline would be required (Exelon 2003). Exelon further estimated that this pipeline would require approximately 40 to 49 ha (100 to 120 ac) for an easement (Exelon 2003). The gas line requirements at an alternate site would depend on the characteristics and location of the alternate site.

8.2.2.1 Closed-Cycle Cooling System

For purposes of this SEIS, the staff assumed a natural-gas-fired plant would use a closed-cycle cooling system at the Quad Cities site. The overall impacts of the natural-gas-fired generating system using a closed-cycle cooling system at the Quad Cities site and at an alternate site are discussed in the following sections and summarized in Table 8-4. For completeness, the staff also considered the impacts of a fully open-cycle cooling system at the Quad Cities site, consistent with current practice. Additional impacts from the use of an open-cycle cooling system are considered in Section 8.2.1.2.

• Land Use

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

If the natural-gas-fired facility were built at the Quad Cities site, there would be an additional land requirement to bring in enough gas to supply the combined-cycle facility. Exelon estimated that a minimum of 6 miles of 16-inch gas pipeline would be required (Exelon 2003). Exelon further estimated that this pipeline would require approximately 40 to 49 ha (100 to 120 ac) for an easement (Exelon 2003). Exelon asserts that this would likely be of

only minimal impact, because Exelon would use best management practices during construction, such as minimizing soil loss and restoring vegetation immediately after the excavation is backfilled (Exelon 2003).

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

Regardless of whether the natural-gas facility is built at the Quad Cities site or at an alternate site, additional land could be required for natural gas wells and collection stations. In the GEIS, the staff estimated that approximately 1500 ha (3600 ac) would be needed for a 1000-MW(e) plant (NRC 1996). Proportionately more land would be needed for the 1650- MW(e) facility considered here. Partially offsetting these offsite land requirements would be the elimination of the need for uranium mining to supply fuel for Quad Cities Units 1 and 2. In the GEIS (NRC 1996), the staff estimated that approximately 400 ha (1000 ac) would be affected for mining the uranium and processing it during the operating life of a 1000-MW(e) nuclear power plant.

Overall, the land-use impacts of constructing the natural-gas-fired alternative at the Quad Cities site are considered SMALL to MODERATE. Overall, the land-use impacts of siting the natural-gas-fired alternative at an alternate site would depend on the chosen site, but are characterized as SMALL to LARGE.

• Ecology

Locating a natural-gas-fired plant at the Quad Cities site would alter ecological resources because of the need to convert currently unused land to industrial use for the plant and for building a new natural gas line to the site. Some of this land would have been previously disturbed. Exelon asserts the new gas pipeline would likely be of only minimal impact, because Exelon would use best management practices during construction, such as minimizing soil loss and restoring vegetation immediately after the excavation is backfilled (Exelon 2003). There could be potential onsite habitat degradation, fragmentation or loss, reduced ecological productivity and a reduction in biological diversity, resulting from disturbing previously intact land. Use of a closed-cycle cooling system would limit operational impacts on the aquatic ecosystem, and would reduce the use of water below current levels. Overall, the ecological impacts of the natural gas-fired alternative at the Quad Cities site are considered SMALL to MODERATE.

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

Impact Category	Quad Cities Site		Alternate Site	
	Impact	Comments	Impact	Comments
Land Use	SMALL to MODERATE	Upwards 45 ha (110 ac) for power block, offices, roads, and parking areas. Additional impact for construction of underground gas pipeline.	SMALL to LARGE	Upwards of 45 ha (110 ac) for power block, offices, roads, and parking areas. Additional impact for construction and/or upgrade of an underground gas pipeline, if required, along with any needed transmission lines.
Ecology	SMALL to MODERATE	Would use undeveloped areas at Quad Cities site. There would be potential for significant habitat loss and fragmentation and reduced productivity and biological diversity.	SMALL to LARGE	Impact would depend on whether site is previously developed. Factors to consider include location and ecology of site and transmission line route. There would be potential for habitat loss and fragmentation and reduced productivity and biological diversity.
Water Use and Quality	SMALL	Would use closed-cycle cooling system with natural gas-fired combined cycle units. This would result in a significant reduction in cooling water requirements. The facility would continue very limited groundwater use.	SMALL to MODERATE	Impact would depend on volume of water withdrawal, the constituents of the discharge water, the characteristics of surface water or groundwater source, and the new intakes structures required.

Table 8-4 (contd)

Impact Category	Quad Cities Site		Alternate Site	
	Impact	Comments	Impact	Comments
Air Quality	MODERATE	<p>Sulfur oxides</p> <ul style="list-style-type: none"> • 121 MT/yr (133 tons/yr). <p>Nitrogen oxides</p> <ul style="list-style-type: none"> • 386 MT/yr (426 tons/yr). Actual impact would depend on emissions offsets. <p>Particulates</p> <ul style="list-style-type: none"> • 74 MT/yr (82 tons/yr) PM₁₀ <p>Carbon monoxide</p> <ul style="list-style-type: none"> • 80 MT/yr (88 tons/yr) <p>Other</p> <ul style="list-style-type: none"> • CO₂ emissions contribute to global warming 	MODERATE	Same emissions as Quad Cities site, although offsets for NO _x would depend on location.
Waste	SMALL	Minimal waste product from fuel combination.	SMALL	Same impacts as for Quad Cities site.
Human Health	SMALL	Impacts are considered to be minor.	SMALL	Same impacts as for Quad Cities site.
Socioeconomics	SMALL to MODERATE	<p>During construction, impacts would be SMALL. Peak workforce during two-to-three-year construction period would be significantly smaller than for other steam-generation facilities.</p> <p>During operation, employment would decrease from approximately 1000 permanent and contract workers to less than 100. All employment impacts would be tempered by proximity to Quad Cities metropolitan area. No impact on tax base.</p> <p>Transportation impacts during operation would be SMALL due to the smaller workforce. Transportation impacts associated with construction workers would be SMALL to MODERATE.</p>	SMALL to MODERATE	<p>Construction impacts at alternate site would be similar to those at Quad Cities site, but would depend on whether new site is located near a major metropolitan area.</p> <p>Minimal impacts on local tax base.</p> <p>Transportation impacts would be similar to those at the Quad Cities site.</p>

Alternatives

Table 8-4 (contd)

Impact Category	Quad Cities Site		Alternate Site	
	Impact	Comments	Impact	Comments
1 Aesthetics	MODERATE	SMALL aesthetic impact due to impact of plant buildings and structures, along with noise impacts from plant operation. Visual impact would be similar to current Quad Cities Units 1 and 2.	MODERATE to LARGE	Impact would depend on location. Greatest impact would likely be from the new transmission line(s) that would be needed.
2 Historic and 3 Archaeological 4 Resources	SMALL to MODERATE	Studies would likely be needed to identify, evaluate, and address mitigation of the potential cultural resource impacts from construction of a new plant on an undeveloped or developed site.	SMALL to MODERATE	Alternate location would necessitate cultural studies. Studies would likely be needed to identify, evaluate, and address mitigation of the potential cultural resource impacts from construction of a new plant on an undeveloped site.
5 Environmental 6 Justice	SMALL	No environmental pathways or locations have been identified that would result in disproportionately high and adverse environmental impacts on minority and low-income populations. Impacts on minority and low-income communities should be similar to those experienced by the population as a whole. Any impacts would be tempered by proximity to the Quad Cities metropolitan area.	SMALL to LARGE	Impacts would vary depending on population distribution and characteristics at new site. Impacts on Quad Cities site would be identical to those in the no-action alternative.

At an alternate site, the natural-gas-fired alternative would introduce construction impacts and new incremental operational impacts. Even assuming siting at a previously disturbed area, the impacts may alter the ecology. Impacts could include habitat degradation, fragmentation, or loss, reduced ecological productivity and a reduction in biological diversity.

If needed, construction and maintenance of new transmission lines would have similar ecological impacts. Use of make-up cooling water from a nearby surface water body could have adverse aquatic resource impacts. Overall, the ecological impacts are dependent on whether a site had been previously developed (SMALL to MODERATE) or is an undeveloped greenfield site (MODERATE to LARGE impact).

• **Water Use and Quality**

Each of the natural-gas-fired units would include a heat-recovery boiler from which steam would turn an electric generator. Steam would be condensed and circulated back to the boiler for reuse. Overall, water requirements for combined-cycle generation are much less than for conventional closed-cycle steam-electric generators. The natural-gas-fired alternative at the existing or at an alternate site would use a closed-cycle cooling system with cooling towers and would therefore significantly reduce water needs from what they would otherwise be in an open-cycle configuration. Plant discharges would consist mostly of cooling-tower blowdown, characterized primarily by an increased temperature and increased concentration of dissolved solids relative to the receiving body of water and intermittent low concentrations of biocides (e.g., chlorine). Treated process waste streams and sanitary waste water may also be discharged. All discharges would likely be regulated through a NPDES permit. Some erosion and sedimentation probably would occur during construction (NRC 1996). Use of groundwater for a natural-gas-fired plant at an alternate site is a possibility. At the existing site, the five groundwater wells that supply limited specific uses would continue to be used. Some erosion and sedimentation probably would occur during construction (NRC 1996). Overall, the impacts of the natural-gas-fired alternative at the Quad Cities site are considered SMALL. Overall, the impacts at an alternate site are considered SMALL to MODERATE.

• **Air Quality**

Natural gas is a relatively clean-burning fuel. The natural-gas-fired alternative would release similar types of emissions, but in lesser quantities, than the coal-fired alternative. Hence, it would be subject to the same type of air quality regulations as a coal-fired plant, discussed in Section 8.2.1.1. The greatest concern from combined-cycle facilities are the emissions of ozone precursors, NO_x and VOCs.

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

- Sulfur oxides – 121 MT/yr (133 tons/yr)
- Nitrogen oxides – 386 MT/yr (426 tons/yr)
- Carbon monoxide – 80 MT/yr (88 tons/yr)
- PM₁₀ particulates – 67 MT/yr (74 tons/yr)
- VOC – 74 MT/yr (82 tons/yr)

A combined-cycle facility would also have unregulated CO₂ emissions that could contribute to global warming. While these emissions have not traditionally been an important environmental concern, they are becoming increasingly relevant at both a national and an international level.

Alternatives

1 In December 2000, the EPA issued regulatory findings on emissions of hazardous air
2 pollutants from electric utility steam-generating units (65 FR 79825 [EPA 2000b]). Natural-
3 gas-fired power plants were found by the EPA to emit arsenic, formaldehyde, and nickel (65
4 FR 79825 [EPA 2000b]). Unlike coal- and oil-fired plants, the EPA did not determine that
5 emissions of hazardous air pollutants from natural-gas-fired power plants should be
6 regulated under Section 112 of the CAA.

7
8 Construction activities would result in temporary fugitive dust. Exhaust emissions would
9 also come from vehicles and motorized equipment used during the construction process.

10
11 The preceding emissions would likely be the same at the Quad Cities site or at the
12 alternate site. Impacts from the above emissions would be clearly noticeable, but they
13 would not be sufficient to destabilize air resources as a whole. The overall air-quality impact
14 for a new natural-gas-fired generating facility sited at the Quad Cities site or at an alternate
15 site is considered MODERATE.

16 17 • Waste

18
19 Natural gas firing results in very few combustion by-products because of the clean nature of
20 the fuel. There will be small amounts of solid-waste products (i.e., ash) from burning
21 natural-gas fuel. In the GEIS, the staff concluded that waste generation from natural-gas-
22 fired technology would be minimal (NRC 1996). Waste generation at an operating natural-
23 gas-fired plant would be largely limited to typical office wastes. Construction-related debris
24 would be generated during construction activities. Overall, the waste impacts would be
25 SMALL for a natural-gas-fired plant sited at the Quad Cities site or at an alternate site.

26 27 • Human Health

28
29 In the GEIS, the staff identifies cancer and emphysema as potential health risks from
30 natural-gas-fired plants (NRC 1996). The risk may be attributable to NO_x emissions that
31 contribute to ozone formation, which in turn contributes to health risks. NO_x emissions from
32 the plant would be regulated. As discussed in Section 8.2.1.1, NO_x emissions for a new
33 combined-cycle plant at the Quad Cities site would be offset through the Emissions
34 Reduction Trading Program. Human-health effects are not expected to be detectable or
35 would be sufficiently minor that they would neither destabilize nor noticeably alter any
36 important attribute of the resource. Overall, the impacts on human health of the natural-
37 gas-fired alternative at the Quad Cities site or at an alternate site are considered SMALL.

• **Socioeconomics**

Construction of a natural-gas-combined facility at the Quad Cities site would take approximately 2 to 3 years. The staff assumed that construction would take place while Quad Cities Units 1 and 2 continued operation and would be completed by the time the units permanently ceased operations. In the GEIS (NRC 1996), the staff concluded that socioeconomic impacts from constructing a natural-gas-fired power plant would be low compared to other steam plants.

If the facility were constructed at the Quad Cities site, the number of construction workers would be in addition to the 850 permanent employees and approximately 130 contract workers that currently work at the Quad Cities site. During construction, the communities immediately surrounding the Quad Cities site would experience demands on housing and public services that would have SMALL impacts. These impacts would be tempered because construction workers would be commuting to the site from a wider range of cities and towns comprising the Quad Cities metropolitan area. After construction, the nearby communities would be impacted by the loss of the construction jobs.

The capital expenditures associated with the new plant would lead to an increase in assessed value and tax revenue that would probably be substantial for several of the small taxing bodies associated with the Cordova Township. Therefore, this alternative would probably have a positive impact in tax revenues. However, even though these new tax revenues would probably more than replace tax revenues lost upon the decommissioning of the current plant, they would not have more than a SMALL effect in terms of tax-related land use effects.

Exelon estimates that the new combined-cycle facility would have a workforce of approximately 25 to 40 (Exelon 2003), significantly less than the 150 assumed in the GEIS for a 1000-MW(e) natural-gas facility. Assuming a workforce of approximately 50 workers, if the combined-cycle facility were constructed at the Quad Cities site and Quad Cities Units 1 and 2 were decommissioned, there would be a loss of 800 permanent, high-paying jobs (850 for Quad Cities Units 1 and 2 down to 50 for the natural-gas alternative), along with the loss of 130 contract workers, with a commensurate reduction in demand on socioeconomic resources and contribution to the regional economy. These impacts would be tempered because the Quad Cities site is within the Quad Cities metropolitan area. The natural-gas alternative would provide a new tax base to offset the loss of tax base associated with the decommissioning of Quad Cities Units 1 and 2. For all these reasons, the appropriate characterization of non-transportation socioeconomic impacts for operating a natural-gas plant constructed at the Quad Cities site is considered SMALL.

Alternatives

1 If the alternative natural-gas-fired power plant were constructed at an alternate site, impacts
2 would depend on the socioeconomic characteristics of the new site. If the site were near a
3 large urban center, as the Quad Cities site is, then the impacts would be small. On the
4 other hand, socioeconomic impacts at a rural site would be larger than at an urban site,
5 because more of the peak construction workforce would need to move into the area to work
6 (NRC 1996). Alternate sites would therefore need to be analyzed on a case-by-case basis.
7 Socioeconomic impacts from construction of the new site could range from SMALL to
8 MODERATE, depending on the characteristics of the surrounding regions. Impacts from
9 operating the facility would likely be SMALL.

10
11 For transportation related to commuting of plant operating personnel, the impacts are
12 considered small. The number of plant operating personnel would be small compared to
13 the current workforce of 850 (Exelon 2003). Therefore, traffic impacts associated with plant
14 personnel commuting to a natural-gas plant would be expected to be SMALL compared to
15 the current impacts from Quad Cities Units 1 and 2. This would exist for both the Quad
16 Cities site and an alternate site.

17
18 During the construction period for the replacement natural-gas-fired units, a significant
19 number of construction workers would be working on the site, in addition to the 850
20 permanent and 130 contract workers currently at the Quad Cities site. The addition of these
21 workers could place significant traffic loads on existing highways near the Quad Cities site.
22 Such impacts would be SMALL to MODERATE. At an alternate site, such impacts are also
23 considered SMALL to MODERATE.

• Aesthetics

24
25
26
27 The turbine buildings, the exhaust stacks (approximately 60 m [200 ft] tall), and the gas
28 pipeline compressors would be visible from offsite during daylight hours. Buildings and
29 structures would also be visible at night because of outside lighting. Cooling towers would
30 be required and these towers and their associated plumes would also be visible offsite.
31 Visual impacts of buildings and structures could be mitigated by landscaping and selecting a
32 color that is consistent with the environment. Visual impacts at night could be mitigated by
33 reduced use of lighting and appropriate use of shielding. At the Quad Cities site, visual
34 aesthetic impacts of a natural gas combined-cycle facility are considered MODERATE. At
35 an alternate site, the aesthetic impacts could be mitigated if the plant were located in an
36 industrial area adjacent to other industrial plants. There would also be significant aesthetic
37 impact from a new transmission line. Overall, the aesthetic impacts associated with a
38 replacement natural-gas-fired power plant at an alternate site are considered MODERATE
39 to LARGE and will depend on the exact location of the alternate site.
40

Natural-gas generation would introduce mechanical sources of noise that would be audible offsite. Sources contributing to total noise produced by plant operation are classified as continuous or intermittent. Continuous sources include the mechanical equipment associated with normal plant operations. Intermittent sources include the use of outside loudspeakers, and the commuting of plant employees. The incremental noise impacts of a natural-gas-fired plant compared to existing operations at the Quad Cities are considered MODERATE. At an alternate site, these noise impacts would be SMALL to LARGE, depending on the site and location. Again, the aesthetic impacts at the plant site would be mitigated if the plant were located in an industrial area adjacent to other power plants or industrial facilities.

- **Historic and Archaeological Resources**

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

Before construction at the Quad Cities site or an alternate site, studies would likely be needed to identify, evaluate, and address mitigation of the potential impacts of new plant construction on cultural resources. The studies would likely be needed for all areas of potential disturbance at the proposed plant site and along associated corridors where new construction would occur (e.g., roads, transmission corridors, rail lines, or other rights-of-ways). Historic and archaeological resource impacts need to be evaluated on a site-specific basis. The impacts can generally be effectively managed, and as such, impacts would vary between SMALL to MODERATE, depending on what historic and archaeological resources are present, and whether mitigation is necessary.

- **Environmental Justice**

No environmental pathways or locations have been identified that would result in disproportionately high and adverse environmental impacts on minority and low-income populations if a replacement natural-gas-fired plant were built at the Quad Cities site. Other impacts, such as impacts on housing availability and prices during construction, might occur, and this could disproportionately affect minority and low-income populations. Closure of Quad Cities Units 1 and 2 would result in a decrease in employment of approximately 850 permanent operating employees and 130 contract employees (same as in the no-action case), offset by construction and operation of the replacement power plant. Resulting economic conditions could reduce employment prospects for minority or low-

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income populations. However, the Quad Cities site is located near an active urban area with many employment possibilities. Overall impacts are expected to be SMALL, and would depend on the ability of minority or low-income populations to commute to other jobs outside the area. The impacts around the alternate site would depend upon the site chosen and the nearby population distribution. These impacts could vary between SMALL and LARGE.

8.2.2.2 Open-Cycle Cooling System

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

Table 8-5. Summary of Environmental Impacts of Natural-Gas-Fired Generation at the Quad Cities Site Using Open-Cycle Cooling

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

8.2.3 Nuclear Power Generation

This section considers construction of a new nuclear power plant at the Quad Cities site and at an alternate site. The staff assumed that the new nuclear plant would have a 40-year lifetime.

The NRC summarized environmental data associated with the uranium fuel cycle in Table S-3 of 10 CFR 51.51. The impacts shown in Table S-3 are representative of the impacts that would be associated with a replacement nuclear power plant built to one of the certified designs, sited at Quad Cities or an alternate site. The impacts shown in Table S-3 are for a 1000-MW(e) reactor and would need to be adjusted to reflect replacement of Quad Cities Units 1 and 2, which have a net capacity of 1860 MW(e). The environmental impacts associated with transporting fuel and waste to and from a light-water cooled nuclear power reactor are summarized in Table S-4 of 10 CFR 51.52. The summary of the NRC's findings on NEPA issues for license renewal of nuclear power plants in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, is also relevant, although not directly applicable, for consideration of environmental impacts associated with the operation of a replacement nuclear power plant. Additional environmental impact information for a replacement nuclear power plant using a closed-cycle cooling is presented in Section 8.2.3.1 and using open-cycle cooling in Section 8.2.3.2.

8.2.3.1 Closed-Cycle Cooling System

For purposes of this SEIS, the staff assumed a nuclear plant would use a closed-cycle cooling system at the Quad Cities site. The overall impacts of the nuclear generating system using closed-cycle cooling at the Quad Cities site and at an alternate site are discussed in the following sections and summarized in Table 8-6. For completeness, the staff also considered the impacts of a fully open-cycle cooling system at the Quad Cities site. Additional impacts from the use of an open-cycle cooling system are considered in Section 8.2.1.2.

- **Land Use**

According to the GEIS, a light-water reactor requires approximately 200 to 400 ha (500 to 1000 ac) excluding transmission lines. Exelon believes that the Quad Cities site is adequate to support a new nuclear facility. However, to support a new nuclear facility at the Quad Cities site, it may be necessary to supplement the site with neighboring land. For siting a new facility, the existing infrastructure would be used to the extent practicable, thus limiting the amount of new construction that would be required. Specifically, the staff assumed that the new nuclear facility would use the existing switchyard, offices, intake and discharge, and transmission rights-of-ways.

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1 There would be no net change in land needed for uranium mining because land needed to
2 supply the new nuclear plant would offset the land needed to supply uranium for fueling the
3 existing reactors at Quad Cities Units 1 and 2. Overall, the impact of a replacement
4 nuclear generating plant on land use at the existing Quad Cities site is best characterized
5 as MODERATE.

6
7 Land-use requirements at an alternate site would be approximately 200 to 400 ha
8 (500 to 1000 ac) plus the possible need for land for a new transmission line (NRC 1996).
9 In addition, it may be necessary to construct a rail spur or barge offloading facility to an
10 alternate site to deliver equipment during construction. Depending on new transmission-
11 line routing, siting a new nuclear power plant at an alternate site could result in
12 MODERATE to LARGE land-use impacts.

13 14 • Ecology

15
16 Locating a new nuclear power plant at the Quad Cities site would alter ecological resources
17 because of the need to convert currently unused land to industrial use. However, some of
18 this land would have been previously disturbed. Use of a closed-cycle cooling system
19 would reduce water needs below their current levels. There could be potential habitat
20 degradation, fragmentation or loss, reduced ecological productivity and a reduction in
21 biological diversity resulting from disturbing previously intact land. Siting a new nuclear
22 power plant at the Quad Cities site would have a SMALL to MODERATE ecological impact
23 that would be greater than renewal of the OLS due to the construction impacts.

24
25 At an alternate site, the new nuclear power alternative would introduce construction
26 impacts and comparable operational impacts. Even assuming siting at a previously
27 disturbed area, the impacts may alter the ecology. Impacts could include habitat
28 degradation, fragmentation, or loss, reduced ecological productivity and a reduction in
29 biological diversity. If needed, construction and maintenance of a transmission line would
30 have similar ecological impacts. Overall, the ecological impacts are dependent on whether
31 a site had been previously developed (MODERATE) or is an undeveloped greenfield site
32 (MODERATE to LARGE impact).

33 34 • Water Use and Quality

35
36 The nuclear alternative at the existing site or at an alternate site would use a closed-cycle
37 cooling system instead of the current practice of using open-cycle cooling, and would
38 therefore decrease cooling-water needs.

Table 8-6. Summary of Environmental Impacts of New Nuclear Power Generation at the Quad Cities site and an Alternate Site Using Closed-Cycle Cooling

Impact Category	Quad Cities Site		Alternate Site	
	Impact	Comments	Impact	Comments
Land Use	MODERATE	Would use unused portion of Quad Cities site, possibly supplemented with neighboring land. Would require approximately 200 to 400 ha (500 to 1000 ac). Existing infrastructure (e.g., transmission lines) used.	MODERATE to LARGE	Same as Quad Cities site, plus land for transmission line and any existing infrastructure. Total impact would depend on whether the alternate site is previously disturbed.
Ecology	SMALL to MODERATE	Would use undeveloped areas at Quad Cities site. There would be potential for significant habitat loss and fragmentation and reduced productivity and biological diversity.	MODERATE to LARGE	Impact would depend on whether site is previously developed. Factors to consider include location and ecology of site and transmission line route. There would be potential for habitat loss and fragmentation and reduced productivity and biological diversity.
Water Use and Quality	SMALL	Would use closed-cycle cooling system, reducing cooling water requirements while increasing evaporative, consumptive use and new heat rejection to the atmosphere, and continues very limited groundwater use.	SMALL to MODERATE	Impact would depend on volume of water withdrawal, the constituents of the discharge water, and the characteristics of surface water or groundwater source.
Air Quality	SMALL	Fugitive emissions and emissions from vehicles and equipment during construction. Small amount of emissions from diesel generators and possibly other sources during operation. Emissions would be similar to current releases at Quad Cities Units 1 and 2.	SMALL	Same impacts as at Quad Cities.
Waste	SMALL	Waste impacts for an operating nuclear power plant are set out in 10 CFR Part 51, Appendix B, Table B-1. Debris would be generated and removed during construction.	SMALL	Same impacts as at Quad Cities.

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Table 8-6 (contd)

Impact Category	Quad Cities Site		Alternate Site	
	Impact	Comments	Impact	Comments
Human Health	SMALL	Human-health impacts for an operating nuclear power plant are set out in 10 CFR Part 51, Appendix B, Table B-1.	SMALL	Same impacts as for Quad Cities site.
Socioeconomics	SMALL to MODERATE	<p>During construction, impacts would be SMALL to MODERATE. Upwards of 2500 workers might be required at peak of the five-year construction period.</p> <p>During operation, employment would be similar to current employment. Tax base would be preserved.</p> <p>Transportation impacts during operation would be SMALL due to the smaller workforce. Transportation impacts associated with construction workers would be SMALL to MODERATE.</p>	SMALL to LARGE	<p>Construction impacts at alternate site would be similar to those at Quad Cities site, but would depend on whether new site is located near a major metropolitan area.</p> <p>Minimal impacts on local tax base.</p> <p>Transportation impacts would be similar to those at the Quad Cities site.</p>
Aesthetics	MODERATE	MODERATE aesthetic impact due to impact of plant buildings and structures, along with noise impacts from plant operation. Visual impact would be similar to current Quad Cities Units 1 and 2.	MODERATE to LARGE	Impacts would be similar to those at Quad Cities site, but would also include any aesthetic impacts from building new transmission lines.
Historic and Archaeological Resources	SMALL to MODERATE	Studies would likely be needed to identify, evaluate, and address mitigation of the potential cultural resource impacts from construction of a new plant on an undeveloped or developed site.	SMALL to MODERATE	Alternate location would necessitate cultural studies. Studies would likely be needed to identify, evaluate, and address mitigation of the potential cultural resource impacts from construction of a new plant on an undeveloped site.

Table 8-6 (contd)

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

Plant discharges would consist mostly of cooling- tower blowdown, characterized primarily by an increased temperature and increased concentration of dissolved salts relative to the receiving body of water and intermittent low concentrations of biocides (e.g., chlorine). Treated process waste streams and sanitary waste water may also be discharged. All discharges would likely be regulated through a NPDES permit. The five groundwater wells that supply limited specific uses at the Quad Cities site could continue to be used. Some erosion and sedimentation probably would occur during construction (NRC 1996). At an alternate site, the cooling water would likely be drawn from a surface body of water. Use of groundwater for a nuclear plant at an alternate site is a possibility. Some erosion and sedimentation probably would occur during construction (NRC 1996). Overall, the impacts of the nuclear alternative at the Quad Cities site are considered SMALL. Overall, the impacts at an alternate site are considered SMALL to MODERATE depending on the location.

• **Air Quality**

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

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• Waste

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

• Human Health

Human-health impacts for an operating nuclear power plant are set out in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. Overall, human-health impacts are considered SMALL at either the Quad Cities site or at an alternate site.

• Socioeconomics

The construction period and the peak workforce associated with the construction of a new nuclear power plant are currently unquantified (NRC 1996). In the absence of quantified data, the staff assumed a construction period of 5 years and a peak workforce of 2500. The staff assumed that construction would take place while Quad Cities Units 1 and 2 continues operation and would be completed by the time Quad Cities Units 1 and 2 permanently cease operations.

If the facility were constructed at the Quad Cities site, the number of construction workers would be in addition to the 850 permanent employees and approximately 130 contract workers that currently work at the Quad Cities site. During construction of the new nuclear power plant, the surrounding communities would experience demands on housing and public services that could have MODERATE impacts. These impacts would be tempered because the Quad Cities site is part of the Quad Cities metropolitan area. After construction, the nearby communities would be impacted by the loss of the construction jobs.

The replacement nuclear units are assumed to have an operating workforce comparable to the approximately 1000 workers currently working at Quad Cities Units 1 and 2. The new nuclear power plant alternative would provide a new tax base to offset the loss of tax base associated with decommissioning Quad Cities Units 1 and 2. For all these reasons, the appropriate characterization of non-transportation socioeconomic impacts for operating a new nuclear power plant constructed at the Quad Cities site is considered SMALL.

The capital expenditures associated with the new plant would lead to an increase in assessed value and tax revenue that would probably be substantial for several of the small

taxing bodies in the Cordova Township. Therefore, this alternative would probably have a positive impact in tax revenues. However, even though these new tax revenues would probably more than replace tax revenues lost upon the decommissioning of the current plant, they would not have more than a SMALL effect in terms of tax-related land use effects.

The impacts around the alternate site would depend on the socioeconomic characteristics of the new site. If the site were near a large urban center, as the Quad Cities site is, then the impacts would be SMALL. On the other hand, in the GEIS, the staff stated that the socioeconomic impacts at a rural site would be larger than at an urban site, because more of the peak construction workforce would need to move into the area to work (NRC 1996). Alternate sites would therefore need to be analyzed on a case-by-case basis. Socioeconomic impacts from construction of the new site could range from SMALL to LARGE, depending on the characteristics of the surrounding regions.

For transportation related to commuting of plant-operating personnel, the impacts are considered small. The number of personnel would be similar to the number currently working at the Quad Cities site. Therefore, traffic impacts associated with plant personnel commuting to a new nuclear power plant would expected to be SMALL compared to the current impacts from Quad Cities Units 1 and 2. This would hold for both the Quad Cities site and an alternate site.

During the 5-year construction period for the replacement new nuclear power plant, a large number of construction workers would be working at the site, in addition to the workers currently at the Quad Cities site. The addition of these workers could place significant traffic loads on existing highways near either the Quad Cities site or an alternate site. Such impacts would be MODERATE.

- **Aesthetics**

The containment buildings and other associated buildings required for a replacement nuclear power plant sited at Quad Cities would be visible in daylight hours. Buildings and structures would also be visible at night because of outside lighting. Cooling towers would be required and these towers and their associated plumes would also be visible offsite. Visual impacts of buildings and structures could be mitigated by landscaping and selecting a color that is consistent with the environment. Visual impact at night could be mitigated by reduced use of lighting and appropriate use of shielding. At the Quad Cities site, visual aesthetic impacts are considered MODERATE. At an alternate site, the aesthetic impacts could be mitigated if the plant were located in an industrial area adjacent to other power plants. There would also be significant aesthetic impacts from a new transmission line. Overall, the aesthetic impacts associated with a replacement nuclear-fired power plant at an

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1 alternate site are considered MODERATE to LARGE and will depend on the exact location
2 of the alternate site.

3
4 Nuclear generation would introduce mechanical sources of noise that would be audible
5 offsite. Sources contributing to total noise produced by plant operation are classified as
6 continuous or intermittent. Continuous sources include the mechanical equipment
7 associated with normal plant operations. Intermittent sources include the use of outside
8 loudspeakers and the commuting of plant employees. The incremental noise impacts of a
9 nuclear-fired plant compared to existing operations at the Quad Cities site are considered to
10 be MODERATE. At an alternate site, these noise impacts would be SMALL to LARGE,
11 depending on the site. Again, aesthetic impacts at the plant site would be mitigated if the
12 plant were located in an industrial area adjacent to other power plants or industrial facilities.
13

14 • Historic and Archaeological Resources

15
16 At the Quad Cities site or an alternate site, a cultural-resource inventory would likely be
17 needed for any on-site property that has not been previously surveyed. Other lands, if any,
18 that are acquired to support the plant would also likely need an inventory of field cultural
19 resources, identification, and recording of existing historic and archaeological resources,
20 and possible mitigation of adverse effects from subsequent ground-disturbing actions
21 related to physical expansion of the plant site.
22

23 Before construction at the Quad Cities site or an alternate site, studies would likely be
24 needed to identify, evaluate, and address mitigation of the potential impacts of new plant
25 construction on cultural resources. The studies would likely be needed for all areas of
26 potential disturbance at the proposed plant site and along associated corridors where new
27 construction would occur (e.g., roads, transmission corridors, rail lines, or other rights-of-
28 ways). Historic and archaeological resource impacts need to be evaluated on a site-specific
29 basis. The impacts can generally be effectively managed, and as such, impacts would vary
30 between SMALL to MODERATE, depending on what historic and archaeological resources
31 are present, and whether mitigation is necessary.
32

33 • Environmental Justice

34
35 No environmental pathways or locations have been identified that would result in
36 disproportionately high and adverse environmental impacts on minority and low-income
37 populations if a new nuclear power plant were built at the Quad Cities site. Other impacts,
38 such as impacts on housing availability and prices during construction, might occur during
39 construction, and this could disproportionately affect minority and low-income populations.
40 Closure of Quad Cities Units 1 and 2 would result in a decrease in employment of
41 approximately 850 permanent operating employees and 130 contract employees (same as

in the no-action case), but this would be offset by construction and operation of the replacement power plant. Resulting economic conditions could reduce employment prospects for minority or low-income populations. However, the Quad Cities site is located near an active urban area with many employment possibilities. Overall, impacts would be SMALL, and would depend on the ability of minority or low income populations to commute to other jobs outside the area. The impacts around the alternate site would depend upon the site chosen and the nearby population distribution. These impacts could vary between SMALL and LARGE.

8.2.3.2 Open-Cycle Cooling System

The environmental impacts of constructing a nuclear generation system at the Quad Cities site using an open-cycle cooling system are largely the same as the impacts for a nuclear generation system using a closed-cycle and once-through cooling systems. Table 8-7 summarizes the incremental differences. This section discusses the environmental impacts of constructing a nuclear power plant at an alternate site using closed-cycle cooling. The impacts of this option are essentially the same as the impacts for a nuclear power plant using once-through cooling. However, there are minor environmental differences between the closed-cycle and once-through cooling systems. Table 8-7 summarizes the incremental differences.

8.2.4 Purchased Electrical Power

This section considers the option of Exelon decommissioning Quad Cities Units 1 and 2, not replacing the lost generation with a new power plant or other option, and then purchasing an equal amount of power and capacity to replace that generated by Quad Cities Units 1 and 2. There are two possibilities for the source of this power. It could come from facilities that are already built but not producing power. Alternatively, it could come from new generation facilities. The likely outcome would be a combination of both sources. Initially, replacement power would come from existing sources. Under normal economic conditions, this will raise the price of capacity and energy because supply will be lowered while demand will remain the same. Over time, this increase in price will spur new generation capacity to take advantage of the new opportunities for profit. In this case, the new generation could be attributed to a mix of sources, most likely natural gas and coal-fired generation, which were discussed above. If there were significant excess supply in the U.S., then it might be the case that no new generation would be brought online to replace the lower supply. No such excess supply condition exists in the Eastern Grid, of which Illinois is a part.

Alternatives

Table 8-7. Summary of Environmental Impacts of a New Nuclear Power Plant at Quad Cities Site Using Open-Cycle Cooling

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

According to DOE/EIA, in 2001, the reserve margin^(a) in the Eastern Grid was 13.9 percent in 2001, well below the traditional levels of 25 to 30 percent (DOE/EIA 2003b). No such excess supply condition exists in the Eastern Grid, of which Illinois is a part. According to DOE/EIA, in 2001, the reserve margin in the Eastern Grid was 13.9 percent in 2001, well below the traditional levels of 25 to 30 percent (DOE/EIA 2003b).

In a traditional regulated utility environment, utilities manage all portions of the utility system from generation to transmission to distribution. In this environment, utilities buy and sell power from other utilities to make up for any shortfalls in demand or excess of generation capacity.

(a) The reserve margin is defined as excess available capacity as a fraction of total demand at a given time.

1 However, Illinois, like many states, has altered the regulation of their electric utilities so that
2 generation is decoupled from transmission and distribution. Generators sell power and energy
3 as commodities. While Exelon holds both generation and distribution companies, these
4 companies are not linked in the traditional fashion—Exelon generation can sell to any distributor
5 and Exelon distribution can purchase from any generator. Exelon's generating arm could
6 purchase and then sell the electricity, but this would not change supply or demand, it would
7 simply add a middle-man in the electricity market.

8
9 For these reasons, the staff does not believe that purchasing power to make up for the
10 generation at Quad Cities Units 1 and 2 is a meaningful alternative that requires independent
11 analysis. Any impacts from purchasing power in the open market will follow those of the
12 generation sources that end up supplying the power, which are covered in other sections in this
13 chapter.

14 15 **8.2.5 Other Alternatives**

16
17 Other generation technologies considered by the NRC are discussed in the following
18 subsections. The staff felt that none of these options alone was sufficient to replace the
19 capacity and energy of Quad Cities Units 1 and 2. However, such alternatives might be used in
20 combination, as is discussed in Section 8.2.6.

21 22 **8.2.5.1 Oil-Fired Generation**

23
24 The EIA projects that oil-fired plants will account for very little of the new generation capacity in
25 the United States through the year 2020 because of higher fuel costs and lower efficiencies
26 (DOE/EIA 2001a). Oil-fired operation is more expensive than nuclear or coal-fired operation.
27 Future increases in oil prices are expected to make oil-fired generation increasingly more
28 expensive than coal-fired generation. The high cost of oil has prompted a steady decline in its
29 use for electricity generation. Increasing domestic concerns over oil security will only
30 exacerbate the move away from oil-fired electricity generation. Therefore, the staff does not
31 consider oil-fired generation, by itself, a feasible alternative to Quad Cities Units 1 and 2.

32 33 **8.2.5.2 Wind Power**

34
35 According to the DOE (2003), Illinois has a capacity of approximately 3000 MW(e) of Class 4
36 wind sites. In addition, there are 6000 MW(e) of Class 3+ sites. Class 3+ sites might prove
37 economically viable for wind generation with near-term technological advances. Wind power
38 plants typically run at capacity factors of 30 to 35 percent (Northwest Power Planning Council
39 [WPPC] 2000). These capacity factors are much lower than those for a nuclear power plant,
40 which commonly run above 90 percent. Therefore, approximately 4200 to 4900 MW(e) would
41 have to be developed to make up for the approximately 13 billion kWh(e) generated by Quad

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1 Cities Units 1 and 2 in 2001 (DOE/EIA 2003c). Because the largest, commercially available
2 wind turbines are in the range of 1 MW to 1.5 MW, approximately 2800 to 4900 of these
3 turbines would be required to replace the generation from Quad Cities Units 1 and 2.
4

5 Although the wind resource in Illinois, in theory, is sufficient to support replacement of the
6 capacity and energy from Quad Cities Units 1 and 2, many difficulties render full replacement a
7 problematic option. For one, the vast bulk of the wind resource would have to be developed;
8 and this development would be an enormously extensive undertaking, especially when one
9 considers that total wind power capacity in the United States at the end of 2002 was
10 approximately 4500 MW(e). Although wind power production in the United States is expected
11 to grow many times over the coming decades, installation of approximately 4200 MW(e) to
12 4900 MW(e) in the midwest to replace the generation from Quad Cities Units 1 and 2 would
13 require approximately near-term doubling of current U.S. wind generation capacity. Further,
14 access to many of the best wind power sites would require easements, extensive road building
15 and, potentially, extensive clearing (for towers and blades). Construction of thousands of wind
16 turbines in Illinois would also require extensive construction of transmission lines to bring the
17 power and the energy to market. Wind energy is an intermittent resource, whereas Quad Cities
18 Units 1 and 2 provide constant baseload power. When there is little wind, wind energy simply
19 would not compensate for Quad Cities Units 1 and 2 energy production. For all these reasons,
20 the staff concludes that wind power alone is not a feasible substitute at this time for the
21 baseload generation from Quad Cities Units 1 and 2.
22

23 8.2.5.3 Solar Power

24
25 Solar technologies use the sun's energy and light to provide heat and cooling, light, hot water,
26 and electricity for homes, businesses, and industry. Solar-power technologies, both
27 photovoltaic and thermal, cannot currently compete with conventional fossil-fueled technologies
28 in grid-connected applications due to higher capital costs per kilowatt of capacity. The average
29 capacity factor of photovoltaic cells is about 25 percent (NRC 1996), and the capacity factor for
30 solar thermal systems is about 25 to 40 percent (NRC 1996). These capacity factors are low
31 because solar power is an intermittent resource, providing power when the sun is strong,
32 whereas Quad Cities Units 1 and 2 provide constant base-load power. Solar technologies
33 simply cannot make up for the capacity from Quad Cities Units 1 and 2 when the sun is not
34 shining.
35

36 There are substantial impacts to natural resources (ecological, land-use, and aesthetic impacts)
37 from the construction of solar-generating facilities. As stated in the GEIS, land requirements
38 are high—140 km² (55 mi²) per 1000 MW(e) for photovoltaic and approximately 57 km²
39 (22 mi²) per 1000 MW(e) for solar thermal systems (NRC 1996). Neither type of solar electric
40 system would fit at the Quad Cities site, and both would have large environmental impacts at an
41 alternate site.

Currently available photovoltaic (PV) cell conversion efficiencies range from approximately 7 to 17 percent. The average solar energy falling on a horizontal surface in the Illinois region in June, a peak month for sunlight, is approximately 6.0 to 6.5 kWh/m² per day. If an average solar energy flux throughout the year of approximately 3 kWh/m² per day (Exelon 2003) and a conversion efficiency of 10 percent are assumed, PV cells would yield an annual electricity production of approximately 110 kWh(e)/m² per year in Illinois. At this assumed rate of generation, replacing the 13 billion kWh generated in 2001 by Quad Cities Units 1 and 2 (DOE/EIA 2003c) would require approximately 120 million m² or 120 km² (46 mi²) of PV arrays. Because of the area's low rate of solar radiation, the high technology costs, and the intermittent nature of the resource, solar power is limited to niche applications and is not a feasible baseload alternative to license renewal of Quad Cities Units 1 and 2.

8.2.5.4 Hydropower

Less than 0.1 percent of Illinois electricity-generating capacity and its electricity generation come from hydroelectric power (DOE/EIA 2003a). As stated in Section 8.3.4 of the GEIS, hydropower's percentage of the country's generating capacity is expected to decline because hydroelectric facilities have become difficult to site as a result of public concern over flooding, destruction of natural habitat, and alteration of natural river courses. According to the U.S. Hydropower Resource Assessment for Illinois (INEEL 1997), there is only 301 MW of undeveloped hydroelectric capacity in Illinois, far below that required to replace the 1860 MW(e) of Quad Cities Units 1 and 2.

The staff estimated in the GEIS that land requirements for hydroelectric power are approximately 400,000 ha (1 million ac or approximately 1600 mi²) per 1000 MW(e). This requirement would need to be adjusted proportionately upward to meet the requirements of Quad Cities Units 1 and 2. This would result in a large impact on land use, most of which would be out of state because of Illinois' limited hydroelectric potential. Further, operation of a hydroelectric facility would alter aquatic habitats above and below the lock and dam, which would impact existing aquatic species. Due to the relatively low amount of undeveloped hydropower resource in Illinois and the large land-use and related environmental and ecological resource impacts associated with siting hydroelectric facilities large enough to replace Quad Cities Units 1 and 2, the staff concludes that local hydropower is not a feasible alternative to Quad Cities Units 1 and 2 OL renewal.

8.2.5.5 Geothermal Energy

Geothermal energy has an average capacity factor of 90 percent and can be used for base-load power where available. However, geothermal technology is not widely used as base-load generation due to the limited geographical availability of the resource and the immature status of the technology (NRC 1996). As illustrated by Figure 8.4 in the GEIS, geothermal plants are

Alternatives

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

8.2.5.6 Wood Waste

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

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

8.2.5.7 Municipal Solid Waste

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

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

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

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

Currently, there are approximately 102 waste-to-energy plants operating in the United States. These plants generate approximately 2800 MW(e), or an average of approximately 28 MW(e) per plant (Integrated Waste Services Association 2001), much smaller than the amount needed to replace the 1826-MW(e) base-load capacity of Quad Cities Units 1 and 2. Therefore, the staff concludes that municipal solid waste would not be a feasible alternative to renewal of the Quad Cities Units 1 and 2 OLS, particularly at the scale required.

8.2.5.8 Other Biomass-Derived Fuels

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

8.2.5.9 Fuel Cells

Fuel cells work without combustion and its local environmental side effects. Power is produced electrochemically by passing a hydrogen-rich fuel over an anode and air over a cathode and separating the two by an electrolyte. The only by-products are heat, water, and carbon dioxide. Hydrogen fuel can come from a variety of hydrocarbon resources by subjecting them to steam under pressure. It can also be produced from electricity using electrolysis. Phosphoric acid fuel cells are the most mature fuel cell technology, but they are only in the initial stages of commercialization. Phosphoric acid fuel cells are generally considered first-generation technology. These are commercially available today at a cost of approximately \$4500 per kilowatt of installed capacity (DOE 2002). Higher-temperature, second-generation fuel cells

Alternatives

1 achieve higher fuel-to-electricity and thermal efficiencies. The higher temperatures contribute
2 to improved efficiencies and give the second-generation fuel cells the capability to generate
3 steam for co-generation and combined-cycle operations.

4
5 DOE has a performance target that in 2003, two second-generation, fuel-cell technologies
6 using molten-carbonate and solid-oxide technology, respectively, will be commercially available
7 in sizes of approximately 3 MW at a cost of \$1000 to \$1500 per kW of installed capacity
8 (DOE 2002). For comparison, the installed capacity cost for a natural-gas-fired combined-cycle
9 plant is on the order of \$500 to \$600 per kW (NWPPC 2000). As market acceptance and
10 manufacturing capacity increase, natural-gas-fueled, fuel-cell plants in the 50- to 100-MW
11 range are projected to become available (DOE 2002). At the present time, however, fuel cells
12 are not economically or technologically competitive with other alternatives for base-load
13 electricity generation. Fuels cells are, consequently, not a feasible alternative to renewing the
14 Quad Cities Units 1 and 2 OLS.

15 16 8.2.5.10 Delayed Retirement

17
18 Exelon has no plans for retiring any reactors in its fleet of nuclear plants and expects to need
19 additional capacity in the near future (Exelon 2003). Further, Exelon indicates that any fossil
20 plants slated for retirement tend to use less efficient generation and pollution control
21 technologies. With more stringent environmental restrictions, the impact of delaying retirement
22 of a fossil fuel plant to compensate for the loss of electricity from Quad Cities Units 1 and 2
23 would be bounded by the impacts for the natural gas and coal-fired alternatives, and would
24 potentially be more severe because of the less efficient pollution control equipment from older
25 plants. The staff therefore concluded that delayed retirement of other Exelon generating units
26 could not provide a replacement of the power supplied by Quad Cities Units 1 and 2 and could
27 not be a feasible alternative to Quad Cities Units 1 and 2 license renewal.

28 29 8.2.5.11 Utility-Sponsored Conservation

30
31 The utility-sponsored conservation alternative refers to a situation in which Quad Cities Units 1
32 and 2 cease to operate, no new generation is brought online to meet the lost generation, and
33 the lost generation is instead replaced by more efficient use of electricity. More efficient use
34 would arise from utility-sponsored conservation programs, potentially including energy audits,
35 incentives to install energy-efficient equipment, and informational programs to inform electricity
36 consumers of the benefits of, and possibilities for, electricity conservation. There are two
37 reasons to believe that conservation is not an appropriate alternative to the energy and capacity
38 provided by Quad Cities Units 1 and 2.

39
40 The first reason is the potential that the supply of cost-effective energy conservation measures,
41 above and beyond what is already planned, may not be large enough to replace the energy and

1 capacity of Quad Cities Units 1 and 2. While it is possible, for example with large incentives, to
2 decrease usage of electricity to meet the lost generation, it is the cost of such measures that
3 ultimately matters. If the costs are high, for example, significantly higher than the costs of coal-
4 fired or natural-gas-fired generation or new nuclear generation, then it is infeasible to consider
5 such measures as a replacement for Quad Cities Units 1 and 2. Hence, the feasibility of the
6 utility-sponsored conservation alternative hinges largely on the costs of reducing demand,
7 which will increase with the level of demand reduction. The cost of these measures has been
8 under debate for many years. One estimate of utility demand-side management (DSM)
9 programs in 1992 gave an average cost of \$0.040/kWh in 1992 dollars (Eto, et al. 1996), more
10 than competitive with new generation. However, others have argued that if such measures are
11 this cost-effective, consumers would undertake them irrespective of utility programs, so such
12 cost estimates must understate full consumer costs. Regardless, replacing the capacity and
13 energy from Quad Cities Units 1 and 2 would require a significant increase in the magnitude
14 and energy conservation in the U.S. According to the EIA (DOE/EIA 2001c), the sum of all
15 large, electric-utility energy conservation programs up through 2000 saved approximately
16 54,000 million kWh(e) in 2000. In 2001, Quad Cities Units 1 and 2 provided approximately
17 12,500 million kWh of electricity (DOE/EIA 2003c). Hence, to replace the lost generation at
18 Quad Cities Units 1 and 2 would require an increase of over 25 percent in the total effect of
19 large-utility sponsored conservation since the time that utilities have been reporting these
20 numbers to the EIA. Such an increase would clearly increase the cost of energy conservation
21 by moving beyond the more cost-effective measures.

22
23 The second reason that energy-conservation might not be an effective replacement for Quad
24 Cities Units 1 and 2 involves the changing regulatory structure of the electric-utility industry.
25 Even if it were cost-effective to replace the capacity from Quad Cities Units 1 and 2 using
26 energy conservation, the regulatory structure in Illinois largely eliminates any incentive for
27 Exelon to do so unilaterally. In a traditional, regulated utility environment, utilities managed all
28 portions of the utility system from generation to transmission to distribution. In this
29 environment, it was feasible for utilities to invest in energy-efficiency programs because they
30 could, in many states, receive reimbursement through changes in their electricity rates.
31 However, Illinois, like many states, has altered the regulation of their electric utilities so that
32 generation is decoupled from transmission and distribution. Generators sell power and energy
33 as commodities. While Exelon holds both generation and distribution companies, these
34 companies are not linked in the traditional fashion. Exelon's generating organization can sell to
35 any distributor and Exelon distribution can purchase from any generator. Generation
36 companies will not be reimbursed for energy-efficiency investments, making such investments
37 infeasible from the perspective of the stockholder. Exelon's generating organization will not be
38 able to offer competitively priced power if it subsidizes demand reduction alternatives. Any
39 energy-efficiency investments would therefore need to come from other sources not associated
40 with Exelon, for example, state-sponsored energy-efficiency programs.

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1 For the two reasons stated above—that the costs of electricity reduction may be too high to
2 cost-effectively replace Quad Cities Units 1 and 2 and that it is out of the purview of Exelon to
3 bring about these reductions—the staff does not consider energy-efficiency, by itself, as a
4 feasible alternative to license renewal.
5

6 **8.2.6 Combination of Alternatives**

7
8 Should the OLs not be renewed, the lost energy and capacity would be replaced by a
9 combination of more than one, and perhaps many of the alternatives discussed thus far. As
10 discussed in Section 8.2, Quad Cities Units 1 and 2 have a combined net summer rating of
11 1826 MW(e).
12

13 There are many possible combinations of alternatives. Table 8-8 contains a summary of the
14 environmental impacts of an assumed combination of alternatives consisting of 1100 MW(e) of
15 generation from a combined-cycle facility at the Quad Cities site, 300 MW(e) of energy
16 conservation, and 429 MW(e) purchased from other generators. The impacts associated with
17 the combined-cycle natural-gas-fired units are based on the gas-fired generation impact
18 assumptions discussed in Section 8.2.2, adjusted for the reduced generation capacity. While
19 the DSM measures would have few environmental impacts, operation of the new natural-gas-
20 fired plant would result in increased emissions and environmental impacts. The environmental
21 impacts associated with power purchased from other generators would still occur but would be
22 located elsewhere within the region or nation, as discussed in Section 8.2.4. The environmental
23 impacts associated with purchased power are not shown in Table 8-8. The staff concludes that
24 it is very unlikely that the environmental impacts of any reasonable combination of generating
25 and conservation options could be reduced to the level of impacts associated with renewing the
26 Quad Cities Units 1 and 2 OLs.

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

Impact Category	Quad Cities Site		Alternate Site	
	Impact	Comments	Impact	Comments
Land Use	SMALL to MODERATE	Upward of 30 ha (75 ac) for power block, offices, roads, and parking areas. Additional impact for construction of underground gas pipeline.	SMALL to LARGE	Same as for Quad Cities site with addition of transmission lines.
Ecology	SMALL to MODERATE	Would use undeveloped areas at Quad Cities site. There would be potential for significant habitat loss and fragmentation and reduced productivity and biological diversity.	SMALL to LARGE	Impact would depend on whether site is previously developed. Factors to consider include location and ecology of site and transmission line route. There would be potential for habitat loss and fragmentation and reduced productivity and biological diversity.
Water Use and Quality	SMALL	Would use closed-cycle cooling system with natural gas combined cycle units. This would result in a significant reduction in cooling water requirements. Facility would continue very limited groundwater use.	SMALL to MODERATE	Impact would depend on volume of water withdrawal, the constituents of the discharge water, the characteristics of surface water or groundwater source, and the new intake structures required.
Air Quality	MODERATE	Sulfur oxides <ul style="list-style-type: none"> • 81 MT/yr (89 tons/yr) Nitrogen oxides <ul style="list-style-type: none"> • 257 MT/yr (284 tons/yr). Actual impact would depend on emissions offsets. Carbon monoxide: <ul style="list-style-type: none"> • 53 MT/yr (59 tons/yr) PM₁₀ Particulates <ul style="list-style-type: none"> • 49 MT/yr (54 tons/yr) PM₁₀ Other <ul style="list-style-type: none"> • CO₂ emissions contribute to global warming 	MODERATE	Same emissions as at Quad Cities site, although offsets for NO _x would depend on location.

Alternatives

Table 8-8 (contd)

Impact Category	Quad Cities Site		Alternate Site	
	Impact	Comments	Impact	Comments
Waste	SMALL	Minimal waste product from fuel combination.	SMALL	Impacts identical to those for Quad Cities site.
Human Health	SMALL	Impacts considered minor.	SMALL	Impacts identical to those for Quad Cities site.
Socioeconomics	SMALL to MODERATE	<p>During construction, impacts would be SMALL. Peak workforce during two-to-three year construction period would be significantly smaller than for other steam generation facilities.</p> <p>During operation, employment would be decreased from approximately 1000 permanent and contract employees to less than 100. All employment impacts would be tempered by proximity to Davenport-Moline-Rock Island, Iowa-Illinois Metropolitan Area. Tax base would be preserved.</p> <p>Transportation impacts during operation would be SMALL due to the smaller workforce. Transportation impacts associated with construction workers would be SMALL to MODERATE.</p>	SMALL to MODERATE	<p>Construction impacts at alternate site would be similar to those at Quad Cities site, but would depend on whether new site is located near a major metropolitan area.</p> <p>Minimal impacts on local tax base.</p> <p>Transportation impacts would be similar to those at the Quad Cities site.</p>
Aesthetics	MODERATE	MODERATE aesthetic impact due to impact of plant buildings and structures, along with noise impacts from plant operation. Visual impact would be similar to current Quad Cities Units 1 and 2.	MODERATE	Impact would depend on location. Greatest impact likely would be from the new transmission line(s) that would be needed.

Table 8-8 (contd)

Impact Category	Quad Cities Site		Alternate Site	
	Impact	Comments	Impact	Comments
1 2 3 Historic and Archaeological Resources	SMALL to MODERATE	Studies would likely be needed to identify, evaluate, and address mitigation of the potential cultural resource impacts from construction of a new plant on an undeveloped or developed site.	SMALL to MODERATE	Alternate location would necessitate cultural studies. Studies would likely be needed to identify, evaluate, and address mitigation of the potential cultural resource impacts from construction of a new plant on an undeveloped site.
4 5 Environmental Justice	SMALL	No environmental pathways or locations have been identified that would result in disproportionately high and adverse environmental impacts on minority and low-income populations. Impacts on minority and low-income communities would be similar to those experienced by the population as a whole. Any impacts would be tempered by proximity to Davenport-Moline-Rock Island, Iowa-Illinois Metropolitan Area.	SMALL to LARGE	Impacts would vary depending on population distribution and characteristics at new site. Impacts on Quad Cities site would be identical to those in the no-action alternative.

8.3 Summary of Alternatives Considered

This chapter considered the alternative actions, (i.e., the no-action alternative [discussed in Section 8.1], new generation alternatives [from coal, natural gas, and nuclear discussed in Sections 8.2.1 through 8.2.3, respectively], purchased electrical power [discussed in Section 8.2.4], alternative technologies [discussed in Section 8.2.5], and the combination of alternatives [discussed in Section 8.2.6]).

The no-action alternative would result in decommissioning Quad Cities Units 1 and 2 and would have SMALL environmental impacts for all impact categories. The no-action alternative is a conceptual alternative resulting in a net reduction in electricity generation; there will be no replacement power, and therefore no environmental impacts from replacement power. In actual

Alternatives

1 practice, the power lost by not renewing the OLs for Quad Cities Units 1 and 2 would likely be
2 replaced by (1) demand-side management (DSM) and energy conservation, (2) electricity
3 generated from other sources, either be Exelon or by another generator, or (3) some
4 combination of these alternatives. Any replacement power would produce environmental
5 impacts in addition to those discussed under the no-action alternative.
6

7 For each of the new generation alternatives (coal, natural gas, and nuclear), the environmental
8 impacts would not be less than the impacts of license renewal. For example, the air-quality
9 impacts from a coal-fired or natural-gas-fired facility would be greater than the impacts of
10 continued operation of Quad Cities Units 1 and 2. The impacts of purchased electrical power
11 would still occur, but they would occur elsewhere, and the notion of purchased power is
12 confused by changes in the electricity regulatory structure in Illinois. Alternative technologies
13 are not considered feasible at this time, and it is very unlikely that the environmental impacts of
14 any reasonable combination of generation and conservation options could be reduced to the
15 level of impacts associated with the renewal of the OLs for Quad Cities Units 1 and 2.
16

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- 26 Report." NUREG-1437, Volume 1, Addendum 1, Washington, D.C.
- 27
- 28 U.S. Nuclear Regulatory Commission (NRC). 2002. *Final Generic Environmental Impact*
- 29 *Statement on Decommissioning of Nuclear Facilities, Supplement 1, Regarding the*
- 30 *Decommissioning of Nuclear Power Reactors*, NUREG-0586, Supplement 1, Vols.1 and 2,
- 31 Washington D.C.

9.0 Summary and Conclusions

By letter dated January 3, 2003, the Exelon Generation Company, LLC (Exelon) submitted an application to the U.S. Nuclear Regulatory Commission (NRC) to renew the operating licenses (OLs) for the Quad Cities Units 1 and 2 nuclear power plants for an additional 20-year period (Exelon 2003a). If the OLs are renewed, state regulatory agencies and Exelon will ultimately decide whether the plant will continue to operate based on factors such as the need for power or other matters within the state's jurisdiction or the purview of the owners. If the OLs are not renewed, then the units must be shut down at or before the expiration of the current OLs, both of which expire on December 14, 2012.

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

Upon acceptance of the Exelon application, the NRC began the environmental review process described in 10 CFR Part 51 by publishing a notice of intent to prepare an EIS and conduct scoping (68 FR 12385 [NRC 2003a]) on March 14, 2003. The staff visited the Quad Cities site in March 2003 and held public scoping meetings on April 8, 2003, in Moline, Illinois (NRC 2003b). The staff reviewed the Exelon Environmental Report (ER; Exelon 2003b), compared it to the GEIS, consulted with other agencies, and conducted an independent review of the issues following the guidance set forth in NUREG-1555, Supplement 1, *Standard Review Plans for Environmental Reviews for Nuclear Power Plants, Supplement 1: Operating License Renewal* (NRC 2000). The staff also considered the public comments received during the scoping process for preparation of this draft supplemental EIS (SEIS) for Quad Cities Units 1 and 2. The public comments received during the scoping process that were considered to be within the scope of the environmental review are provided in Appendix A, Part 1, of this SEIS.

The staff will hold two public meetings in Moline, Illinois in December 2003 to describe the preliminary results of the NRC environmental review and to answer questions to provide members of the public with information to assist them in formulating their comments. When the comment period ends, the staff will consider and disposition all of the comments received. These comments will be addressed in Appendix A, Part 2, of the final SEIS.

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

Summary and Conclusions

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

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

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

The goal of the staff's environmental review, as defined in 10 CFR 51.95(c)(4) and the GEIS, is to determine

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

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

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

The supplemental environmental impact statement for license renewal is not required to include discussion of need for power or the economic costs and economic benefits of the proposed action or of alternatives to the proposed action except insofar as such benefits and costs are either essential for a determination regarding the inclusion of an alternative in the range of alternatives considered or relevant to mitigation. In addition, the supplemental environmental impact statement prepared at the license renewal stage need not discuss other issues not related to the environmental effects of the proposed action and the alternatives, or any aspect of the storage of spent fuel for the facility within the scope of the generic determination in § 51.23(a) ["Temporary storage of spent fuel after cessation of reactor operation — generic determination of no significant environmental impact"] and in accordance with § 51.23(b).^(a)

(a) The title of 10 CFR 51.23 is "Temporary storage of spent fuel after cessation of reactor operations — generic determination of no significant environmental impact."

The GEIS contains the results of a systematic evaluation of the consequences of renewing an OL and operating a nuclear power plant for an additional 20 years. In the GEIS, the NRC evaluated 92 environmental issues using the NRC's three-level standard of significance—SMALL, MODERATE, or LARGE—developed using the Council on Environmental Quality guidelines. The following definitions of the three significance levels are set forth in a footnote to Table B-1 of 10 CFR Part 51, Subpart A, Appendix B:

SMALL – Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.

MODERATE – Environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.

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

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

- (1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristics.
- (2) A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective offsite radiological impacts from the fuel cycle and from high-level waste [HLW] and spent fuel disposal).
- (3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation.

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

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

Summary and Conclusions

This SEIS documents the staff's evaluation of all 92 environmental issues considered in the GEIS. The staff considered the environmental impacts associated with alternatives to license renewal and compared the environmental impacts of license renewal and the alternatives. The alternatives to license renewal that were considered include the no-action alternative (not renewing the OLs for Quad Cities Units 1 and 2) and alternative methods of power generation. These alternatives are evaluated assuming that the replacement power-generation plant is located at the Quad Cities site or some other unspecified location.

9.1 Environmental Impacts of the Proposed Action — License Renewal

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

Exelon's license renewal application presents an analysis of the Category 2 issues that are applicable to Quad Cities Units 1 and 2 plus environmental justice. The staff has reviewed the Exelon analysis for each issue and has conducted an independent review of each issue. Four Category 2 issues are not applicable because they are related to plant design features or site characteristics not found at Quad Cities. Four Category 2 issues are not discussed in this SEIS because they are specifically related to refurbishment. Exelon has indicated that its evaluation of structures and components, as required by 10 CFR 54.21, did not identify any major plant refurbishment activities or modifications as necessary to support the continued operation of Quad Cities Units 1 and 2 for the license renewal period (Exelon 2003b). In addition, any replacement of components or additional inspection activities are within the bounds of normal plant component replacement and, therefore, are not expected to affect the environment outside of the bounds of the plant operations evaluated in the *Final Environmental Statement Related to the Operation of Quad Cities Units 1 and 2* (AEC 1972).

Thirteen Category 2 issues related to operational impacts and postulated accidents during the renewal term, as well as environmental justice and chronic effects of electromagnetic fields, are discussed in detail in this draft SEIS. For 12 Category 2 issues and environmental justice, the staff concludes that the potential environmental effects are of SMALL significance in the context of the standards set forth in the GEIS. In addition, the staff determined that appropriate Federal health agencies have not reached a consensus on the existence of chronic adverse effects

from electromagnetic fields. Therefore, no further evaluation of this issue is required. For threatened or endangered species, the staff's conclusion is that the impact of resulting license renewal would be SMALL and further mitigation is not warranted. For severe accident mitigation alternatives (SAMAs), the staff concludes that a reasonable, comprehensive effort was made to identify and evaluate SAMAs. Based on its review of the SAMAs for Quad Cities Units 1 and 2, the staff concludes that none of the candidate SAMAs are cost-beneficial.

For one issue, the staff's preliminary conclusion is that the potential environmental impacts of renewal term operations of Quad Cities Units 1 and 2 are greater than SMALL. The staff concludes that the impact of the potential for induced electric shock from transmission lines along transmission line corridors is MODERATE for the portions of the north Nelson line where calculated induced currents exceed the National Electric Safety Code specification of 5 mA. For a portion of the north Nelson line, the calculated induced electric shock was 6 mA. The NRC staff has informed the transmission line owner of this finding.

Mitigation measures were considered for each category 2 issue. Current measures to mitigate the environmental impacts of plant operation were found to be adequate for 11 issues, and no additional mitigation measures were deemed sufficiently beneficial in these issue areas to be warranted. However, for the issues of electric shock potential and impacts to historic and archaeological resources, further mitigation is recommended.

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

9.1.1 Unavoidable Adverse Impacts

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

The adverse impacts identified for 12 of the 13 Category 2 issues relevant to continued operation are considered to be of SMALL significance, and none warrant the implementation of additional mitigation measures. The potential adverse impact of electric shock for the north Nelson line is considered MODERATE. As noted above, consideration of mitigation measures for this issue may be warranted. The adverse impacts of likely alternatives if Quad Cities Units 1 and 2 cease operation at or before the expiration of the current OLs will not be smaller than

Summary and Conclusions

those associated with continued operation of these units, and they may be greater for some impact categories in some locations.

9.1.2 Irreversible or Irretrievable Resource Commitments

The commitment of resources related to construction and operation of Quad Cities Units 1 and 2 during the current license periods was made when the plant was built. The resource commitments to be considered in this SEIS are associated with the continued operation of the plant for an additional 20 years. These resources include materials and equipment required for plant maintenance and operation, the nuclear fuel used by the reactors, and ultimately, permanent offsite storage space for the spent fuel assemblies.

The most significant resource commitments related to operation during the renewal term are the fuel and the permanent storage space. Quad Cities Units 1 and 2 replace approximately one-third of the fuel assemblies in each of the two units during every refueling outage, which occurs on a 24-month cycle.

The likely power-generation alternatives if Quad Cities Units 1 and 2 cease operation on or before the expiration of the current OLs will require a commitment of resources for constructing the replacement plants as well as for fuel to run the plants.

9.1.3 Short-Term Use Versus Long-Term Productivity

An initial balance between short-term use and long-term productivity of the environment at the Quad Cities site was set when the plant was approved and construction began. That balance is now well established. Renewing the OLs for Quad Cities Units 1 and 2 and the continued operation of the plant will not alter the existing balance, but renewing the OL may postpone the availability of the site for other uses. Denial of the application to renew the OLs will lead to the shutdown of the plant and will alter the balance in a manner that depends on subsequent uses of the site. For example, the environmental consequences of turning the Quad Cities site into a park or an industrial facility are quite different.

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

The proposed action is renewal of the OLs for Quad Cities Units 1 and 2. Chapter 2 describes the site, power plant, and interactions of the plant with the environment. As noted in Chapter 3, no refurbishment and no refurbishment impacts are expected at Quad Cities Units 1 and 2. Chapters 4 through 7 discuss environmental issues associated with renewing the OLs.

Environmental issues associated with the no-action alternative and alternatives involving power generation and use reduction are discussed in Chapter 8.

The significance of the environmental impacts from the proposed action (approval of the application for renewing the OLS), the no-action alternative (denial of the application, no replacement generation, and decommissioning the two units); alternatives involving alternate power generation by nuclear, coal, or gas generation of power at the Quad Cities site or an unspecified alternate site and a combination of alternatives are compared in Table 9-1. Use of a closed-cycle cooling system with cooling towers for alternate power generation is assumed for Table 9-1. Once-through cooling impacts will be smaller in some instances (e.g., land use) and larger in others (e.g., aquatic ecology).

Table 9-1. Summary of Environmental Significance of License Renewal, the No-Action Alternative, and Alternative Methods of Generation

Option	Impact Category	Land Use	Ecology	Water Use and Quality	Air Quality	Waste
Proposed Action	License Renewal	SMALL	SMALL	SMALL	SMALL	SMALL
No-Action Alternative	Denial of Renewal	SMALL	SMALL	SMALL	SMALL	SMALL
Coal-Fired Generation	Quad Cities Site	MODERATE	MODERATE to LARGE	SMALL	MODERATE	MODERATE
	Alternate Site	MODERATE to LARGE	MODERATE to LARGE	SMALL to MODERATE	MODERATE	MODERATE
Natural-Gas-Fired Generation	Quad Cities Site	SMALL to MODERATE	SMALL to MODERATE	SMALL	MODERATE	SMALL
	Alternate Site	SMALL to LARGE	SMALL to LARGE	SMALL to MODERATE	MODERATE	SMALL
New Nuclear Generation	Quad Cities Site	MODERATE	MODERATE to LARGE	SMALL	SMALL	SMALL
	Alternate Site	MODERATE to LARGE	MODERATE to LARGE	SMALL to MODERATE	SMALL	SMALL
Combination of Alternatives	Quad Cities Site	SMALL to MODERATE	SMALL to MODERATE	SMALL	MODERATE	SMALL
	Alternate Site	SMALL to LARGE	SMALL to LARGE	SMALL to MODERATE	MODERATE	SMALL

Summary and Conclusions

Table 9-1 (contd)

Option	Impact Category	Human Health ^(a)	Socioeconomics	Aesthetics	Historic and Archaeological Resources	Environmental Justice
Proposed Action	License Renewal	SMALL to MODERATE	SMALL	SMALL	LARGE	SMALL
No-Action Alternative	Denial of Renewal	SMALL	SMALL	SMALL	SMALL	SMALL
Coal-Fired Generation	Quad cities Site	SMALL	SMALL to MODERATE	MODERATE	SMALL to MODERATE	SMALL
	Alternate Site	SMALL	SMALL to LARGE	MODERATE to LARGE	SMALL to MODERATE	SMALL to LARGE
Natural Gas-Fired Generation	Quad Cities Site	SMALL	SMALL to MODERATE	MODERATE	SMALL to MODERATE	SMALL
	Alternate Site	SMALL	SMALL to MODERATE	MODERATE to LARGE	SMALL to MODERATE	SMALL to LARGE
New Nuclear Generation	Quad Cities Station Site	SMALL	SMALL to MODERATE	MODERATE	SMALL to MODERATE	SMALL
	Alternate Site	SMALL	SMALL to LARGE	MODERATE to LARGE	SMALL to MODERATE	SMALL to LARGE
Combination of Alternatives	Quad Cities Site	SMALL	SMALL to MODERATE	MODERATE	SMALL to MODERATE	SMALL
	Alternate Site	SMALL	SMALL to MODERATE	MODERATE to LARGE	SMALL to MODERATE	SMALL to LARGE

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

Table 9-1 shows that the significance of the environmental effects of the proposed action are SMALL for 8 impact categories (except for collective offsite radiological impacts from the fuel cycle and from HLW and spent fuel disposal, for which a single significance level was not assigned [See Chapter 6]). The significance of the potential for shock is considered MODERATE. The significance of potential impacts to historic and archaeological resources is considered LARGE. The alternative actions, including the no-action alternative, may have environmental effects in at least some impact categories that reach MODERATE or LARGE significance.

9.3 Staff Conclusions and Recommendations

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

9.4 References

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

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

Exelon Generation Company, LLC (Exelon). 2003a. *Application for Renewed Operating Licenses, Quad Cities Units 1 and 2*. Warrenville, Illinois.

Exelon Generation Company, LLC (Exelon). 2003b. *Applicant's Environmental Report — Operating License Renewal Stage Quad Cities Units 1 and 2*. Docket Nos. 50-254 and 50-265. Warrenville, Illinois

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

U.S. Atomic Energy Commission (AEC). 1973. *Final Environmental Statement Related to the Operation of Quad-Cities Nuclear Power Station, Units 1&2, Commonwealth Edison Company and the Iowa-Illinois Gas and Electric Company*. Docket No. 50-254 and 50-265. Directorate of Licensing, Washington, D.C.

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

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

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1 U.S. Nuclear Regulatory Commission (NRC). 2000. *Standard Review Plans for Environmental*
2 *Reviews for Nuclear Power Plants, Supplement 1: Operating License Renewal*. NUREG-1555,
3 Supplement 1, Washington, D.C.

4
5 U.S. Nuclear Regulatory Commission (NRC). 2003a. "Notice of Intent to Prepare an
6 Environmental Impact Statement and Conduct Scoping Process." *Federal Register*, Vol. 68,
7 No. 50, pp. 12385–123386. March 14, 2003.

8
9 U.S. Nuclear Regulatory Commission (NRC). 2003b. *Environmental Impact Statement*
10 *Scoping Process: Summary Report — Quad Cities Units 1 and 2*, Moline, Illinois. Washington,
11 D.C.

Appendix A

Comments Received on the Environmental Review

Appendix A

Comments Received on the Environmental Review

Part I – Comments Received During Scoping

On March 14, 2003, the U.S. Nuclear Regulatory Commission (NRC) published a Notice of Intent in the *Federal Register* (68 FR 12385) to notify the public of the staff's intent to prepare a plant-specific supplement to the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2, to support the renewal application for the Quad Cities Units 1 and 2 operating licenses and to conduct scoping. This plant-specific supplement to the GEIS has been prepared in accordance with the National Environmental Policy Act (NEPA), Council on Environmental Quality (CEQ) guidelines, and 10 CFR Part 51. As outlined by NEPA, the NRC initiated the scoping process with the issuance of the *Federal Register* Notice. The NRC invited the applicant; Federal, state, and local government agencies; local organizations; and individuals to participate in the scoping process by providing oral comments at scheduled public meetings and/or submitting written suggestions and comments no later than May 12, 2003.

The scoping process included two public scoping meetings, which were held at The Mark of the Quad Cities in Moline, Illinois, on April 8, 2003. To publicize the meetings, the NRC staff issued a press release and posted flyers in nearby areas commonly visited by local residents. Approximately 120 members of the public attended the meetings. Both sessions began with NRC staff members providing brief overviews of the license renewal process and the NEPA process. After the NRC's prepared statements, the meetings were opened for public comments. Thirteen attendees provided either oral or written statements that were recorded and transcribed by a certified court reporter. The meeting transcripts are an attachment to the *Summary of Public Scoping Meetings to Support Review of the Quad Cities Nuclear Power Station, Units 1 and 2 License Renewal Application*, dated June 16, 2003. The Public Electronic Reading Room (ADAMS) accession number for the document package containing the summary report, the transcripts and presentation slides is ML0321631260. (This accession number is provided to facilitate access to the document through the Agencywide Documents Access and Management System [ADAMS] at <http://www.nrc.gov/reading-rm.html>.) In addition to the comments provided during the public meetings, four e-mail messages were received by the NRC in response to the Notice of Intent published in the *Federal Register*.

The scoping process provides an opportunity for public participation to identify issues to be addressed in the plant-specific supplement to the GEIS and highlight public concerns and issues. The Notice of Intent to prepare an EIS identified the following objectives of the scoping process:

Appendix A

- 1 • Define the proposed action
- 2
- 3 • Determine the scope of the supplement to the GEIS and identify significant issues to be
- 4 analyzed in depth
- 5
- 6 • Identify and eliminate peripheral issues
- 7
- 8 • Identify any environmental assessments and other environmental impact statements being
- 9 prepared that are related to the supplement to the GEIS
- 10
- 11 • Identify other environmental review and consultation requirements
- 12
- 13 • Indicate the schedule for preparation of the supplement to the GEIS
- 14
- 15 • Identify any cooperating agencies
- 16
- 17 • Describe how the supplement to the GEIS will be prepared.
- 18

19 At the conclusion of the scoping period, the NRC staff and its contractors reviewed the
20 transcripts and all written material received to identify specific comments and issues. All
21 comments and suggestions received orally or in writing during the scoping meetings were
22 considered. Each set of comments from an individual was given a unique identifier (Commenter
23 ID) so that the comments could be traced back to the original transcript, letter, or e-mail
24 containing the comment. Several commenters submitted more than one set of comments
25 (e.g., they made statements in both the afternoon and evening scoping meetings). In these
26 cases, there is a unique Commenter ID for each set of comments.

27
28 Table A-1 identifies the individuals who provided comments applicable to the environmental
29 review and gives the Commenter ID associated with each set of comments. Individuals who
30 spoke at the scoping meetings are listed in the order in which they spoke at the public meeting,
31 and in alphabetical order for the comments received by letter or e-mail.

32
33 Specific comments were categorized and consolidated by topic. Comments with similar specific
34 objectives were combined to capture the common essential issues raised by the commenters.
35 The comments fall into one of several general groups. These groups include:

- 36
- 37 • Specific comments that address environmental issues within the purview of the NRC
- 38 environmental regulations related to license renewal. These comments address Category 1
- 39 or Category 2 issues or issues that were not addressed in the GEIS. They also address
- 40 alternatives and related Federal actions.
- 41

- General comments (1) in support of or opposed to nuclear power or license renewal or (2) on the renewal process, the NRC's regulations, and the regulatory process. These comments may or may not be specifically related to the Quad Cities license renewal application.
- Questions that do not reveal new information.
- Specific comments that address issues that do not fall within or are specifically excluded from the purview of NRC environmental regulations. These comments typically address issues such as the need for power, emergency preparedness, current operational safety issues, and safety issues related to operation during the renewal period.

Each comment received during the scoping process is summarized in the *Environmental Scoping Summary Report Associated with the Staff's Review of the Application by Exelon Generation Company for Renewal of the Operating Licenses for the Quad Cities Nuclear Power Station, Units 1 and 2*, dated July 21, 2003. The ADAMS accession number for this document is ML032030456.

Each comment applicable to this environmental review is summarized here in Part 1 of Appendix A. This information, which was extracted from the July 21, 2003, scoping summary report, is provided for the convenience of those interested in the scoping comments applicable to this environmental review. The comments that are general in nature or outside the scope of the environmental review for the proposed Quad Cities Units 1 and 2 license renewal are not included here. More detail regarding the disposition of general or inapplicable comments can be found in the summary report. The following pages summarize the contents and suggestions received as part of the scoping process that are applicable to this environmental review and discuss the disposition of the comments and suggestions. The parenthetical identifier after each comment refers to the comment set (Commenter ID) and the comment number.

Comments in this section are grouped in the following categories:

- (1) Comments Concerning Category 2 Aquatic Ecology Issues
- (2) Comments Concerning Category 2 Terrestrial Resource Issues
- (3) Comments Concerning Category 2 Socioeconomic Issues
- (4) Comments Concerning Alternatives

Appendix A

Table A-1. Individuals Providing Comments During the Scoping Comment Period

Commenter ID	Commenter	Affiliation (If Stated)	Comment Source and ADAMS Accession Number ^(a)
QCS-A	Jim Bohnsack	Rock Island County Board	Afternoon Scoping Mtg.
QCS-B	Leo Geerts	Albany Fire Protection District	Afternoon Scoping Mtg.
QCS-C	Tim Tulon	Quad Cities Nuclear Power Station	Afternoon Scoping Mtg.
QCS-D	Fred Polaski	Exelon	Afternoon Scoping Mtg.
QCS-E	Rob Lamb	Quad Cities Development Group	Afternoon Scoping Mtg.
QCS-F	Stuart Whitt	Whitt Law	Afternoon Scoping Mtg.
QCS-G	Chris Filbert	Cordova Township Road Commission	Afternoon Scoping Mtg.
QCS-H	Larry Toppert	Toppert Jetting Service	Afternoon Scoping Mtg.
QCS-I	Don Swensson		Afternoon Scoping Mtg.
QCS-J	Patrick O'Conner	Newberg-Perinni/Stone and Webster	Afternoon Scoping Mtg.
QCS-K	John Malvik	Rock Island County Board	Afternoon Scoping Mtg.
QCS-L	Tim Tulon	Quad Cities Nuclear Power Station	Evening Scoping Mtg.
QCS-M	Fred Polaski	Exelon	Evening Scoping Mtg.
QCS-N	Sue Hebel	Cordova District Library	Evening Scoping Mtg.
QCS-O	Leslie Perrigo		Evening Scoping Mtg.
QCS-P	David Olson		Email (ML031400167)
QCS-Q	Joyce/Jack Wiley		Email (ML031400174)
QCS-R	M.J. Regan		Email ML031400177)
QCS-S	Scott Gardner	Cordova Dragway Park	Email (ML031700164)

(a) The afternoon transcripts can be found under accession number ML031640068 and the evening transcripts can be found under accession number ML031640085.

Part I – Comments Received During Scoping**Comments****1. Comments Concerning Category 2 Aquatic-Ecology Issues**

As stated in 10 CFR Part 51, Table B-1, Category 2 aquatic ecology issues include the following:

- Entrainment of fish and shellfish in early life stages
- Impingement of fish and shellfish Entrainment of fish and shellfish in early life stages
- Heat shock

Comment: I think many people probably do not realize that we are the only private sector facility to operate a fish hatchery on the Mississippi River. And ever since 1984 we have put four million fish right here locally in Mississippi Pools 13 and 14. (QCS-C-9)

Comment: Also the station supports this fish hatchery and stocks the river with walleye and striped bass. (QCS-N-3)

Comment: Now because of the elevated temperature of the river which is directly related to the nuclear plant dumping radioactive warmer water back into the Mississippi, it no longer freezes completely. This has directly resulted in loss of larger clams which no longer can be found in the area. (QCS-R-3)

Response: *The comments are noted. The comments relate to aquatic ecology issues and are discussed in Chapters 2 and 4 of this draft SEIS.*

2. Comments Concerning Category 2 Terrestrial Resource Issues

As stated in 10 CFR Part 51, Table B-1, Category 2 terrestrial resource issues include the following:

- Refurbishment impacts to terrestrial resources
- Threatened or endangered species

Appendix A

Comment: The plant keeps the river open in the winter time. Because of this, there are many more eagles and water fowl in the area. (QCS-N-2)

Response: *The comment is noted. The comment relates to terrestrial resource issues and are discussed in Chapter 4 of this draft SEIS.*

3. Comments Concerning Category 2 Socioeconomic Issues

As stated in 10 CFR Part 51, Table B-1, Category 2 socioeconomic issues include the following:

- Housing
- Public services: public utilities
- Public services: education (refurbishment)
- Offsite land use (refurbishment)
- Offsite land use (license renewal term)
- Public services: transportation
- Historic and archaeological resources.

Comment: And of course we could not go without saying that it does provide an economic stability in this area. (QCS-B-3)

Comment: So it is an economic source that we don't want to lose. (QCS-B-5)

Comment: So our payroll is 57 million dollars, 57 million dollars worth of payroll which directly helps the local community. (QCS-C-4)

Comment: Right here in the Quad Cities to obtain that labor and so last year that resulted in 30 million dollars, a 30-million dollar payroll to these local craftsmen. (QCS-C-5)

Comment: So I would offer to you that, number one, is we are a very significant source of employment for the local area and number two, we are a positive economic force. (QCS-C-6)

Comment: And regardless of any extreme positions that were taken in the appeal process at

1 PECO and Chairman Bohnsack, I want to just tell you flat out is that we intend to pay property
2 taxes. We intend to be a good neighbor. (QCS-C-7)

3
4 **Comment:** Also, I want to mention that our employees are generous and involved in many local
5 activities. (QCS-C-8)

6
7 **Comment:** The second is in terms of jobs. The station employs about 700 local citizens and
8 provides good income to many area families. The annual payroll from the station puts about 50
9 million dollars into the greater Quad Cities community. (QCS-E-3)

10
11 **Comment:** Finally, the station pays about three and a half million dollars in taxes annually.
12 These taxes support our schools and our community infrastructure, making the greater Quad
13 Cities more attractive to companies looking to expand in this area and making the Quad Cities a
14 better place for our residents and corporate citizens as well. (QCS-E-4)

15
16 **Comment:** Since that time the Quad Cities Nuclear Power Station has had a significant, positive
17 impact upon the area's economic vitality. The county, the college, and the school district all
18 recognize and appreciate the positive benefits the station has brought to the area. (QCS-F-1)

19
20 **Comment:** They have provided quality jobs to many residents of Cordova Township and funds
21 to the area school district. (QCS-G-3)

22
23 **Comment:** The biggest boost to the road and bridge district is the tax share supported by
24 Exelon. Without that tax base our district would be in serious and desperate trouble.
25 Approximately 70 percent of the monies collected in taxes are Exelon's share. This tax base
26 helps keep our roads in tip top condition. (QCS-G-5)

27
28 **Comment:** Last year our firm worked more than 750,000 person-hours at the Quad Cities
29 Station. That's the equivalent of 375 full-time employees working at the site throughout the year.
30 Our employees earned more than \$30 million, much of which was returned to the local economy.
31 (QCS-J-2)

32
33 **Comment:** That investment has resulted in additional jobs for our employees in the short term
34 and will mean plenty of work in the future for refueling outages and to maintain that equipment to
35 a high state of readiness and availability. (QCS-J-6)

36
37 **Comment:** I'm also in charge of Academic Achievement Award Program for Riverdale High
38 School, which is supported by the Quad Cities Chamber of Commerce, and the plant has been
39 very generous with this scholarship program. (QCS-N-4)

Appendix A

1 **Comment:** Aside from the tax issue, the Quad Cities Nuclear Power Station has been a good
2 neighbor financially to the Cordova Library as well. (QCS-N-5)

3
4 **Response:** *The comments are noted. Socioeconomic issues specific to the plant are*
5 *Category 2 issues and are addressed in Chapter 4 of this draft SEIS.*
6

7 **Comment:** Our concern is that they pay their fair taxes and I know this is talking about
8 environmental but also had calls from different public and private sectors in the last week saying
9 Exelon or MidAmerica has called them asking them as a public relations and I think that's, that's
10 not the fair gimmick or the thing that you want to hear today. (QCS-A-1)
11

12 **Comment:** In their tax appeal, they pretty much show that they want nothing, it's over \$700
13 million and they're saying they don't want to pay any, any property taxes. We think that's
14 terrible. We are trying to negotiate with them now to have some kind of equitable property tax.
15 (QCS-A-2)
16

17 **Comment:** And so I want to make sure you understand that they're worthy of, of running a good
18 facility, but they also need to be paying their fair share. (QCS-A-3)
19

20 **Comment:** However, reduction of the station's taxable value as requested by the owners will
21 have a devastating impact upon the local taxing districts responsible for those social services
22 which are vital to the community. The county will lose over \$400,000 and the college will lose
23 over a quarter of a million, resulting in substantial layoffs and the corresponding reduction of
24 social services. The school district will lose more than \$2 million or nearly 29 percent of its entire
25 budgeted revenue. (QCS-F-2)
26

27 **Comment:** With this loss, it will be impossible for the district to maintain a quality educational
28 program for its students. (QCS-F-3)
29

30 **Comment:** The county, the college, and the school district all request that the Nuclear
31 Regulatory Commission solicit and accept statements from the local taxing bodies for inclusion
32 in the supplemental environmental impact statement and further ask that Edison drop its appeal.
33 (QCS-F-4)
34

35 **Comment:** Exelon doesn't want to pay for its fair share of taxes. That's the bottom line. They
36 don't want to pay as much in taxes as they are paying. (QCS-K-1)
37

38 **Comment:** This giant and profitable corporation wants to shift its civic duty to pay taxes to the
39 little guy, the working men and women of our community, our senior citizens, those who have to
40 struggle to make ends meet. (QCS-K-2)

Comment: I realize that Cordova is a major employer for our area, but I would also like to point out that under deregulation, many jobs have already been cut. (QCS-O-9)

Response: *The comments are noted. Socioeconomic issues specific to the plant are Category 2 issues and are addressed in Chapter 4 of this draft SEIS.*

Appendix A

4. Comments Concerning Alternatives

Comment: During the preparation of the license extension paperwork, a comparison was done to say, okay, if you take the generation of Quad Cities and you don't use the nuclear option and you use a coal-burning type of option, what would that result in? The result would be 6000 tons of sulphur dioxide emission to the environment. Seventeen hundred tons of both nitric oxides and also carbon monoxides. So it's a very significant benefit, I think, that nuclear has is the avoidance of this greenhouse issue. (QCS-C-11)

Comment: And we looked at other ways of generating nuclear power and determined that any alternate means of generating electricity that 1800 megawatts would have more of an impact on the environment than if we continued to operate Quad Cities for an additional 20 years. (QCS-D-2)

Comment: Although the nuclear industry does produce far less, or does emit far less carbon than conventional plants, such as coal, carbon dioxide is still emitted at every step of the nuclear fuel chain from uranium mining to the decommissioning of old reactors. (QCS-O-7)

Comment: So it is possible to function in the Quad Cities without nuclear power plants, and we do have amazing potential for renewable energy. (QCS-O-10)

Comment: Every year the sun emits two thousand times more energy than the world consumption needs. When resources in the West and Midwest have more potential energy than the oil fields of Saudi Arabia and together electricity and hydrogen can meet all the energy needs of a modern society. (QCS-O-11)

Comment: This is a very exciting time in technology, so we would just like the NRC to consider other options and just acknowledge that there are other options out there and taking it into consideration all the safety concerns regarding nuclear power. (QCS-O-12)

Comment: There are other sources of energy that are renewable and environmentally safe, such as wind and solar that would also create good, high-paying jobs. (QCS-P-5)

Response: *The comments are noted. Impacts from reasonable alternatives for the Quad Cities license renewal will be evaluated in Section 8 of the SEIS.*

Part II – Comments Received on the Draft SEIS

(Reserved for comments received on the draft SEIS.)

Appendix B

Contributors to the Supplement

Appendix B

Contributors to the Supplement

The overall responsibility for the preparation of this supplement was assigned to the Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission (NRC). The statement was prepared by members of the Office of Nuclear Reactor Regulation with assistance from other NRC organizations, and the Lawrence Livermore National Laboratory. Representatives from Argonne National Laboratory, Pacific Northwest National Laboratory, Energy Research Incorporated, and the Information Systems Laboratory also participated in this review.

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Appendix B

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(a) Lawrence Livermore National Laboratory is operated for the U.S. Department of Energy by the University of California.

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(c) Pacific Northwest National Laboratory is operated for the U.S. Department of Energy by Battelle Memorial Institute.

Appendix C

Chronology of NRC Staff Environmental Review Correspondence Related to Exelon Generation Company, LLC's Application for License Renewal of Quad Cities Nuclear Power Station, Units 1 and 2

Appendix C

Chronology of NRC Staff Environmental Review Correspondence Related to Exelon Generation Company, LLC's Application for License Renewal of Quad Cities Nuclear Power Station, Units 1 and 2

This appendix contains a chronological listing of correspondence between the U.S. Nuclear Regulatory Commission (NRC) and Exelon Generation Company, LLC (Exelon) and other correspondence related to the NRC staff's environmental review, under 10 CFR Part 51, of Exelon's application for renewal of the Quad Cities Nuclear Power Station (QCNPS), Units 1 and 2, operating licenses. All documents, with the exception of those containing proprietary information, have been placed in the Commission's Public Document Room, at One White Flint North, 11555 Rockville Pike (first floor), Rockville, MD, and are available electronically from the Public Electronic Reading Room found on the Internet at the following Web address: <<http://www.nrc.gov/reading-rm.html>>. From this site, the public can gain access to the NRC's Agencywide Documents Access and Management System (ADAMS), which provides text and image files of NRC's public documents in the publicly available records component of ADAMS. The ADAMS accession number for each document is included below.

November 12, 2002 Comments from the Regular Minutes of the Prophetstown City Council pertaining to QCNPS license renewal application (Accession No. ML031970772).

January 3, 2003 Letter from Mr. Jeffrey A. Benjamin, Exelon, to NRC submitting the application for the renewal of the operating license for QCNPS, Units 1 and 2 (Accession No. ML030090203).

January 10, 2003 NRC Press Release No. 03-007 "NRC Announces Availability of License Renewal Applications for Dresden and Quad Cities Nuclear Power Plants" (Accession No. ML030100360).

January 22, 2003 Comment letter from Mr. James E. Bohnsack, County Board Chairman, Rock Island County Board, to NRC concerning the county board's decision to rescind their resolution of support for the license renewal of QCNPS (Accession No. ML030290020).

January 24, 2003 Comment letter from Roger Drey, Mayor, City of Morrison, Illinois, to NRC regarding the license renewal of QCNPS, Units 1 and 2 (Accession No. ML030450342).

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1 January 24, 2003 NRC staff letter to Mr. John L. Skolds, Exelon, forwarding an information
2 copy of a notice sent to the Office of the *Federal Register* regarding
3 receipt and public availability of the Dresden and QCNPS license renewal
4 applications (Accession No. ML03024063) (The notice was published in
5 the *Federal Register* on January 30, 2003, at 68 FR
6 4800-4801.)
7
8 February 11, 2003 Letter from NRC staff to Ms. Sue Hebel, Cordova District Library,
9 Cordova, Illinois, concerning the maintenance of reference material for
10 public access related to the QCNPS license renewal environmental
11 review (Accession No. ML030430199).
12
13 February 11, 2003 NRC staff letter to Ms. Lisa Ford, River Valley Public Library, Port Byron,
14 Illinois, regarding the maintenance of reference material for public access
15 related to the QCNPS license renewal environmental review (Accession
16 No. ML030430314).
17
18 February 11, 2003 Letter from NRC staff to Ms. Cathy Stone, Davenport Public Library,
19 Davenport, Iowa, concerning the maintenance of reference material for
20 public access related to the QCNPS license renewal environmental
21 review (Accession No. ML030430347).
22
23 February 26, 2003 NRC staff letter to Mr. John L. Skolds, Exelon, forwarding an information
24 copy of a *Federal Register* notice of acceptance for docketing of the
25 application and notice of opportunity for hearing regarding the renewal of
26 QCNPS operating licenses, and the NRC schedule for the safety and
27 environmental reviews of the license renewal application. (Accession No.
28 ML030570654). (The notice was published on March 4, 2003, at 68 FR
29 10273-10274).
30
31 March 6, 2003 NRC staff letter to Mr. John L. Skolds, Exelon, forwarding an information
32 copy of a *Federal Register* notice of intent to prepare an environmental
33 impact statement and conduct scoping. (Accession No. ML030660237).
34 (The notice was published on March 14, 2003, at 68 FR 12385-12386.)
35
36 March 11, 2003 NRC staff letter to the Honorable Steve Cadue, Chairperson, Kickapoo
37 Tribe of Indians of the Kickapoo Reservation in Kansas, inviting
38 participation in the environmental review scoping process (Accession No.
39 ML030720491).
40

1	March 11, 2003	NRC staff letter to the Honorable Danny Kaskaske, Chairperson,
2		Kickapoo Tribe of Oklahoma, inviting participation in the environmental
3		review scoping process (Accession No. ML030710092).
4		
5	March 11, 2003	NRC staff letter to the Honorable Alex Walker, Jr., Chairperson, Sac &
6		Fox Nation of the Mississippi in Iowa, inviting participation in the
7		environmental review scoping process (Accession No. ML030710774).
8		
9	March 11, 2003	NRC staff letter to the Honorable John A. Barrett, Jr., Chairperson,
10		Citizen Potawatomi Nation of Oklahoma, inviting participation in the
11		environmental review scoping process (Accession No. ML030710725).
12		
13	March 11, 2003	NRC staff letter to the Honorable Harold Frank, Chairperson, Forest
14		County Potawatomi Tribal Community, inviting participation in the
15		environmental review scoping process (Accession No. ML030710160).
16		
17	March 11, 2003	NRC staff letter to the Honorable Gil Holliday, Chairperson, Huron
18		Potawatomi Inc. of Michigan, inviting participation in the environmental
19		review scoping process (Accession No. ML030720345).
20		
21	March 11, 2003	NRC staff letter to the Honorable David K. Sprague, Chairperson, Match-
22		E-Be-Nash-She-Wish Band of Potawatomi Indians of Michigan, inviting
23		participation in the environmental review scoping process (Accession No.
24		ML030720315).
25		
26	March 11, 2003	NRC staff letter to the Honorable John Miller, Chairperson, Pokagon
27		Band of Potawatomi Indians of Michigan, inviting participation in the
28		environmental review scoping process (Accession No. ML030720282).
29		
30	March 11, 2003	NRC staff letter to the Honorable Zachariah Pahmahmie, Chairperson,
31		Prairie Band of Potawatomi Tribal Council, inviting participation in the
32		environmental review scoping process (Accession No. ML030720370).
33		
34	March 12, 2003	NRC staff letter to the Honorable Kenneth Meshigaud, Chairperson,
35		Hannahville Indian Community, inviting participation in the environmental
36		review scoping process (Accession No. ML030720573).
37		
38	March 12, 2003	NRC staff letter to the Honorable Juan Garcan, Jr., Provisional
39		Chairperson, Kickapoo Traditional Tribe of Texas, inviting participation in
40		the environmental review scoping process (Accession No.
41		ML030720600).

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1	March 12, 2003	NRC staff letter to the Honorable Sandra Keo, Chairperson, Sac & Fox
2		Nation of Missouri in Kansas and Nebraska, inviting participation in the
3		environmental review scoping process (Accession No. ML030720617).
4		
5	March 12, 2003	NRC staff letter to the Honorable Don Abney, Principal Chief, Sac & Fox
6		Nation of Oklahoma, inviting participation in the environmental review
7		scoping process (Accession No. ML030720275).
8		
9	March 12, 2003	NRC staff letter to the Honorable Lewis DeRoin, Chairperson, Iowa Tribe
10		of Kansas and Nebraska, inviting participation in the environmental
11		review scoping process (Accession No. ML030770314).
12		
13	March 12, 2003	NRC staff letter to the Honorable Lawrence P. Murray, Chairperson, Iowa
14		Tribe of Oklahoma, inviting participation in the environmental review
15		scoping process (Accession No. ML030770384).
16		
17	March 12, 2003	Letter from NRC staff to Mr. Rick Nelson, U.S. Fish and Wildlife Service,
18		requesting information relevant to the NRC environmental review
19		(Package No. ML030730775; Accession No. ML030730774; NRC letter;
20		ML030760214, enclosures).
21		
22	March 14, 2003	NRC public meeting notice (memorandum with information for the NRC
23		web site) of the April 8, 2003, public meetings in Moline, Illinois to
24		facilitate public participation in the environmental review scoping process
25		(Accession No. ML030730776).
26		
27	March 20, 2003	E-mail to the NRC staff from Exelon providing information requested
28		during the site audit regarding groundwater drawdown (Accession No.
29		ML031770777).
30		
31	March 31, 2003	NRC Press Release No. III-03-021, "Public Meetings April 8 on License
32		Renewal of Quad Cities Nuclear Power Plant" (Accession No.
33		ML030910264).
34		
35	April 11, 2003	E-mail to QuadCitiesEIS@nrc.gov from Mr. Scott Gardner providing
36		public input to the environmental review scoping process (Accession No.
37		ML031400164).
38		
39	April 17, 2003	NRC staff letter to Exelon requesting additional information regarding
40		new and significant information (Accession No. ML031070572).
41		

1 April 24, 2003 E-mail to QuadCitiesEIS@nrc.gov from Mr. David Olson providing public
2 input to the environmental review scoping process (Accession No.
3 ML 031400167).
4
5 May 2, 2003 NRC staff letter to Exelon revising request for additional information
6 regarding new and significant information (Accession No. ML031220535).
7
8 May 8, 2003 E-mail to QuadCitiesEIS@nrc.gov from Jack and Joyce Wiley providing
9 public input to the environmental review scoping process (Accession
10 No. ML031400174).
11
12 May 8, 2003 Letter from Mr. Stephen K. Davis, Illinois Department of Natural
13 Resources, providing input to the environmental review scoping process
14 (Accession No. ML03142000027).
15
16 May 12, 2003 E-mail to QuadCitiesEIS@nrc.gov from M.J. Regan providing public input
17 to the environmental scoping process (Accession No. ML031400177).
18
19 May 14, 2003 Letter from Exelon providing supplemental information for the analysis of
20 transmission lines at QCNPS (Accession No. ML031400661).
21
22 May 14, 2003 E-mail from Exelon to the NRC staff providing information which was
23 requested during the site audit regarding land use classifications
24 (Accession No. ML031970776).
25
26 May 23, 2003 NRC staff letter to Mr. John Skolds, Exelon, requesting additional
27 information regarding Severe Accident Mitigation Alternatives and
28 transmission lines (Accession No. ML031430600).
29
30 May 27, 2003 NRC staff Note to File with information enclosed for the docket files and
31 public availability which was provided to the staff by the licensee
32 (Package No. ML031480249).
33
34 May 28, 2003 Letter from Exelon forwarding additional information regarding the
35 environmental review (Accession No. ML031540677).
36
37 June 3, 2003 NRC public meeting notice (memorandum with information for the NRC
38 web site) of the June 7, 2003, public meetings in Rockville, MD to discuss
39 the May 23, 2003, request for additional information regarding
40 transmission line corridors (Accession No. ML031550388).
41

Appendix C

1	June 6, 2003	Letter to the NRC staff from the U.S. Department of the Interior, Fish and
2		Wildlife Service, which provides comments regarding Federally listed
3		threatened or endangered species for the proposed QCNPS license
4		renewal (ML031970770).
5		
6	June 16, 2003	Summary of the public scoping meetings held in Moline, Illinois, as part of
7		the NRC staff environmental scoping process (Package No.
8		ML031631260).
9		
10	June 30, 2003	E-mail from Exelon to the NRC staff forwarding a draft of responses to
11		the May 23, 2003, Request for Additional Information related to Severe
12		Accident Mitigation Alternatives (Accession No. ML031960554).
13		
14	July 1, 2003	NRC staff letter to Ms. Anita Walker, State Historical Society of Iowa,
15		providing information regarding plans for publishing this draft
16		Supplemental Environmental Impact Statement and requesting
17		comments (Accession No. ML031830396).
18		
19	July 1, 2003	NRC staff letter to Mr. Maynard Crossland, Illinois Historic Preservation
20		Agency, providing information regarding plans for publishing this draft
21		Supplemental Environmental Impact Statement and requesting
22		comments (Accession No. ML031830303).
23		
24	July 3, 2003	E-mail from Exelon to the NRC staff providing replacement pages 2-3
25		and 2-34 for the QCNPS license renewal Environmental Report
26		(Accession No. ML031970774).
27		
28	July 8, 2003	E-mail from Exelon to the NRC staff forwarding environmental monitoring
29		data provided to Exelon by the Illinois Department of Nuclear Safety
30		(Accession No. ML032030211).
31		
32	July 11, 2003	E-mail from Exelon to the NRC staff providing a revised draft response to
33		SAMA Question 6c (Accession No. ML032030217).
34		
35	July 17, 2003	Exelon letter to the NRC staff providing the formal response to the staff's
36		May 23, 2003, RAI (ML032040302).
37		
38	July 21, 2003	NRC staff letter to Exelon regarding issuance of the Scoping Summary
39		Report for the QCNPS license renewal environmental review (Accession
40		NO. ML032030456).

1
2 July 24, 2003 NRC staff letter to Exelon providing the NRC staff position regarding
3 Exelon's initial and subsequent interpretations of the NRC regulation
4 regarding an assessment of electric shock from induced currents along
5 transmission lines (ML032050121).
6
7 July 29, 2003 Summary of the June 17, 2003, meeting between the NRC staff and
8 Exelon to discuss the May 23, 2003, RAI regarding the scope of
9 transmission lines included in the ER and the July 24, 2003, NRC staff
10 follow up letter to Exelon (ML032100697).
11
12 August 12, 2003 NRC staff letter to Mr. Rick Nelson, U.S. Fish and Wildlife Service,
13 expanded the scope of the QCNPS license renewal environmental
14 review, and requesting comments (ML032250420).
15
16 September 15, 2003 Letter from the U.S. Fish and Wildlife Service providing a response to the
17 August 12, 2003, NRC staff letter requesting information regarding
18 threatened and endangered species in the vicinity of the QCNPS site and
19 transmission lines (ML032730715).
20
21 September 17, 2003 Email from Exelon to the NRC staff providing information related to
22 MidAmerican Construction Services transmission line vegetation
23 management practices (ML032730712.)
24
25 September 18, 2003 Email from Exelon to the NRC staff providing information on proposed
26 procedure modifications to address interests related to potential historic
27 and archeological sites (ML032730705).
28
29 September 22, 2003 NRC staff letter to Mr. Fidel Marquez, Exelon Energy Delivery,
30 Transmission and Substations, regarding the findings of the QCNPS
31 license renewal environmental review of the North Nelson Line
32 (ML032660226).
33
34 October 14, 2003 Email from Exelon to the NRC staff providing information related to Alliant
35 Energy transmission line vegetation management practices
36 (ML032890481).

Appendix D

Organizations Contacted

Appendix D

Organizations Contacted

During the course of the staff's independent review of environmental impacts from operations during the renewal term, the following Federal, tribal, state, regional, and local agencies were contacted:

Bi-State Regional Commission Community Development Director

Blackhawk Community College Vice President for Administration and Finance

City of Rock Island Public Works Director

Erie School District Superintendent

Forest Potawatomi Tribal Community

Hannahville Indian Community

Huron Potawatomi Inc. of Michigan

Illinois Department of Natural Resources—Springfield Office

Illinois Department of Transportation

Illinois Environmental Protection Agency—Compliance Unit

Illinois Environmental Protection Agency—Industrial Unit

Illinois Environmental Protection Agency—Watershed Management Section

Illinois Historic Preservation Agency

Illinois State Social Services Department

Iowa Area Education Association

Iowa Tribe of Kansas and Nebraska

Iowa Tribe of Oklahoma

Appendix D

1	Kickapoo Traditional Tribe of Texas
2	
3	Kickapoo Tribe of Oklahoma
4	
5	Match-E-Be-Nash-She-Wish Band of Potawatomi Indians of Michigan
6	
7	Pokagon Band of Potawatomi Indians of Michigan
8	
9	Potawatomi Nation of Oklahoma
10	
11	Prairie Band of Potawatomi Tribal Council
12	
13	Rock Island City Manager
14	
15	Rock Island County Board of Supervisors Chairman
16	
17	Rock Island County Director of Planning and Geographic Information Systems
18	
19	Rock Island County Public Works
20	
21	Rock Island County Sheriff's Department
22	
23	Rock Island County Supervisor of Assessors
24	
25	Rock Island Regional Office of Education
26	
27	Sac and Fox Nation of Missouri
28	
29	Sac and Fox Nation of Oklahoma
30	
31	Sac and Fox Nation of the Mississippi in Iowa
32	
33	Scott County Director of Planning and Development
34	
35	State Historical Society of Iowa
36	
37	University of Illinois Educational Extension, Rock Island County
38	
39	Upper Mississippi National Wildlife and Fish Refuge—Savanna District
40	
41	U.S. Fish and Wildlife Service—Rock Island Ecological Services Field Office

- 1 U.S. Fish and Wildlife Service—Twin Cities Field Office
- 2
- 3 Whiteside County Administrator
- 4
- 5 Whiteside County Regional Office of Education Regional Superintendent

Appendix E

Quad Cities Nuclear Power Station, Units 1 and 2 Compliance Status and Consultation Correspondence

Appendix E

Quad Cities Nuclear Power Station, Units 1 and 2 Compliance Status and Consultation Correspondence

Correspondence received during the evaluation process of the application for renewal of the operating license for Quad Cities, Units 1 and 2 is identified in Table E-1. Copies of the correspondence are included at the end of this appendix.

The licenses, permits, consultations, and other approvals obtained from Federal, State, regional, and local authorities for Quad Cities, Units 1 and 2 are listed in Table E-2.

Table E-1. Consultation Correspondence

Source	Recipient	Date of Letter
U.S. Nuclear Regulatory Commission (P. T. Kuo)	U.S. Fish and Wildlife Service (R. C. Nelson)	March 12, 2003
Illinois Department of Natural Resources (S. K. Davis)	U.S. Nuclear Regulatory Commission	May 8, 2003
U.S. Fish and Wildlife Service (R. C. Nelson)	U.S. Nuclear Regulatory Commission (P. T. Kuo)	June 6, 2003
U.S. Nuclear Regulatory Commission (P. T. Kuo)	State Historical Society of Iowa (A. Walker)	July 1, 2003
U.S. Nuclear Regulatory Commission (P. T. Kuo)	Illinois Historic Preservation Agency (M. Crossland)	July 1, 2003
U.S. Nuclear Regulatory Commission (P. T. Kuo)	U.S. Fish and Wildlife Service (R. Nelson)	August 12, 2003
U.S. Fish and Wildlife Service (R. C. Nelson)	U.S. Nuclear Regulatory Commission (L.L. Wheeler)	September 15, 2003
U.S. Nuclear Regulatory Commission (L.L. Wheeler)	Exelon Energy (F. Marquez)	September 22, 2003

Table E-1. Federal, State, Local, and Regional Licenses, Permits, Consultations, and Other Approvals for Current Quad Cities Units 1 and 2 Operation

Agency	Authority	Description	Number	Issue Date	Expiration Date	Remarks
NRC	Atomic Energy Act 10 CFR Part 50	Operating license, Quad Cities Unit 1	DPR-29	December 14, 1972	December 14, 2012	Authorizes operation of Quad Cities Unit 1.
NRC	Atomic Energy Act 10 CFR Part 50	Operating license, Quad Cities Unit 2	DPR-29	December 14, 1972	December 14, 2012	Authorizes operation of Quad Cities Unit 2.
FWS	Section 7 of the Endangered Species Act (16 USC 1536)	Consultation	NA	N/A	NA	Requires a Federal agency to consult with FWS regarding whether a proposed action will affect endangered or threatened species.
NMFS	Section 7 of the Endangered Species Act (16 USC 1536)	Consultation	N/A	N/A	N/A	
Illinois Historic Preservation Agency	Section 106 of the National Historic Preservation Act (16 USC 470f)	Consultation	N/A	N/A	N/A	The National Historic Preservation Act requires Federal agencies to take into account the effect of any undertaking on any district, site, building, structure, or object that is included in or eligible for inclusion in the National Register of Historic Places.
IEPA	Illinois Environmental Protection Act (Title 35 IAC, Subtitle C, Ch. 1)	National Pollution Discharge Elimination System	N/A	N/A	N/A	Permit for discharge of wastewater and once- through cooling water to the Mississippi. Section 1.E.15 of the permit states that the permit constitutes certification of compliance with Section 401 of the Federal Water Pollution Control Act (Clean Water Act).

Table E-1 (contd)

Agency	Authority	Description	Number	Issue Date	Expiration Date	Remarks
IEPA	IRS Ch. 111-1/2 Section 1039	Federally Enforceable Air Operating Permit	161807AAB	December 11, 2000	December 11, 2005	This permit authorizes emissions from diesel emergency generators, miscellaneous diesel engines, and miscellaneous emissions units and activities.
IEPA	IRS Ch. 111-1/2, Section 1039	Open Burning permit	App. #B0212031 ID #043083 Location ID #161807AAB	February 16, 2003	February 16, 2004	Open burning for emergency response fire fighting training
CFR – Code fo Federal Regulations FWS – U.S. Fish and Wildlife Service NRC – Nuclear Regulatory Commission NMFS – National Marine Fisheries Service IEPA – Illinois Environmental Protection Act IRS – Illinois Revised Statutes						

Appendix E



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D C 20555-0001

March 12, 2003

Mr Rick Nelson
Field Supervisor
U S Fish and Wildlife Service
4469 48th Avenue Court
Rock Island, IL 61201

SUBJECT REQUEST FOR COMMENTS CONCERNING QUAD CITIES NUCLEAR
POWER STATION APPLICATION FOR OPERATING LICENSE RENEWAL

Dear Mr Nelson

The U S Nuclear Regulatory Commission (NRC) is reviewing an application for the renewal of the operating license for the Quad Cities Nuclear Power Station (QCNPS), located on the east bank of Pool 14 of the Mississippi River. As part of the review of the license renewal application, the NRC is preparing a Supplemental Environmental Impact Statement (SEIS) under the provision of the National Environmental Policy Act (NEPA) which includes analyses of pertinent environmental issues, including endangered or threatened species and impacts to fish and wildlife. This letter is being submitted under the provisions of the Endangered Species Act and the Fish and Wildlife Coordination Act.

The proposed action would include use and continued maintenance of existing facilities and transmission lines and would not result in any new construction or disturbance. The Quad Cities Station is located in Rock Island County, Illinois. In total, for the specific purpose of connecting QCNPS to the regional transmission system, there are approximately 53 miles of corridor that occupy around 1100 acres of land. The transmission lines traverse the counties of Rock Island and Whiteside Counties, Illinois, and Scott and Clinton Counties in Iowa. Starting at QCNPS, the Davenport line runs south of the plant, turns west crossing the Mississippi River for 12.8 miles with a 180 foot right-of-way, ending just north of Davenport, Iowa. The Barstow line runs 2 miles southeast of QCNPS, and has a 520 foot right-of-way that ends in Rock Island County. There are two Nelson lines. The first is approximately 2 miles long heading southeast with a 520 foot wide right-of-way ending in Rock Island County, and the other line with a corridor width of 145 feet, runs 33 miles east of QCNPS ending in Rock Falls, Illinois. The last line connecting QCNPS to the regional system is the Rock Creek line, that runs 5 miles north of the station with a 170 foot right-of-way, terminates in Comanche, Iowa. Three figures are enclosed which show counties that fall within a 50-mile radius of QCNPS, a site boundary map, and a transmission line map.

The plant uses once-through (open-cycle) cooling water system which draws from and discharges to the Mississippi River to remove waste heat from the facility. River water is drawn through a canal, that is perpendicular to river flow, into the plant. The heated water is discharged back to the Mississippi River through two 16-foot-diameter diffuser pipes into the deepest part of the river channel. The Mississippi River in the vicinity of the plant is considered part of the aquatic environment of interest.

R Nelson


-2-

To support the environmental impact statement preparation process and to ensure compliance with Section 7 of the Endangered Species Act, the NRC requests a list of species and information on protected, proposed, and candidate species and critical habitat that may be in the vicinity of the Quad Cities Station and its associated transmission lines. In addition, please provide any information you consider appropriate under the provisions of the Fish and Wildlife Coordination Act.

We plan to hold a public NEPA scoping meeting on April 8, 2003, at The Mark of the Quad Cities, 1201 River Drive, Moline, Illinois. You and your staff are invited to attend. Your office will receive a copy of the draft SEIS along with a request for comments. The anticipated publications date for the Draft SEIS is November 2003.

If you have any questions concerning OCHPS, the license renewal application, or other aspects of this project, please contact Mr. Louis Wheeler, Senior Project Manager, at (301) 415-1444 or by email at DxW@nrc.gov.

Sincerely,


Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

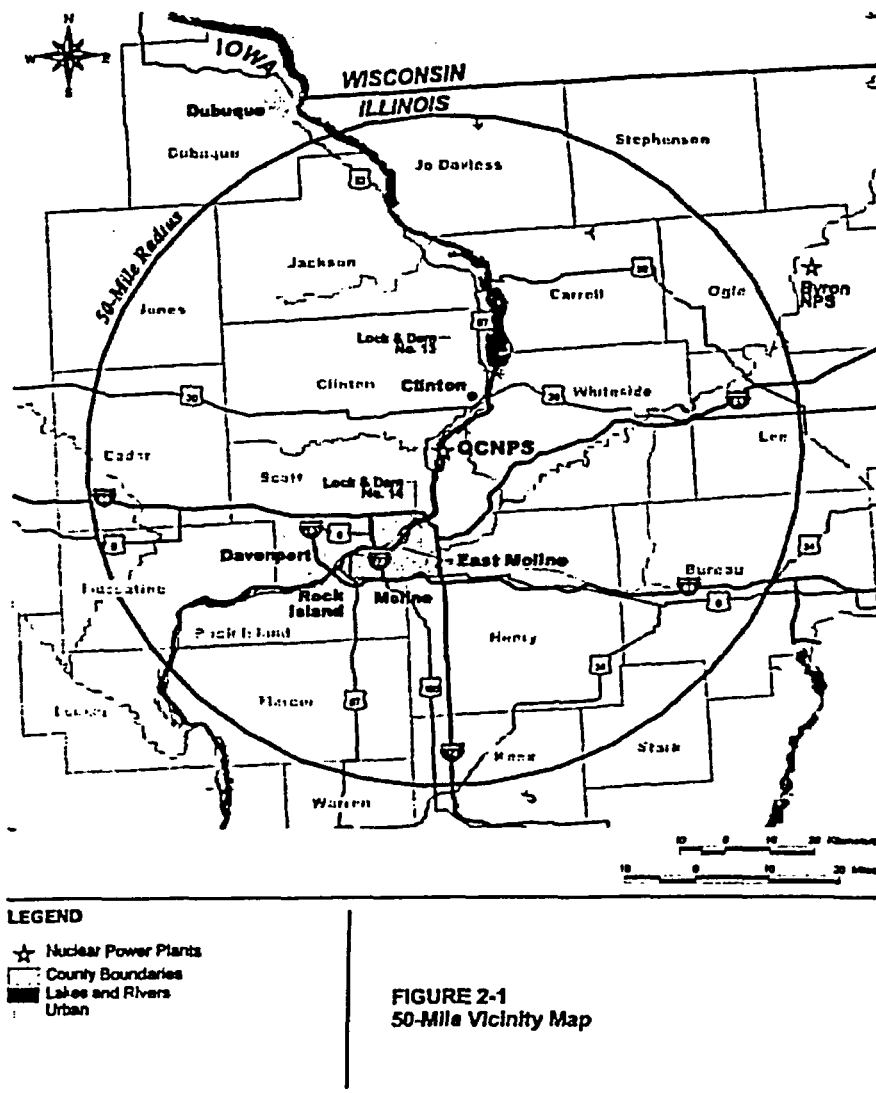
Docket Nos. 50-254 and 50-265

Enclosure. As stated

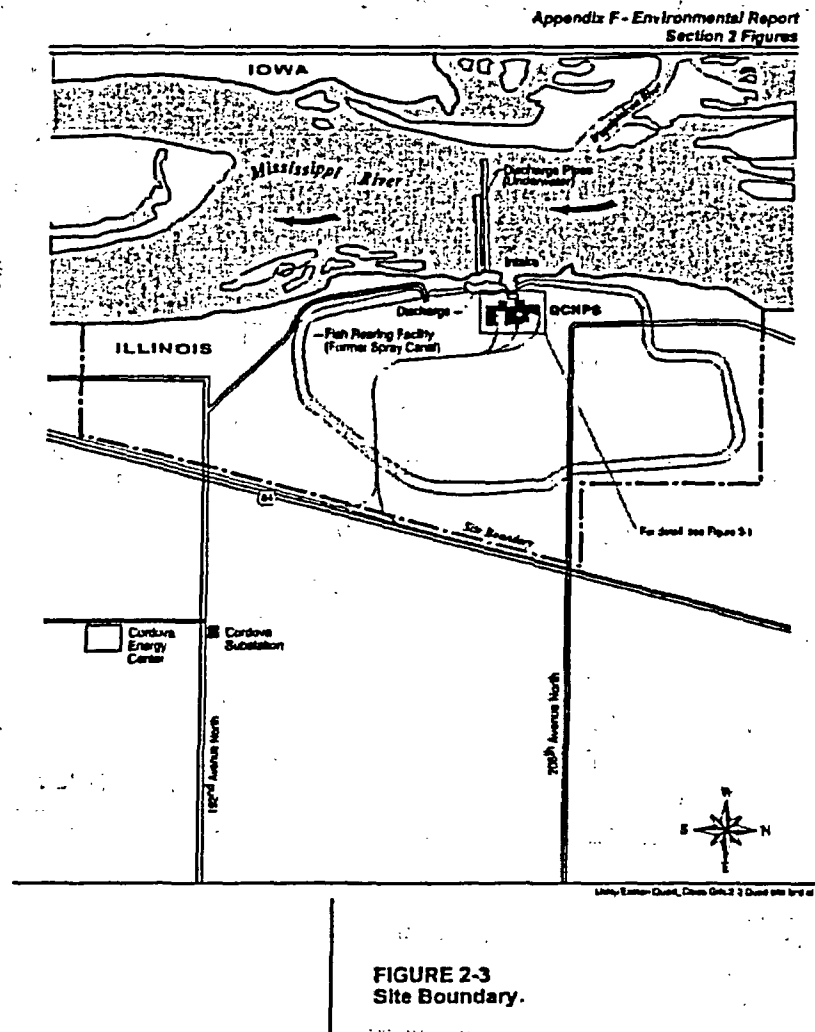
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Appendix E

Appendix F - Environmental Report



Appendix F - Environmental Report

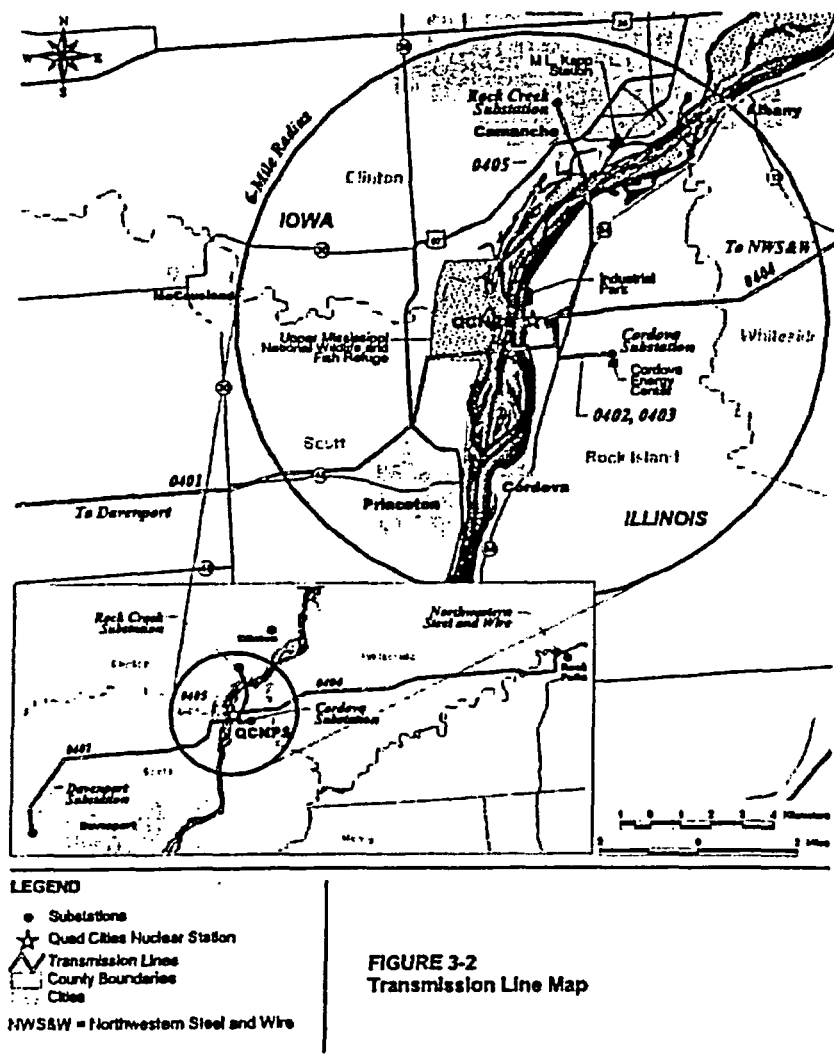


Quad Cities
License Renewal Application

Page F2-33

Appendix E

Appendix F - Environmental Report





Illinois Department of Natural Resources

One Natural Resources Way • Springfield Illinois 62702-1271

<http://dnr.state.il.us>

May 8, 2003

Rod R. Blagojevich, Governor

3/14/03
68 FR 12385
(6)

NRC Docket Nos. 50-254 and 50-265
50-238 and 50-249

Chief of Rules and Directives Branch
Division of Administrative Services
Mailstop T-6D59
United States Nuclear Regulatory Commission
Washington, DC 20555

RECEIVED
MAY 19 2003
NRC
Division of Administrative Services

RE: Dresden Nuclear Power Station, Units 2 & 3 License Renewal
Grundy County - License Nos. DPR-19 and DPR-25
Quad Cities Nuclear Power Station, Units 1 & 2 License Renewal
Rock Island County - License Nos. DPR-29 and DPR-30

Endangered Species Consultation Program
Natural Heritage Database Review #'s 0201014 & 0201015

To Whom This Concerns,

Thank you for submitting the January 3, 2003 operating license renewal applications regarding the Quad Cities Nuclear Power Station, Units 1 & 2 and Dresden Nuclear Power Station, Units 2 & 3 for consultation in accordance with the *Illinois Endangered Species Protection Act* (520 ILCS 10/11), the *Illinois Natural Areas Preservation Act* (525 ILCS 30/17), and Title 17 *Illinois Administrative Code* Part 1075. The Natural Heritage Database identified the presence of State protected resources within the vicinity of portions of the existing transmission lines associated with each power station. Adverse impacts to State protected resources do not appear likely. Excelsior has been advised to inform the Department if new transmission lines are proposed in the future.

The Department thoroughly discussed and evaluated the operating license renewal applications for each of the subject power stations. It is the Department's biological opinion that continued operation of the power stations, as described and detailed in the operating license applications, will not adversely affect State protected resources or existing environmental conditions in the immediate vicinity of the Dresden and Quad Cities nuclear power stations.

Consultation is limited to State-listed threatened or endangered species, Illinois Natural Areas and dedicated Land & Water Reserves and Nature Preserves; it does not entail a comprehensive environmental impact assessment. The Department may raise concerns through other venues regarding potential impacts to other natural resources as it deems appropriate.

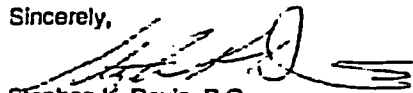
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Appendix E

NRC Docket Nos. 50-254 and 50-265
50-238 and 50-249

Thank you for the opportunity to comment on these nuclear power station operating license renewal applications. Should you have any questions, please do not hesitate to contact me

Sincerely,



Stephen K. Davis, P.G.
Chief
Division of Natural Resource Review and Coordination
Office of Realty and Environmental Planning

cc: Division File
M. Conlin
T. Hickman
R. Pietruszka
D. Wheeler, NRC
K. Jury, Exelon



IN REPLY REFER
TO
FWS/RIFO

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Rock Island Field Office
4469 48th Avenue Court
Rock Island, Illinois 61201
Phone: (309) 793-5800 Fax: (309) 793-5804



June 6, 2003

United States Nuclear Regulatory Commission
Attn: Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation
Washington, D C. 20555-0001

Dear Pao-Tsin Kuo

This is in response to your letter of March 12, 2003, requesting our comments regarding federally listed threatened and endangered species for the proposed Quad Cities nuclear power plant station application for operating license renewal for the Quad Cities Station in Rock Island County, Illinois.

The following federally listed species are known to occur in Rock Island and Whiteside Counties, Illinois and Scott and Clinton Counties, Iowa.

<u>Classification</u>	<u>Common Name (Scientific Name)</u>	<u>Habitat</u>
Rock Island County		
Threatened	Bald eagle <i>Haliaeetus leucocephalus</i>	wintering
Endangered	Higgins' eye pearly mu ssel <i>Lampsilis higginsii</i>	sand/gravel substrates swift flowing current
Whiteside County		
Threatened	Bald eagle <i>Haliaeetus leucocephalus</i>	wintering
Scott County		
Threatened	Bald eagle <i>Haliaeetus leucocephalus</i>	wintering

Appendix E

Pao-Tsin Kuo

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Endangered	Higgins' eye pearly mussel <i>Lampsilis higginsii</i>	sand/gravel substrates swift flowing current
Clinton County Threatened	Bald eagle <i>Haliaeetus leucocephalus</i>	wintering/Breeding
Endangered	Higgins' eye pearly mussel <i>Lampsilis higginsii</i>	sand/gravel substrates swift flowing current
Endangered	Iowa Pleistocene snail (<i>Discus macclintocki</i>)	algific talus slopes
Statewide Threatened	Prairie bush-clover <i>Lespedeza leptostachya</i>	dry to mesic prairies
Threatened	Eastern prairie fringed orchid <i>Discus macclintocki</i>	wet grassland habitats
Endangered	Indiana bat	caves, mines; small stream corridors with well- developed riparian woods, upland and bottomland forests

The threatened bald eagle is listed as breeding in Clinton and Scott Counties, Iowa. Bald eagles build their nests in large trees near rivers or lakes. A typical nest is around 5 feet in diameter. Eagles often use the same nest year after year.

During the winter, this species feeds on fish in the open water areas created by dam tailwaters, the warm water effluents of power plants and municipal and industrial discharges, or in power plant cooling ponds. The more severe the winter, the greater the ice coverage and the more concentrated the eagles become. They roost at night in groups in large trees adjacent to the river in areas that are protected from the harsh winter elements. They perch in large shoreline trees to rest or feed on fish. There is no critical habitat designated for this species. The eagle may not be harassed, harmed, or disturbed when present nor may nest trees be cleared.

The endangered Higgins' eye pearly mussel is known to occur in the Mississippi River north of Lock and Dam 20 which includes the above listed counties. This species prefers sand/gravel substrates with a swift current and is most often found in the main channel border or an open, flowing side channel.

You should refer to the following document, "2001 Monitoring Report – Unionid Relocation from the Cordova Energy Effluent Site at Mississippi River Mile 504," (Ecological Specialists, Inc., 2002). Freshwater mussels being affected by the effluent plume of the power plant were relocated in 1999. The Fish and Wildlife Service issued a Biological Opinion stating that the

Pao-Tsin Kuo

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project was "not likely to jeopardize the continued existence of *L. higginsi*" and allowed an incidental take of 33 *L. higginsi* over the life of the project (USFWS, 1999). Conditions of the Biological Opinion included relocating unionids from the discharge area and establishing a monitoring program for relocated unionids and unionids that might recolonize the discharge area.

One of the largest populations of *Higgins' eye pearl mussel* known to occur is in the Mississippi River near Cordova. The Biological Opinion and 2001 Monitoring Report should be reviewed and the conditions stated in these documents should be included in your environmental impact statement. If any other projects are located near a known Higgins' eye mussel bed, it may be necessary to conduct a survey to determine the presence of the species.

The endangered Iowa pleistocene snail is known to occur on north-facing slopes of the driftless area in Clinton County, Iowa. It occupies algific (cold producing) talus slopes at the outlet of underground ice caves along limestone bluffs within a narrow regime of soil moisture and temperature. There is no critical habitat designated. It must not be harmed, harassed or disturbed.

The prairie bush clover occupies dry to mesic prairies with gravelly soil. Federal regulations prohibit any commercial activity involving this species or the destruction, malicious damage or removal of this species from Federal land or any other lands in knowing violation of State law or regulation, including State criminal trespass law. This species should be searched for whenever prairie remnants are encountered.

The eastern prairie fringed orchid occupies wet grassland habitats. Federal regulations prohibit any commercial activity involving this species or the destruction, malicious damage or removal of this species from Federal land or any other lands in knowing violation of State law or regulation, including State criminal trespass law. This species should be searched for whenever wet prairie remnants are encountered.

The Indiana bat potentially may occur in all counties in Illinois and Iowa south of Interstate 80.

During the summer, the Indiana bat frequents the corridors of small streams with well developed riparian woods as well as mature upland forests. It forages for insects along the stream corridor, within the canopy of floodplain and upland forests, over clearings with early successional vegetation (old fields), along the borders of croplands, along wooded fencerows, and over farm ponds and in pastures. It has been shown that the foraging range for the bats varies by season, age, and sex and ranges up to 81 acres (33ha). It roosts and rears its young in cavities and beneath the loose bark some live species of trees and those of large dead or dying trees. It winters in caves and abandoned mines.

An Indiana bat maternity colony typically consists of a primary roost tree and several alternate roost trees. The use of a particular tree appears to be influenced by weather conditions (temperature and precipitation). For example, dead trees found in more open situations were used more often during cooler or drier days while interior live and dead trees were selected during periods of high temperature and/or precipitation. It has been shown that pregnant and neonatal bats do not thermoregulate well and the selection of the roost tree with the appropriate microclimate may be a matter of their survival. The primary roost tree, however, appears to be

Appendix E

Pao-Tsin Kuo

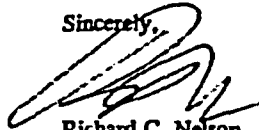
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used on all days and during all weather conditions by at least some bats. Indiana bats tend to be philopatric, i.e., they return to the same roosting area year after year.

These comments provide technical assistance only and do not constitute a report of the Secretary of the Interior on a project within the meaning of Section 2(b) of the Fish and Wildlife Coordination Act, do not fulfill the requirements under Section 7 of the Endangered Species Act, nor do they represent the review comments of the U.S. Department of the Interior on any forthcoming environmental statement.

If you have any questions concerning our comments, please contact Kraig McPeck of my staff at (309) 793-5800 ext. 210.

Sincerely,



Richard C. Nelson
Supervisor

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

July 1, 2003

Ms. Anita Walker
Acting State Historic Preservation Officer
State Historical Society of Iowa
600 East Locust Street
Des Moines, IA 50319-0290

SUBJECT: QUAD CITIES NUCLEAR POWER STATION LICENSE RENEWAL REVIEW
(REFERENCE NO. 020482156)

Dear Ms. Walker:

The U.S. Nuclear Regulatory Commission (NRC) staff is reviewing an application to renew the operating licenses for Quad Cities Nuclear Power Station, Units 1 and 2 (QCNPS), which is located in Rock Island County, Illinois. Exelon Generation Company, LLC (Exelon) owns 75 percent of QCNPS and MidAmerican Energy Company (MidAmerican) owns the remaining 25 percent. Exelon holds the NRC license to operate the plant, acting for itself and as agent for MidAmerican. The application for renewal was submitted by Exelon on January 3, 2003, pursuant to NRC requirements at Title 10 of the *Code of Federal Regulations* Part 54 (10 CFR 54). The NRC has established that, as part of the staff review of any nuclear power plant license renewal action, a site-specific Supplemental Environmental Impact Statement (SEIS) to its "Generic Environmental Impact Statement for License Renewal of Nuclear Plants" (GEIS), NUREG-1437, will be prepared under the provisions of 10 CFR Part 51, the NRC rules that implement the National Environmental Policy Act (NEPA). In accordance with 36 CFR 800.8, the SEIS will include analyses of potential impacts to historic and cultural resources. A draft SEIS is scheduled for publication in November of 2003, and will be provided to you for review and comment.

In the context of the National Historic Preservation Act, the Agency official (the Director, Office of Nuclear Reactor Regulation, NRC) has determined that the area of potential effect (APE) for a license renewal action is the area at the power plant site and its immediate environs which may be impacted by post-license renewal land disturbing operation or projected refurbishment activities associated with the proposed action. The APE may extend beyond the immediate environs in those instances where post-license renewal land disturbing operations or projected refurbishment activities, specifically related to license renewal, potentially have an effect on known or proposed historic sites. This determination is made irrespective of ownership or control of the lands of interest.

While preparing its application, Exelon contacted your office by letter dated April 17, 2002, and your office responded on June 24, 2002. In its letter, Exelon stated that the operation of QCNPS, including the maintenance of identified transmission lines, through the license renewal term is not expected to affect cultural or historic resources in the area. Exelon further stated that no new construction was planned, and maintenance activities would be limited to previously disturbed areas. The June 24, 2002, State Historical Society of Iowa response letter stated that based on the information provided, no historic properties would be affected, and your office could concur with a determination of "No Historic Properties Affected" for this proposed project.

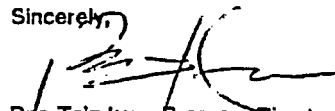
Appendix E

A Walker

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We request that you respond to this letter and indicate whether there are any changes to the determination in your June 24, 2002, letter to Exelon. For your information, enclosed is one example of a letter sent from the NRC staff to 15 Native American Tribes identified by the Bureau of Indian Affairs as having potential interest in the proposed undertaking affording them the opportunity to participate in this process and identify issues of concern to them. No issues have been identified to date. If you have any questions or require additional information, please contact the Environmental Project Manager for the OCNIPS project, Duke Wheeler at 301-415-1444 or D.W@nrc.gov.

Sincerely,



Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket Nos 50-254, 50-265

Enclosure As stated

cc w/o encl See next page

ENCLOSURE

**LETTER TO THE HONORABLE ALEX WALKER, JR, CHAIRPERSON
SAC & FOX NATION OF THE MISSISSIPPI IN IOWA
(NATIVE AMERICAN TRIBE IDENTIFIED BY THE BUREAU OF INDIAN AFFAIRS)
MARCH 11, 2003**



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

March 11, 2003

The Honorable Alex Walker, Jr., Chairperson
Sac & Fox Nation of the Mississippi in Iowa
349 Meskawaki Road
Tama, IA 52339

SUBJECT U.S. NUCLEAR REGULATORY COMMISSION REVIEW OF THE QUAD CITIES
NUCLEAR POWER STATION LICENSE RENEWAL APPLICATION

Dear Mr. Walker:

The U.S. Nuclear Regulatory Commission (NRC) is seeking input for its environmental review of an application from Exelon Generation Company, LLC (Exelon) to renew its operating license for the Quad Cities Nuclear Power Station, Units 1 and 2 (QCNP), located in Rock Island County, Illinois. QCNP is in close proximity to lands that may be of interest to the Sac & Fox Nation. As described below, the NRC process includes an opportunity for public participation in the environmental review. We want to ensure that you are aware of our efforts and, pursuant to 10 CFR 51.28(b), the NRC invites the Sac & Fox Nation of the Mississippi in Iowa to provide input to the scoping process relating to the NRC's environmental review of the application.

The NRC will hold public scoping meetings for the QCNP license renewal supplement to the NRC's "Generic Environmental Impact Statement for License Renewal of Nuclear Plants" (GEIS) (NUREG-1437). These scoping meetings will be held at the The Mark of the Quad Cities, 1201 River Drive, Moline, Illinois, on April 8, 2003. There will be two sessions to accommodate interested parties. The first session will convene at 1:30 p.m. and will continue until 4:30 p.m., as necessary. The second session will convene at 7:00 p.m., with a repeat of the overview portions of the meeting, and will continue until 10:00 p.m., as necessary. Additionally, the NRC staff will host informal discussions one hour before the start of each session. No formal comments on the proposed scope of the supplement to the GEIS will be accepted during the informal discussions. To be considered, comments must be provided either at the transcribed public meetings or in writing. The application and the environmental review process are described below.

Under NRC regulations, the original operating license for a nuclear power plant is issued for up to 40 years. The license may be renewed for up to an additional 20 years if NRC requirements are met. The current operating licenses for QCNP will expire in 2012. Exelon submitted an environmental report as part of its application for renewal of the QCNP operating license on January 3, 2003. The application is electronically available for inspection from the Publicly Available Records component of NRC's Agencywide Documents Access and Management System (ADAMS). ADAMS is accessible at <http://www.nrc.gov/reading-rm/adams.html>, which provides access through the NRC's Public Electronic Reading Room (PERR) link. If you do not have access to ADAMS or if there are problems in accessing the documents located in ADAMS, contact the NRC's Public Document Room (PDR) Reference staff at 1-800-397-4209, 301-415-4737, or by e-mail to pdr@nrc.gov. In addition, the application can be viewed on the Internet <http://www.nrc.gov/reactors/operating/licensing/renewal/applications/dresden-quad.html>.

A Walker

- 2 -

A paper copy of the document can be viewed at the NRC's PDR, located at One White Flint North, 11555 Rockville Pike (first floor), Rockville, Maryland, at the Cordova District Library, 402 Main Avenue, Cordova, Illinois, the River Valley Library, 214 South Main Street, Port Byron, Illinois, and at the Davenport Public Library, 321 Main Street, Davenport, Iowa. Also, the GEIS assesses the scope and impact of environmental effects that would be associated with license renewal at any nuclear power plant site. A copy of this document can also be found on the NRC's website or at the NRC's PDR.

The NRC is gathering information for the document that will be a QCNPS-specific supplement to the GEIS. The supplement will contain the results of the review of the environmental impacts on the area surrounding the QCNPS site that are related to terrestrial ecology, aquatic ecology, hydrology, cultural resources, and socioeconomic issues (among others) and will contain a recommendation regarding the environmental acceptability of the license renewal action.

Please submit any written comments the Sac & Fox Nation of the Mississippi in Iowa may have to offer on the scope of the environmental review by May 12, 2003. Comments should be submitted either by mail to the Chief, Rules and Directives Branch, Division of Administrative Services, Mail Stop T-6 D59, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555-0001, or by e-mail to QuadCitiesEIS@nrc.gov.

At the conclusion of the scoping process, the NRC staff will prepare a summary of the significant issues identified, the conclusions reached, and will mail a copy to you.

The NRC will prepare a draft supplemental environmental impact statement (SEIS) for public comment, and will hold another set of public meetings in the site vicinity to solicit comments on the draft. A copy of the draft SEIS will be sent to you for your review and comment. After consideration of public comments received on the draft, the NRC will prepare a final SEIS. The issuance of a final environmental statement for QCNPS is planned for July 2004. If you need additional information regarding the environmental review process, please contact Louis L. Wheeler, Project Manager, at (301) 415-1444.

Sincerely,



Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts Program
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket Nos. 50-254, 50-265

cc See next page

Appendix E



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

July 1, 2003

Mr. Maynard Crossland
Director
Illinois Historic Preservation Agency
Preservation Services Division
One Old State Capitol Plaza
Springfield, IL 62701

SUBJECT QUAD CITIES NUCLEAR POWER STATION LICENSE RENEWAL REVIEW
(IHPA LOG NO 020116003WVA)

Dear Mr. Crossland:

The U.S. Nuclear Regulatory Commission (NRC) staff is reviewing an application to renew the operating licenses for Quad Cities Nuclear Power Station, Units 1 and 2 (QCNPS), which is located in Rock Island County, Illinois. Exelon Generation Company, LLC (Exelon) owns 75 percent of QCNPS and MidAmerican Energy Company (MidAmerican) owns the remaining 25 percent. Exelon holds the NRC license to operate the plant, acting for itself and as agent for MidAmerican. The application for renewal was submitted by Exelon on January 3, 2003, pursuant to NRC requirements at Title 10 of the *Code of Federal Regulations*, Part 54 (10 CFR 54). The NRC has established that, as part of the staff review of any nuclear power plant license renewal action, a site-specific Supplemental Environmental Impact Statement (SEIS) to its "Generic Environmental Impact Statement for License Renewal of Nuclear Plants" (GEIS), NUREG-1437, will be prepared under the provisions of 10 CFR Part 51. The NRC rules that implement the National Environmental Policy Act (NEPA). In accordance with 36 CFR 800.8, the SEIS will include analyses of potential impacts to historic and cultural resources. A draft SEIS is scheduled for publication in November of 2003, and will be provided to you for review and comment.

In the context of the National Historic Preservation Act, the Agency official (the Director, Office of Nuclear Reactor Regulation, NRC) has determined that the area of potential effect (APE) for a license renewal action is the area at the power plant site and its immediate environs which may be impacted by post-license renewal land disturbing operation or projected refurbishment activities associated with the proposed action. The APE may extend beyond the immediate environs in those instances where post-license renewal land disturbing operations or projected refurbishment activities, specifically related to license renewal, potentially have an effect on known or proposed historic sites. This determination is made irrespective of ownership or control of the lands of interest.

While preparing its application, Exelon contacted your office by letter dated January 11, 2002, and your office responded on February 7, 2002. In its letter, Exelon stated that the operation of QCNPS, including the maintenance of identified transmission lines, through the license renewal term is not expected to affect cultural or historic resources in the area. Exelon further stated that no new construction was planned, and maintenance activities would be limited to previously disturbed areas. The February 7, 2002, response letter stated that, based on the information provided, no historic properties would be affected, and IHPA had no objection to the undertaking proceeding as planned.

M Crossland

2

We request that you respond to this letter and indicate whether there are any changes to the determination in your February 7, 2002, letter to Exelon. For your information, enclosed is one example of a letter sent from the NRC staff to 15 Native American Tribes identified by the Bureau of Indian Affairs as having potential interest in the proposed undertaking affording them the opportunity to participate in this process and identify issues of concern to them. No issues have been identified to date. If you have any questions or require additional information, please contact the Environmental Project Manager for the QCNPIS project, Duke Wheeler at 301-415-1444 or DXW@nrc.gov

Sincerely,



Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket Nos 50-254, 50-265

Enclosure As stated

cc w/o encl See next page

Appendix E

ENCLOSURE

LETTER TO THE HONORABLE JOHN A BARRETT, JR, CHAIRPERSON
CITIZEN POTAWATOMI NATION, OKLAHOMA
(NATIVE AMERICAN TRIBE IDENTIFIED BY THE BUREAU OF INDIAN AFFAIRS)
MARCH 11, 2003



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

March 11, 2003

The Honorable John A. Barrett, Jr., Chairperson
Citizen Potawatomi Nation, Oklahoma
1901 South Gordon Cooper Drive
Shawnee, Ok 74801

SUBJECT: U.S. NUCLEAR REGULATORY COMMISSION REVIEW OF THE QUAD CITIES
NUCLEAR POWER STATION LICENSE RENEWAL APPLICATION

Dear Mr. Barrett:

The U.S. Nuclear Regulatory Commission (NRC) is seeking input for its environmental review of an application from Exelon Generation Company, LLC (Exelon) to renew its operating license for the Quad Cities Nuclear Power Station, Units 1 and 2 (QCNPS), located in Rock Island County, Illinois. QCNPS is in close proximity to lands that may be of interest to the Citizen Potawatomi Nation. As described below, the NRC process includes an opportunity for public participation in the environmental review. We want to ensure that you are aware of our efforts and, pursuant to 10 CFR 51.28(b), the NRC invites the Citizen Potawatomi Nation of Oklahoma to provide input to the scoping process relating to the NRC's environmental review of the application.

The NRC will hold public scoping meetings for the QCNPS license renewal supplement to the NRC's "Generic Environmental Impact Statement for License Renewal of Nuclear Plants" (GEIS) (NUREG-1437). These scoping meetings will be held at the Quad Cities, 1201 River Drive, Moline, Illinois, on April 8, 2003. There will be two sessions to accommodate interested parties. The first session will convene at 1:30 p.m. and will continue until 4:30 p.m., as necessary. The second session will convene at 7:00 p.m., with a repeat of the overview portions of the meeting, and will continue until 10:00 p.m., as necessary. Additionally, the NRC staff will host informal discussions one hour before the start of each session. No formal comments on the proposed scope of the supplement to the GEIS will be accepted during the informal discussions. To be considered, comments must be provided either at the transcribed public meetings or in writing. The application and the environmental review process are described below.

Under NRC regulations, the original operating license for a nuclear power plant is issued for up to 40 years. The license may be renewed for up to an additional 20 years if NRC requirements are met. The current operating licenses for QCNPS will expire in 2012. Exelon submitted an environmental report as part of its application for renewal of the QCNPS operating license on January 3, 2003. The application is electronically available for inspection from the Publicly Available Records component of NRC's Agencywide Documents Access and Management System (ADAMS). ADAMS is accessible at <http://www.nrc.gov/reading-rm/adams.html>, which provides access through the NRC's Public Electronic Reading Room (PERR) link. If you do not have access to ADAMS or if there are problems in accessing the documents located in ADAMS, contact the NRC's Public Document Room (PDR) Reference staff at 1-800-397-4209, 301-415-4737, or by e-mail to pdr@nrc.gov. In addition, the application can be viewed on the Internet <http://www.nrc.gov/reactors/operating/licensing/renewal/applications/dresden-quad.html>.

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J Barrett

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A paper copy of the document can be viewed at the NRC's PDR, located at One White Flint North, 11555 Rockville Pike (first floor), Rockville, Maryland, at the Cordova District Library, 402 Main Avenue, Cordova, Illinois; the River Valley Library, 214 South Main Street, Port Byron, Illinois, and at the Davenport Public Library, 321 Main Street, Davenport, Iowa. Also, the GEIS assesses the scope and impact of environmental effects that would be associated with license renewal at any nuclear power plant site. A copy of this document can also be found on the NRC's website or at the NRC's PDR.

The NRC is gathering information for the document that will be a QCNPS-specific supplement to the GEIS. The supplement will contain the results of the review of the environmental impacts on the area surrounding the QCNPS site that are related to terrestrial ecology, aquatic ecology, hydrology, cultural resources, and socioeconomic issues (among others) and will contain a recommendation regarding the environmental acceptability of the license renewal action.

Please submit any written comments the Citizen Potawatomi Nation may have to offer on the scope of the environmental review by May 12, 2003. Comments should be submitted either by mail to the Chief, Rules and Directives Branch, Division of Administrative Services, Mail Stop T-6 D59, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555-0001, or by e-mail to QuadCitiesEIS@nrc.gov.

At the conclusion of the scoping process, the NRC staff will prepare a summary of the significant issues identified, the conclusions reached, and will mail a copy to you.

The NRC will prepare a draft supplemental environmental impact statement (SEIS) for public comment, and will hold another set of public meetings in the site vicinity to solicit comments on the draft. A copy of the draft SEIS will be sent to you for your review and comment. After consideration of public comments received on the draft, the NRC will prepare a final SEIS. The issuance of a final environmental statement for QCNPS is planned for July 2004. If you need additional information regarding the environmental review process, please contact Louis L. Wheeler, Project Manager, at (301) 415-1444.

Sincerely,



Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts Program
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket Nos. 50-254, 50-265

cc See next page



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001
August 12, 2003

Mr. Rick Nelson
Field Supervisor
U.S. Fish and Wildlife Service
4469 48th Avenue Court
Rock Island, IL 61201

SUBJECT EXPANDED SCOPE OF QUAD CITIES NUCLEAR POWER STATION
APPLICATION FOR OPERATING LICENSE RENEWAL - REQUEST FOR
COMMENTS

Dear Mr. Nelson:

This letter requests comments regarding the expanded scope of the environmental review associated with the proposed license renewal for Quad Cities Nuclear Power Station, Units 1 and 2 (QCNPS).

First, thank you for your letter of June 6, 2003, responding to our March 12, 2003, letter which requested comments on the application submitted by Exelon Generation Company, LLC (Exelon) for the renewal of the operating licenses for QCNPS, located on the east bank of Pool 14 of the Mississippi River near Cordova, Illinois. To support the preparation of an environmental impact statement and to ensure compliance with Section 7 of the Endangered Species Act (ESA), the NRC staff requested information on protected, proposed and candidate species and critical habitat which may be in the vicinity of QCNPS and its associated transmission lines. In addition, we requested that you provide any information considered appropriate under the provisions of the Fish and Wildlife Coordination Act (FWCA).

As you may be aware from our March 12, 2003, letter, as part of the process for review of the license renewal application, the NRC staff is preparing a Supplemental Environmental Impact Statement under the provision of the National Environmental Policy Act. This will include analyses of pertinent environmental issues, including impacts to endangered or threatened species.

Based on new information provided by Exelon in response to an NRC staff request for additional information, the scope of the transmission lines included in this environmental review has been expanded since our March 12, 2003, letter. Specifically, the Davenport, Barstow, South Nelson and North Nelson lines have been extended as follows:

The Davenport Line (0401): Our March 12, 2003, letter stated this line was 12.8 miles from the QCNPS site to Substation 91. The portion of the line applicable to this environmental review has now been extended to a total length of 27 miles from QCNPS to Substation 56.

The Barstow Line (0402): Our letter stated this line was 2 miles long. It ended at the Cordova Energy Station. The portion of this line applicable to this environmental review now runs 17.5 miles from QCNPS to the Barstow Substation.

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The South Nelson Line (0403): Our letter stated this line was 2 miles long. It also ended at the Cordova Energy Station. The portion of this line applicable to our review now runs 41.9 miles from QCNPS to the Nelson Substation.

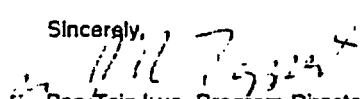
The North Nelson Line (0404): Our letter stated this line was 33 miles long. It ended in Rock Falls, Illinois at the Northwestern Steel and Wire Company. The portion of this line applicable to our review now runs 39.7 miles from QCNPS to the Nelson Substation.

The Rock Creek Line (0405) remains the same as stated in our March 12, 2003, letter.

As provided for by the ESA and FWCA, we request that you consider what effects the expanded scope of the project may have on endangered and threatened species of fish and wildlife. Please notify us of any issues which should be considered in our evaluation.

If you have any questions concerning the process for the NRC staff review of the license renewal application, please contact Mr. Louis Wheeler, Senior Project Manager, of my staff at (301) 415-1444 or via email at DXW@nrc.gov.

Sincerely,

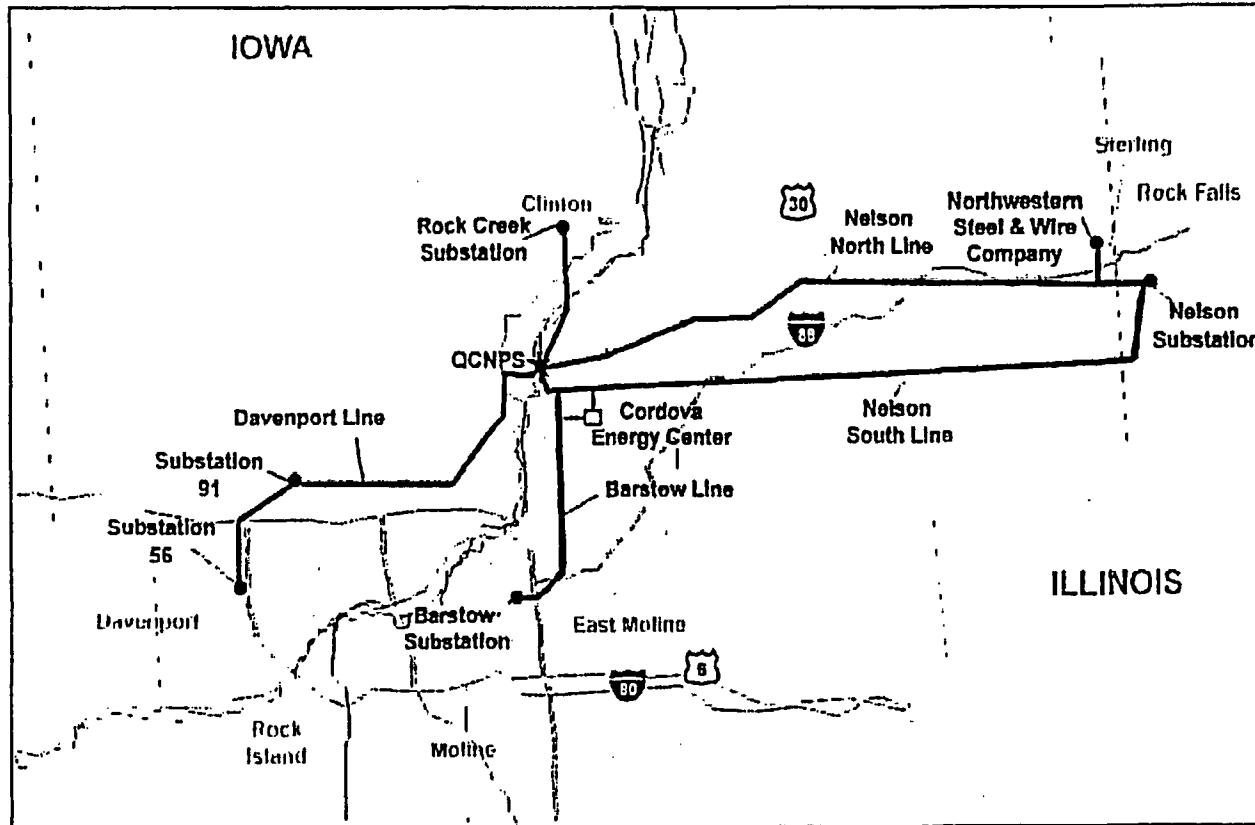

Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket Nos. 50-237 and 50-249

Enclosure: QCNPS Transmission Line Map

cc w/encl. See next page

QCNPS Transmission Lines



ENCLOSURE

Appendix E

November 2003

E-27

Draft NUREG-1437, Supplement 16

Appendix E



BY REPLY REFER
TO
FWS/RIFO

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Rock Island Field Office
4469 48th Avenue Court
Rock Island, Illinois 61201
Phone: (309) 793-5800 Fax: (309) 793-5804



September 15, 2003

United States Nuclear Regulatory Commission
Attn: Mr. Louis Wheeler, Senior Project Manager
License Renewal and Environmental Impacts
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation
Washington, D.C. 20555-0001

Dear Mr. Wheeler:

This is in response to your letter of August 12, 2003, requesting our comments regarding the expanded scope of the environmental review associated with the proposed license renewal for Quad Cities Nuclear Power Station (QCNPS), Units 1 and 2 in Rock Island, Whiteside, Scott, Clinton, and Lee Counties in Iowa and Illinois. The expanded scope consists of expanding transmission lines into other counties.

The following federally listed species are known to occur in the counties of Rock Island, Whiteside, Scott, Clinton and Lee.

<u>Classification</u>	<u>Common Name (Scientific Name)</u>	<u>Habitat</u>
Rock Island County Threatened	Bald eagle <i>Haliaeetus leucocephalus</i>	wintering
Endangered	Higgins' eye pearly mussel <i>Lampsilis higginsii</i>	sand/gravel substrates swift flowing current
Whiteside County Threatened	Bald eagle <i>Haliaeetus leucocephalus</i>	wintering
Scott County Threatened	Bald eagle <i>Haliaeetus leucocephalus</i>	wintering

Mr. Louis Wheeler

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Endangered	Higgins' eye pearly mussel <i>Lampsilis higginsii</i>	sand/gravel substrates swift flowing current
Clinton County Threatened	Bald eagle <i>Haliaeetus leucocephalus</i>	wintering/breeding
Endangered	Higgins' eye pearly mussel <i>Lampsilis higginsii</i>	sand/gravel substrates swift flowing current
Endangered	Iowa Pleistocene snail <i>Discus macclintocki</i>	algific talus slopes
Lee County Threatened	Prairie bush-clover <i>Lespedeza leptostachya</i>	dry to mesic prairies
Statewide Threatened	Prairie bush-clover <i>Lespedeza leptostachya</i>	dry to mesic prairies
Threatened	Eastern prairie fringed orchid <i>Discus macclintocki</i>	wet grassland habitats
South of Interstate 80 in Iowa and Statewide in Illinois Endangered	Indiana bat <i>Myotis sodalis</i>	caves, mines; small stream corridors with well- developed riparian woods; upland and bottomland forests

The threatened bald eagle is listed as breeding Clinton County, Iowa, and wintering in Rock Island and Whiteside Counties in Illinois and Scott and Clinton Counties in Iowa. Bald eagles build their nests in large trees near rivers or lakes. A typical nest is around 5 feet in diameter. Eagles often use the same nest year after year.

During the winter, this species feeds on fish in the open water areas created by dam tailwaters, the warm water effluents of power plants and municipal and industrial discharges, or in power plant cooling ponds. The more severe the winter, the greater the ice coverage and the more concentrated the eagles become. They roost at night in groups in large trees adjacent to the river in areas that are protected from the harsh winter elements. They perch in large shoreline trees to rest or feed on fish. There is no critical habitat designated for this species. The eagle may not be harassed, harmed, or disturbed when present nor may nest trees be cleared. Please refer to the enclosed "Management Guidelines for Breeding Areas."

Mr. Louis Wheeler

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The endangered Higgins' eye pearly mussel is known to occur in the Mississippi River north of Lock and Dam 20, which includes Rock Island, Scott and Clinton Counties. We have entered into Section 7 consultation with QCNPS in the past with regard to this species.

We recommend that you refer to the following document, "2001 Monitoring Report - Unionid Relocation from the Cordova Energy Effluent Site at Mississippi River Mile 504," (Ecological Specialists, Inc., 2002). Freshwater mussels being affected by the effluent plume of the power plant were relocated in 1999. The Fish and Wildlife Service issued a Biological Opinion stating that the project was "not likely to jeopardize the continued existence of *L. higginsii*" and allowed an incidental take of 33 *L. higginsii* over the life of the project (USFWS, 1999). Conditions of the Biological Opinion included relocating unionids from the discharge area and establishing a monitoring program for relocated unionids and unionids that might recolonize the discharge area.

One of the largest populations of *L. higginsii* in the world is known to occur in the Mississippi River near Cordova. The Biological Opinion and 2001 Monitoring Report should be reviewed and the conditions stated in these documents should be included in your environmental impact statement. If any other projects are located near a known Higgins' eye mussel bed, it may be necessary to conduct a survey to determine the presence of the species.

The endangered Iowa Pleistocene snail is known to occur on north-facing slopes of the driftless area in Clinton County, Iowa. It occupies algific (cold-producing) talus slopes at the outlet of underground ice caves along limestone bluffs within a narrow regime of soil moisture and temperature. There is no critical habitat designated. It must not be harmed, harassed or disturbed.

The prairie bush clover is known to occur in Lee County, Illinois and potentially occurs throughout Iowa and Illinois. Prairie bush clover occupies dry to mesic prairies with gravelly soil. Federal regulations prohibit any commercial activity involving this species or the destruction, malicious damage or removal of this species from Federal land or any other lands in knowing violation of State law or regulation, including State criminal trespass law. This species should be searched for whenever prairie remnants are encountered.

The eastern prairie fringed orchid occupies wet grassland habitats and potentially occurs throughout Illinois and the eastern half of Iowa. Federal regulations prohibit any commercial activity involving this species or the destruction, malicious damage or removal of this species from Federal land or any other lands in knowing violation of State law or regulation, including State criminal trespass law. This species should be searched for whenever wet prairie remnants are encountered.

The Indiana bat may occur in all counties in Iowa south of Interstate 80 and statewide in Illinois.

During the summer, the Indiana bat frequents the corridors of small streams with well-developed riparian woods as well as mature upland forests. It forages for insects along the stream corridor, within the canopy of floodplain and upland forests, over clearings with early successional vegetation (old fields), along the borders of croplands, along wooded fence rows, and over farm ponds and in pastures. It has been shown that the foraging range for the bats varies by season, age, and sex and ranges up to 81 acres (33ha). It roosts and rears its young in cavities and

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beneath the loose bark some live species of trees and those of large dead or dying trees. It winters in caves and abandoned mines.

An Indiana bat maternity colony typically consists of a primary roost tree and several alternate roost trees. The use of a particular tree appears to be influenced by weather conditions (temperature and precipitation). For example, dead trees found in more open situations were used more often during cooler or drier days while interior live and dead trees were selected during periods of high temperature and/or precipitation. Indiana bats tend to return to the same roosting area year after year. Please refer to the attached "Indiana bat guidelines for Iowa and Illinois."

Migratory birds

In addition to trying to ensure that electrical transmission lines and structures do not adversely affect threatened and endangered species, the U. S. Fish and Wildlife Service is also interested in minimizing potential impacts to other wildlife resources, particularly migratory birds. The Migratory Bird Treaty Act (16 U.S.C. 703-712) prohibits the taking, killing, possession, sale, transportation and importation of migratory birds, their eggs, parts and nests, except when specifically authorized by the Secretary of the Interior. The Bald and Golden Eagle Protection Act (16 U.S.C. 668) prohibits the taking of any bald or golden eagle except when specifically authorized by the Secretary of the Interior. These laws do not allow the killing of migratory birds, including eagles without a permit. To avoid killing migratory birds, many companies employ raptor and migratory bird deterrents and line configurations, which minimize electrocution. These and other methods are described in *Avian Power Line Interaction Committee (APLIC), 1994; Mitigating Bird Collisions with Power Lines: The State of the Art in 1994, Edison Electric Institute, Washington D.C., 78 pp.*; *Avian Power Line Interaction Committee (APLIC), 1996; Suggested Practices for Raptor Protection on Power Lines, Edison Electric Institute/Raptor Research Foundation, Washington, D. C., 128 pp.* Copies can be obtained via the internet at <http://www.eei.org/productsandservices/descriptionandaccess/> or by calling 1-800-334-3453.

We encourage you to work with us to eliminate loss of migratory birds attributable to power lines and other power transmission facilities. If you would like additional information, please contact us as indicated below.

In addition, The Corps of Engineers is the Federal agency responsible for wetland regulation. We recommend that you contact them for assistance in delineating any wetland types and acreage within the expanded scope of the project. Priority consideration should be given to avoid impacts to these wetland areas. Any activities that would alter these wetlands may require a Section 404 permit. Unavoidable impacts will require a mitigation plan to compensate for any losses of wetland functions and values. The U.S. Army Corps of Engineers, Clock Tower Building, P.O. Box 2004, Rock Island, Illinois 61201, should be contacted for information about the permit process.

These comments provide technical assistance only and do not constitute a report of the Secretary of the Interior on a project within the meaning of Section 2(b) of the Fish and Wildlife Coordination Act, do not fulfill the requirements under Section 7 of the Endangered Species Act, nor do they represent the review comments of the U.S. Department of the Interior on any forthcoming environmental statement.

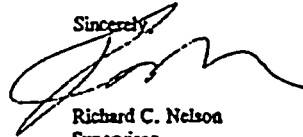
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Mr. Louis Wheeler

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If you have any questions concerning our comments, please contact Ginger Molitor of my staff at (309) 793-5800 ext. 212.

Sincerely,



Richard C. Nelson
Supervisor

On: Janelle Coy
Enclosures

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From:
Northern States Recovery Plan
1983

Appendix E

MANAGEMENT GUIDELINES FOR BREEDING AREAS

The purpose of these guidelines is to provide minimum criteria for protecting bald eagles at their breeding areas from human disturbance and to preserve and enhance important habitat features of these areas. The criteria are based on a synthesis of existing guidelines in present use by the U.S. Forest Service (Eastern Region), U. S. Fish and Wildlife Service, and the views of eagle researchers.

Although eagles often use particular nests for many years, they frequently move to different sites. Turnover of existing nests, from losses to wind, changes by the eagles, and other natural factors may be as much as 12% of the sites per year. Eagle "real estate" is much less fixed than for humans. Thus, the conservation and management of nesting habitat is far more important than the identification and preservation of specific nest sites or even breeding areas.

Eagle tolerance of human presence is highly variable, both seasonally and among different individuals or pairs of eagles. Some bald eagles nest and accept people, boaters, hikers, cabins, roads, and other human presence in very close proximity, possibly as a result of habituation. On the other hand, some may be extremely intolerant and be disturbed readily. This variability must be recognized in both research and management. Management should be conservative and assume that intolerant birds may be present now or in the future. We should be especially conservative in areas with low populations.

All nesting eagles are disturbed more easily at some times of the nesting season than at others. Four periods of sensitivity to disturbance can be identified for nesting areas. These are as follows.

1. Most critical period. Prior to egg laying bald eagles engage in courtship activities and nest building. During this and the incubation periods they are most intolerant of external disturbances and may readily abandon the area. The most critical period for disturbances therefore extends from approximately one month prior to egg laying through the incubation period.
2. Moderately critical period. This includes approximately one month prior to the above period and about four weeks after hatching. Prior to the nesting season individual pairs of eagles vary considerably in time of return to the nest site or, if permanent residents, the time they begin to come into physiological condition for breeding and become sensitive to

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disturbance. After hatching the chicks are quite vulnerable to inclement weather and need frequent brooding and feeding. Disturbance can keep adults from nests and, depending on the weather and length of time involved, may cause weakening or death of chicks. The adults are quite protective of the nest site as long as one or more healthy chicks are present. Thus, disturbance at this time is less critical, although still potentially detrimental, than during the pre-laying and incubation period.

3. Low critical period. This period extends from the time chicks are about one month of age until approximately six weeks after fledging. During this time adults are still quite attached to nesting areas but tolerate moderate amounts of human presence. Restriction should be decided on a case by case basis.
4. Not critical period. The existence of this period depends on whether adults are permanent residents in their nesting areas. In most regions adults leave the vicinity for a few weeks or months each year. During the time they are gone one need be concerned only with activities that alter the habitat in ways that would make it unsuitable for future nesting.

The timing of these periods depends on geographic location. Eagles tend to breed earlier farther south or in coastal locations. Establishment of critical periods in management planning will therefore depend on the timing of nesting in each area.

Management of nesting areas will depend on the amount of suitable habitat, numbers of pairs present, extent of the areas used by nesting eagles, and present land uses. Plans should be prepared for each breeding area and planning should encompass larger units when habitat is suitable and many nesting pairs are present. In planning for a large region, particularly if major changes in land use or development are anticipated, the following major items should be addressed:

1. Distribution of habitat modification. Large contiguous areas of habitat should remain suitable, not just small, specific sites where nests currently are located.
2. Upper limit to habitat modification. Limits on habitat modification should be clearly established in advance, and unplanned development should be discouraged or prohibited. Limits set in advance are generally more acceptable to persons desiring further development; the process permits reasonable negotiation and compromise and limits are easier to enforce.
3. Rate of development. Development should only be allowed to approach the upper limit slowly, over a period of years. Sudden, large-scale development should be prevented if possible.
4. Seasonal timing of human activity. Construction and related activities should be confined to the low or non-critical periods of the year described above.

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5. Human attitudes toward eagles in the area. Much human-eagle interaction depends on the predominant attitude of human residents of each area. Residents and visitors of some areas are very favorably disposed toward the birds, if not proud and quite protective. They may be careful not to disturb the birds and may help prevent disturbance or destruction by other persons. Such attitudes should be encouraged through education and law enforcement. Illegal shooting of eagles, especially young birds of the year still in the vicinity of nests during the fall hunting season, should be severely penalized.

The above guidelines pertain to larger geographic units where several eagles may be nesting. The following pertain to specific breeding areas.

SITE-SPECIFIC MANAGEMENT PLANS

A. Basic information and essential habitat. Site-specific management plans should be tailored to the size and configuration of essential habitats, and should address such factors as the prey base, habitat used for foraging, and any other features necessary for maintaining habitat suitability. In addition, management plans should clearly specify restrictions on human activities and habitat alterations in establishing buffer zones around nests (see next point in outline). For basic information forms, see end of this appendix.

B. Disturbance Buffer Zones for Nest Trees. Each nest within a breeding area will be protected by three zones that become less restrictive to human activity as the distance from the nest increases. Some activities need to be restricted only during the nesting season, or critical periods. Guidelines for zones, based on those developed by the U. S. Forest Service in the Eastern Region and used in several parts of the United States, are described below. If buffer zones are used they should be established around all nest sites within a breeding area regardless of their activity status, since alternate nests often are used as feeding platforms and roosting sites.

1. Primary Zone

- a) Size: The boundary of this zone should be 330 feet (5 chains) from the nest.
- b) Restrictions: All land use except actions necessary to protect or improve the nest site should be prohibited in this zone. Human entry and low-level aircraft operations should be prohibited during the most critical and moderately critical periods, unless performed in connection with eagle research or management by qualified individuals. Motorized access into this zone should be prohibited. Restrictions on human entry

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at other times should be addressed in the breeding area management plan, considering the types, extents, and durations of proposed or likely activities.

2. Secondary zone

- a) Size: This zone should extend 660 feet (10 chains) from the nest.
- b) Restrictions: Land-use activities that result in significant changes in the landscape, such as clearcutting, land clearing, or major construction, should be prohibited. Actions such as thinning tree stands or maintenance of existing improvements can be permitted, but not during the most critical and moderately critical periods. Human entry and low-level aircraft operations should be prohibited during the most critical period unless performed in connection with necessary eagle research and management by qualified individuals. Roads and trails in this zone should be obliterated, or at least closed during the most and moderately critical periods. Restrictions on human entry at other times should be addressed in the breeding area management plan, considering the types, extents, and durations of proposed or likely activities.

3. Tertiary Zone

- a) Size: This is the least restrictive zone. It should extend one-quarter mile (20 chains) from the nest, but may extend up to one-half mile (40 chains) if topography and vegetation permit a direct line of sight from the nest to potential activities at that distance. The configuration of this zone, therefore, may be variable.
- b) Restrictions: Some activities are permissible in this zone except during the most critical period. Each breeding area management plan may identify specific hazards that require additional constraints.

C. Other Management Guidelines.

1. Abandoned Nest Trees

- a) When a tree containing an eagle nest has blown down or has been damaged so it can no longer support a nest, remove all buffer zones. The breeding area management plan itself, however, should remain in effect or be revised, such as by removing buffer zones until a new nest is established.
- b) When a nest structure disappears but the nest tree remains the buffer zones should remain in effect through at least the following three breeding seasons. If the nest is not rebuilt, remove the zoning but still consider the area as essential habitat and protect it accordingly.

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- c) When a nest is classified as a remnant, that is, one that has been unoccupied for five consecutive years, and is not being maintained by eagles, retain only the primary zone.

Roosting and Potential Nest Trees.

- a) Three or more super-canopy trees (preferably dead or with dead tops) should be identified and preserved within one-quarter mile of each nest as roosting and perching sites.
- b) In areas identified as potential nesting habitat, there should be at least four to six over-mature trees of species favored by bald eagles for every 320 acres within 1320 feet of a river or lake larger than 40 acres. These trees should be taller than surrounding trees or at the edge of the forest stand, and there should be clear flight paths to them.
- c) Artificial nest structures may be provided where suitable nest sites are unavailable in occupied or potential habitat. Structures may be placed in trees containing dilapidated nests; in trees without existing nests, but which otherwise appear suitable; or in man-made structures such as powerlines or tripods. Nest platforms should be approximately five to six feet in length and width (25-36 square feet) and be made to last for several years. Roosting structures may be erected using powerpoles with several horizontal perches near the upper end.

3. Prey Base Management

- a) Fisheries management should strive to maintain a prey base consistent with eagle food habits.
- b) In some breeding areas, particularly in the west, mammals form a portion of the diet of bald eagles. Land management in these areas should maintain an adequate prey base in terrestrial habitats.
- c) Feeding of eagles may be considered a valid management tool in areas where natural prey are highly contaminated or temporarily unavailable for some reason. This management option rarely will be used.
- d) In some regions, commercial and sport fishermen may be providing an important but unrecognized (by people) food source for eagles by dumping rough fish. Many commercial fishermen are also suffering from reduced catches of game fish and quotas imposed for the purpose of managing fisheries. Subsidization perhaps in the form of monetary or tax incentives might benefit eagles, fishermen, and possibly the fisheries.

SITE-SPECIFIC MANAGEMENT PLANS
Outline for data file and breeding area management plans

Breeding Area No. and Name: _____

Nest No.(s): _____

Location: _____

Date: _____

By: _____

I. Breeding Area Characteristics

- A. General Description
Nest Site Relationships
Overview of Habitat and Land Uses
- B. Feeding Areas (Known and/or Assumed)
- C. Known or Potential Perch/Roost Trees
- D. Potential Nest Sites Available
- E. Land Ownership within Breeding Area
Identify Acquisition Needs
- F. Post-nesting Use of Habitat

II. Nest Site Characteristics (Each nest in territory)

- A. Tree Measurements (height, DBH, size); Nest Measurements
- B. Condition of Nest Tree
- C. Date Constructed
- D. Timber Type, Size and Density
- E. Distance to Water
- F. Distance to Roads and Other Development
- G. Accessibility
- H. Relation of Nest Height to Surrounding Canopy
- I. Precise Directions for Reaching Nest

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Guidelines for Protection of Indiana Bat Summer Habitat in Illinois

The endangered Indiana bat (*Myotis sodalis*) is known to occur in Adams, *Alexander, Bond, Ford, *Hardin, Henderson, *Jackson, *Jersey, Johnson, *La Salle, Madison, Macoupin, McDonough, *Monroe, Perry, Pike, *Pope, Pulaski, Saline, Schuyler, Scott, *Union, and Vermilion Counties in Illinois. (*Counties with hibernacula) The Blackball Mine in La Salle County has been listed as Critical Habitat. Potential habitat for this species occurs statewide, therefore, Indiana bats are considered to potentially occur in any area with forested habitat.

Indiana bats migrate seasonally between winter hibernacula and summer roosting habitats. Winter hibernacula include caves and abandoned mines. Females emerge from hibernation in late March or early April to migrate to summer roosts. Females form nursery colonies under the loose bark of trees (dead or alive) and/or cavities, where each female gives birth to a single young in June or early July. A maternity colony may include from one to 100 individuals. A single colony may utilize a number of roost trees during the summer, typically a primary roost tree and several alternates. Some males remain in the area near the winter hibernacula during the summer months, but others disperse throughout the range of the species and roost individually or in small numbers in the same types of trees as females. The species or size of tree does not appear to influence whether Indiana bats utilize a tree for roosting provided the appropriate bark structure is present. However, the use of a particular tree does appear to be influenced by weather conditions, such as temperature and precipitation.

During the summer, the Indiana bat frequents the corridors of small streams with riparian woods as well as mature upland forests. It forages for insects along stream corridors, within the canopy of floodplain and upland forests, over clearings with early successional vegetation (old fields), along the borders of croplands, along wooded fencerows, over farm ponds and in pastures. To avoid impacting this species, tree clearing activities should not occur during the period of April 15 to September 15. If a proposed action occurs within a 5-mile radius of a winter hibernacula, tree clearing should be prohibited from April 1 to November 15. If it is necessary to clear trees during this time frame, mist net surveys may be necessary to determine if Indiana bats are present. "Mist Netting Guidelines" can be obtained from our office. A search for this species should be made prior to any cave-impacting activities.

Suitable summer habitat in Illinois is considered to have the following characteristics within a ¼ mile radius of a project site:

- 1) forest cover of 15% or greater;
- 2) permanent water;
- 3) one or more of the following tree species: shagbark and shellbark hickory that may be dead or alive, and dead bitternut hickory, American elm, slippery elm, eastern cottonwood, silver maple, white oak, red oak, post oak, and shingle oak with slabs or plates of loose bark;
- 4) potential roost trees with 10% or more peeling or loose bark

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If the project site contains any habitat that fits the above description, it may be necessary to conduct a survey to determine whether the bat is present. If Indiana bats are known to be present, they must not be harmed, harassed or disturbed when present. Large-scale habitat alterations within known or potential Indiana bat habitat should not be permitted without a bat survey and/or consultation with this office.

Minor tree clearing (i.e. timber stand improvement or clearing of small stands) should conserve trees which are dead or have loose bark and should be limited to non-maternity periods between the dates of September 16 and April 14.

If you have any comments or questions, please contact the Rock Island Field Office at (309) 793-5800.

Guidelines for Protection of Indiana Bat Summer Habitat in Iowa

The endangered Indiana bat (*Myotis sodalis*) has been noted as occurring in Appanoose, Clarke, Davis, Decatur, Des Moines, Henry, Iowa, Jasper, Jefferson, Keokuk, Lee, Louisa, Lucas, Madison, Mahaska, Marion, Monroe, Muscatine, Poweshiek, Ringgold, Union, Van Buren, Wapello, Warren, Washington, and Wayne Counties in Iowa. It could potentially occur in all counties south of Interstate 80, including those portions of Dallas, Polk, Jasper, Poweshiek, Iowa, Johnson, Muscatine and Scott counties south of Interstate 80.

Indiana bats migrate seasonally between winter hibernacula and summer roosting habitats. Winter hibernacula include caves and abandoned mines. Females emerge from hibernation in late March or early April to migrate to summer roosts. Females form nursery colonies under the loose bark of trees (dead or alive) and/or cavities, where each female gives birth to a single young in June or early July. A maternity colony may include from one to 100 individuals. A single colony may utilize a number of roost trees during the summer, typically a primary roost tree and several alternates. Some males remain in the area near the winter hibernacula during the summer months, but others disperse throughout the range of the species and roost individually or in small numbers in the same types of trees as females. The species or size of tree does not appear to influence whether Indiana bats utilize a tree for roosting provided the appropriate bark structure is present. However, the use of a particular tree does appear to be influenced by weather conditions, such as temperature and precipitation.

During the summer, the Indiana bat frequents the corridors of small streams with riparian woods as well as mature upland forests. It forages for insects along stream corridors, within the canopy of floodplain and upland forests, over clearings with early successional vegetation (old fields), along the borders of croplands, along wooded fencerows, over farm ponds and in pastures. To avoid impacting this species, tree clearing activities should not occur during the period of April 15 to September 15.

Suitable summer habitat in Iowa is considered to have the following characteristics within a ½ mile radius of a project site:

- 1) forest cover of 15% or greater;
- 2) permanent water;
- 3) one or more of the following tree species: shagbark and shellbark hickory that may be dead or alive, and dead bitternut hickory, American elm, slippery elm, eastern cottonwood, silver maple, white oak, red oak, post oak, and shingle oak with slabs or plates of loose bark;
- 4) potential roost trees with 10% or more peeling or loose bark

If the project site contains any habitat that fits the above description, it may be necessary to conduct a survey to determine whether the bat is present. If Indiana bats are known to be present, they must not be harmed, harassed or disturbed when present. Large-scale habitat alterations within known or potential Indiana bat habitat should not be permitted without a bat

Appendix E

survey and/or consultation with this office. "Mist Netting Guidelines" can be obtained from our office.

Minor tree clearing (i.e. timber stand improvement or clearing of small stands) should conserve trees which are dead or have loose bark and should be limited to non-maternity periods between the dates of September 16 and April 14.

If you have any comments or questions, please contact the Rock Island Field Office at (309) 793-5800.



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

September 22, 2003

Mr. Fidel Marquez
Vice President, Exelon Energy Delivery
Transmission and Substations
2 Lincoln Centre
Oakbrook Terrace, IL 60181

SUBJECT: INFORMATION REGARDING THE NORTH NELSON LINE PERTAINING TO
QUAD CITIES NUCLEAR POWER STATION LICENSE RENEWAL

Dear Mr. Marquez:

The purpose of this letter is to provide information regarding a transmission line owned, operated and maintained by Exelon Energy Delivery which came to the attention of the U.S. Nuclear Regulatory Commission (NRC) staff during an environmental review related to an application by Exelon Generation Company, LLC (Exelon) for renewal of the operating licenses for Quad Cities Nuclear Power Station, Units 1 and 2 (QC).

An Environmental Report (ER) was included with Exelon's license renewal application. The ER stated in Section 4.13, Electromagnetic Fields - Acute Effects, that EGC calculated induced currents using the AC/DCLINE computer code produced by the Electric Power Research Institute, and the results of the calculations have been verified through field measurements by several utilities. The input parameters included the National Electric Safety Code (NESC) requirements that line sag be determined at 120 degrees Fahrenheit conductor temperature, and the maximum vehicle size under the lines as a tractor trailer truck.

The NESC specifies a maximum field strength of 5 milliamperes. However, Exelon's ER stated that one of the lines reviewed (the North Nelson Line - 0404) had a limiting case induced current of 6.0 milliamperes. The NRC staff has determined that the environmental impact of license renewal is SMALL for lines which comply with NESC specifications. The NRC staff has further determined that for the North Nelson Line, the environmental impact of the proposed license renewal is MODERATE, based on the amount by which this line exceeds the NESC Code specification. This determination will be included in a draft environmental impact statement scheduled for publication in November 2003.

If there are any questions regarding this correspondence, please contact me at (301) 415-1444.

Sincerely,

A handwritten signature in dark ink, appearing to read "Louis L. Wheeler".

Louis L. Wheeler, Senior Project Manager
Environmental Section
License Renewal and Environmental Impacts Program
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket Nos. 50-254 and 50-265

cc: See next page

Appendix F

GEIS Environmental Issues Not Applicable to Quad Cities Units 1 and 2

Appendix F

GEIS Environmental Issues Not Applicable to Quad Cities Units 1 and 2

Table F-1 lists those environmental issues listed in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants (GEIS)* (NRC 1996; 1999)^(a) and 10 CFR Part 51, Subpart A, Appendix B, Table B-1 that are not applicable to Quad Cities Units 1 and 2 because of plant or site characteristics.

Table F-1. GEIS Environmental Issues Not Applicable to Quad Cities Units 1 and 2

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	Category	GEIS Sections	Comment
SURFACE WATER QUALITY, HYDROLOGY, AND USE (FOR ALL PLANTS)			
Altered salinity gradients	1	4.2.1.2.2 4.4.2.	The Mississippi River is an inland freshwater river with no salinity gradient.
Altered thermal stratification of lakes	1	4.2.1.2.3 4.4.2.2	The Quad Cities plant has a once-through cooling system that discharges directly to a river.
Water use conflicts (plants with cooling ponds or cooling towers using make-up water from a small river with low flow)	2	4.3.2.1 4.4.2.1	The Quad Cities plant has a once-through cooling system that discharges directly to a river.
AQUATIC ECOLOGY (FOR PLANTS WITH COOLING-TOWER-BASED HEAT DISSIPATION SYSTEMS)			
Entrainment of fish and shellfish in early life stages	1	4.3.3	This issue is related to heat dissipation systems that are not installed at Quad Cities.
Impingement of fish and shellfish	1	4.3.3	This issue is related to heat dissipation systems that are not installed at Quad Cities.
Heat shock	1	4.3.3	This issue is related to heat dissipation systems that are not installed at Quad Cities.

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

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Table F-1 (contd)

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	Category	GEIS Sections	Comment
GROUND-WATER USE AND QUALITY			
Ground-water use conflicts (potable and service water, and dewatering; plants that use > 100 gpm)	1	4.8.1.1 4.8.1.2	Quad Cities uses more than 100 gpm of groundwater.
Ground-water use conflicts (plants using cooling towers withdrawing make-up water from a small river)	2	4.8.1.3	This issue is related to heat dissipation systems that are not installed at Quad Cities.
Ground-water-use conflicts (Ranney wells)	2	4.8.1.4	Quad Cities Units 1 and 2 do not have or use Ranney wells.
Ground-water quality degradation (Ranney wells)	1	4.8.2.2	Quad Cities Units 1 and 2 do not have or use Ranney wells.
Ground-water quality degradation (saltwater intrusion)	1	4.8.2.1	The Mississippi River is an inland freshwater river with no salinity gradient.
Ground-water quality degradation (cooling ponds in salt marshes)	1	4.8.3	This issue is related to heat dissipation systems that are not installed at Quad Cities.
Ground-water quality degradation (cooling ponds at inland sites)	2	4.8.3	This issue is related to heat dissipation systems that are not installed at Quad Cities.
TERRESTRIAL RESOURCES			
Cooling tower impacts on crops and ornamental vegetation	1	4.3.4	This issue is related to heat dissipation systems that are not installed at Quad Cities.
Cooling tower impacts on native plants	1	4.3.5.1	This issue is related to heat dissipation systems that are not installed at Quad Cities Units 1 and 2.
Bird collisions with cooling towers	1	4.3.5.2	This issue is related to heat dissipation systems that are not installed at Quad Cities Units 1 and 2.
Cooling pond impacts on terrestrial resources	1	4.4.4	This issue is related to heat dissipation systems that are not installed at Quad Cities.

F.1 References

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

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

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

Appendix G

**NRC Staff Evaluation of Severe Accident
Mitigation Alternatives (SAMAs) for Quad
Cities Nuclear Power Station, Units 1 & 2,
in Support of License Renewal
Application**

Appendix G

NRC Staff Evaluation of Severe Accident Mitigation Alternatives (SAMAs) for Quad Cities Nuclear Power Station, Units 1 & 2, in Support of License Renewal Application

G.1 Introduction

Exelon Generation Company, LLC (Exelon) submitted an assessment of SAMAs for Quad Cities as part of the ER (Exelon 2003a). This assessment was based on the most recent Quad Cities Probabilistic Risk Assessment (PRA) available at that time, a plant-specific offsite consequence analysis performed using the MELCOR Accident Consequence Code System 2 (MACCS2), and insights from the Quad Cities Individual Plant Examination (IPE) (ComEd 1996a & b) and Individual Plant Examination of External Events (IPEEE) (ComEd 1997). In identifying and evaluating potential SAMAs, Exelon considered SAMA analyses performed for other operating plants which have submitted license renewal applications, as well as industry and NRC documents that discuss potential plant improvements, such as NUREG-1560 (NRC 1997a). Exelon identified 280 potential SAMA candidates. This list was reduced to 15 unique SAMA candidates by eliminating SAMAs that were not applicable to Quad Cities due to design differences, had already been implemented, or had high implementation costs. (A set of 14 candidate SAMAs is identified in the ER. One additional SAMA that was originally identified for retention was omitted and subsequently identified and addressed while responding to a staff request for additional information.) Exelon assessed the costs and benefits associated with each of the potential SAMAs and concluded that none of the candidate SAMAs evaluated would be cost-beneficial for Quad Cities.

Based on a review of the SAMA assessment, the NRC issued a request for additional information (RAI) to Exelon by letter dated May 23, 2003 (NRC 2003). Key questions concerned: dominant risk contributors at Quad Cities and the SAMAs that address these contributors, the potential impact of external event initiators and uncertainties on the assessment results, and detailed information on some specific candidate SAMAs. Exelon submitted additional information by letter dated July 17, 2003 (Exelon 2003b). In the response, Exelon provided tables containing importance measures for various events and their relationship to evaluated SAMAs; rationale for why the core damage frequency (CDF) for fire events would be substantially lower than reported in the IPEEE; results of a revised screening based on consideration of the potential impact of external events and uncertainties; more realistic estimates of the benefits and implementation costs for seven SAMAs that appeared to be cost-beneficial based on the revised screening; and the costs and benefits associated with several lower cost alternatives. Exelon's responses addressed the staff's concerns and

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reaffirmed that none of the SAMAs would be cost-beneficial. Despite the fact that Exelon determined that there were no cost-beneficial SAMAs, Exelon stated that they plan to implement a modification to provide alternative air supplies in the case of failure of instrument air (Phase 2 SAMA 17).

Based on its review, the staff concluded that the contribution to risk from fire events would be higher than assumed in Exelon's SAMA analysis. The staff adjusted Exelon's risk reduction estimates to account for the contribution to risk (and risk reduction) from fire events, and found that four of the candidate SAMAs would be cost-beneficial and two additional SAMAs are close to being cost-beneficial, and could be cost-beneficial given a more detailed assessment of their benefits in external events, or when uncertainties are taken into account. However, these six SAMAs do not relate to adequately managing the effects of aging during the period of extended operation, and therefore need not be implemented as part of license renewal pursuant to 10 CFR Part 54.

An assessment of SAMAs for Quad Cities is presented below.

G.2 Estimate of Risk for Quad Cities

Exelon's estimates of offsite risk at Quad Cities are summarized in Section G.2.1. The summary is followed by the staff's review of Exelon's risk estimates in Section G.2.2.

G.2.1 Exelon's Risk Estimates

Two distinct analyses are combined to form the basis for the risk estimates used in the SAMA analysis: (1) the Quad Cities Level 1 and 2 PRA model, which is an updated version of the "Updated" (IPE) (ComEd 1996a and 1996b), and (2) a supplemental analysis of offsite consequences and economic impacts (essentially a Level 3 PRA model) developed specifically for the SAMA analysis. The SAMA analysis is based on the most recent Level 1 and 2 PRA model available at the time of the ER, referred to as the 2002B model (or Update Revision 02B). The scope of the Quad Cities PRA does not include external events.

The baseline CDF for the purpose of the SAMA evaluation is approximately 2.2×10^{-6} per year, and the baseline large early release frequency (LERF) is approximately 2.7×10^{-7} per year. The CDF and LERF are based on the risk assessment for internally-initiated events. Although there have been several PRA revisions since the time of the IPE, the CDF for the 2002B model is coincidentally the same as the value reported in the Updated IPE. Exelon did not include the contribution to risk from external events within the Quad Cities risk estimates, nor did it account for the potential risk reduction benefits associated with external events in the SAMA screening process described in the ER. It is Exelon's position that the existing fire and IPEEE programs have already addressed potential plant improvements related to these areas (Exelon 2003a). In response to an RAI, Exelon performed a separate assessment of the impact on the results if the SAMA benefits (for internal events) were increased to account for additional benefits in external events. This is discussed further in Sections G.4 and G.6.2.

The breakdown of CDF by initiating event/accident type is provided in Table G-1. As shown in this table, loss of the 125 V DC buses, loss of offsite power, transients (such as turbine trip, loss of turbine building closed cooling water, and loss of condenser vacuum), and loss of service water are dominant contributors to the CDF. Bypass events contribute one percent to the total internal events CDF.

Table G-1. Quad Cities Core Damage Frequency

Initiating Event/Accident Class	CDF (Per Year)	% Contribution to CDF
Loss of 125 V DC Buses 1 and 2	7.6×10^{-7}	35
Loss of Offsite Power (LOOP) ¹ (dual-unit and single-unit)	4.2×10^{-7}	19
Transients	3.2×10^{-7}	15
Loss of Service Water	3.0×10^{-7}	14
Loss-of-Coolant Accident (LOCA)	1.5×10^{-7}	7
Loss of Instrument Air	6.8×10^{-8}	3
Manual Shutdown	6.6×10^{-8}	3
Others	6.0×10^{-8}	3
Interfacing Systems LOCA (ISLOCA)	2.3×10^{-8}	1
Total CDF (from Internal events)	2.2×10^{-6}	100

¹Includes station blackout (SBO)

The Level 2 PRA model has been updated since the IPE. During 1999, Exelon revised the PRA to include a simplified LERF methodology as described in NUREG/CR-6595 (NRC 1999a). In 2002, Exelon replaced the simplified LERF model with a full Level 2 PRA. The source terms were also updated to account for the extended power uprate which was approved by the NRC in 2001 (NRC 2001b). The conditional probabilities, fission product release fractions, and release characteristics associated with each release category were provided in response to an RAI (Exelon 2003b).

The offsite consequences and economic impact analyses use the MACCS2 code to determine the offsite risk impacts on the surrounding environment and public. Inputs for this analysis include plant-specific and site-specific input values for core radionuclide inventory, source term and release characteristics, site meteorological data, projected population distribution (within a 80 km [50-mi] radius) for the year 2032, emergency response evacuation modeling, and economic data.

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In the ER, Exelon estimated the dose to the population within 80 km (50 mi) of the Quad Cities site to be approximately 0.0167 person-Sv (1.67 person-rem) per year. The breakdown of the total population dose by containment release mode is summarized in Table G-2.

Table G-2. Breakdown of Population Dose by Containment Release Mode

Containment Release Mode	Population Dose (Person-Rem ^a Per Year)	% Contribution
Early containment failure	0.93	56
Late containment failure	0.67	40
Containment Bypass	0.07	4
No Containment Failure	~0	~0
Total	1.67	100

^aOne person-Rem = 0.01 person-Sv

G.2.2 Review of Exelon's Risk Estimates

Exelon's determination of offsite risk at Quad Cities is based on the following three major elements of analysis:

- the Level 1 and 2 risk models that form the bases for the 1996 "Modified" and "Updated" IPE submittals (ComEd 1996a and 1996b) and the 1997 IPEEE submittal (ComEd 1997),
- the major modifications to the IPE model that have been incorporated in the Quad Cities PRA, and
- the MACCS2 analyses performed to translate fission product release frequencies from the Level 2 PRA model into offsite consequence measures.

Each of these analyses was reviewed to determine the acceptability of Exelon's risk estimates for the SAMA analysis, as summarized below.

The staff's review of the Quad Cities IPE is described in an NRC report dated November 9, 1995 (NRC 1995). Based on a review of the original IPE submittal, the staff could not reach the conclusion that Commonwealth Edison had met the intent of Generic Letter 88-20 (NRC 1988). By letter dated August 30, 1996, Commonwealth Edison submitted a "Modified" IPE (ComEd 1996a), and in December 1996, an "Updated" IPE was submitted (ComEd 1996b). The staff's review of the Modified and Updated IPEs is documented in a letter dated July 9, 1997 (NRC 1997b). In that review, the staff focused on whether the licensee addressed the concerns documented in the November 9, 1995, staff evaluation. The staff concluded that Modified and Updated IPE submittals met the intent of Generic Letter 88-20; that is, the Updated IPE was of adequate quality to be used to look for design or operational vulnerabilities.

The Updated IPE CDF, which included internal floods, was reported to be 2.2×10^{-6} per year. The PRA used in the SAMA analysis indicates no increase in the total CDF of 2.2×10^{-6} per year; however, the current PRA model does not include internal floods. A separate analysis was completed which yielded a flooding CDF of 4.67×10^{-7} per year, which is approximately 18-percent of the total internal events CDF (Exelon 2003b). The total internal events CDF, including internal floods, is slightly higher than what was reported in the Updated IPE. Since the time of the Updated IPE, there have not been any significant plant hardware changes at Quad Cities, with the exception of changes related to the extended power uprate (EPU). These changes are summarized in response to an RAI (Exelon 2003b). A summary listing of the notable PRA changes was provided in the ER and in response to an RAI (Exelon 2003a, 2003b), and include:

- updated initiating event frequencies utilizing Quad Cities most recent operating experience,
- revised offsite AC power recovery,
- revised human reliability analysis, especially to include dependent operator actions,
- revised anticipated transients without scram (ATWS) event trees to make consistent with standard boiling water reactor (BWR) practice, and revised mechanical and electrical ATWS probabilities based on NUREG/CR-5500 (NRC 1999b)
- revised model for EPU plant configuration and MAAP 4.0.4 computer code analysis,
- updated maintenance unavailability data and individual component random failure probabilities, and revised common cause failure calculations using NUREG/CR-5497 (NRC 1998c) and NUREG/CR-5485 (NRC 1998d),
- revised LOOP/dual-unit LOOP analysis for initiating event frequencies and non-recovery probabilities, and
- credited repair/recovery of residual heat removal for long term loss of decay heat removal events.

The CDF value for Quad Cities is at the lower end of the range of the CDF values reported in the IPEs for other BWR 3/4 plants. Figure 11.2 of NUREG-1560 shows that the IPE-based total internal events CDF for BWR 3/4 plants ranges from 1×10^{-6} to 8×10^{-5} per year (NRC 1997a). It is recognized that other plants have reduced values for CDF subsequent to the IPE submittals due to modeling and hardware changes. The current internal events CDF results for Quad Cities remain comparable to other plants of similar vintage and characteristics.

The staff considered the peer reviews performed for the Quad Cities PRA, and the potential impact of the review findings on the SAMA evaluation. In response to an RAI, Exelon described the previous peer reviews, the most significant of which was the Nuclear Energy Institute (NEI)/Boiling Water Reactor Owners Group (BWROG) Peer Review/Certification conducted in

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the Fall of 1999 (Exelon 2003b). The NEI/BWROG review of 1999 PRA model concluded that the Quad Cities PRA is consistent with other industry PRAs in scope, methods, data usage, and results. In response to a follow-up question, Exelon indicated that all suggestions for improvement were evaluated for potential impact on risk results. Many of the items were implemented as noted in the RAI response. Those that were deferred or otherwise dispositioned were assessed and determined to have only a minor impact on risk.

One recommendation that was not addressed was that a capability to model uncertainties be added to the model and uncertainty analyses be performed. In an RAI, the staff requested that Exelon provide an estimate of the uncertainties associated with the internal events CDF, and an assessment of the impact on the Phase 1 screening and Phase 2 evaluation if the risk reduction estimates are increased to account for uncertainties (NRC 2003). In response to this request, Exelon estimated the uncertainties based on a review of other plants' CDF uncertainty distributions (Exelon 2003b). Exelon's evaluation and results are discussed in further detail in Section G.4 and G.6.2.

Given that the Quad Cities PRA has been peer reviewed and the peer review findings were either addressed or judged to have no impact on the SAMA evaluation, and that Exelon satisfactorily addressed staff questions regarding the PRA, the staff concludes that the Level 1 PRA model is of sufficient quality to support the SAMA evaluation.

Exelon submitted an IPEEE in February 1997 (ComEd 1997), in response to Supplement 4 of Generic Letter 88-20. The initial fire analysis portion of the Quad Cities IPEEE identified potential fire vulnerabilities which resulted, in part, from the lack of separation of redundant equipment, the complex operator actions for fire recovery, and the reliance on opposite unit equipment to shut down the affected unit. The associated fire CDF was estimated to be about 5.4×10^{-3} per year for Unit 1 and about 5.2×10^{-3} per year for Unit 2. During the IPEEE review, the staff identified discrepancies between the safe shutdown analysis and the post-fire safe shutdown procedures. These issues led to a shutdown of both units in 1997. The NRC issued a confirmatory action letter on January 16, 1998, to document the licensee's commitments related to resolving the safe shutdown issues (NRC 1998a). The NRC closed the confirmatory action letter by letter dated May 22, 1998 (NRC 1998b). By letter dated July 29, 1999, the licensee submitted a revised fire analysis which reflected its resolution of the safe shutdown issues and included other changes to the fire model. In the revised analysis, the CDFs were reduced to about 6.6×10^{-5} per year for Unit 1 and about 7.13×10^{-5} per year for Unit 2 (ComEd 1999). The revised fire analysis also concluded that there are no potential fire vulnerabilities.

Based on the staff safety evaluation of the Quad Cities IPEEE, the differences between the original and revised analyses were mostly due to more detailed and realistic information on cable routing, a revised fire initiation frequency evaluation, the use of the safe-shutdown model, and the use of a fire propagation model. The revised analysis showed that more equipment would be available for safe-shutdown, and recovery actions could be performed using plant emergency operating procedures with most operator actions taken in the main control room. In a letter dated April 26, 2001, (NRC 2001a), the staff concluded that the submittal met the intent of Supplement 4 to Generic Letter 88-20, and that the licensee's IPEEE process is capable of identifying the most likely severe accidents and severe accident vulnerabilities.

The Quad Cities fire analysis employed the Fire Induced Vulnerability Evaluation methodology for screening of compartments and Electric Power Research Institute's (EPRI) Fire PRA Implementation Guide (EPRI 1995) for detailed evaluation of the unscreened compartments. The licensee's overall approach in the IPEEE fire analysis is similar to other fire analysis techniques, employing a graduated focus on the most-important fire zones using qualitative and quantitative screening criteria. The fire zones or compartments were subjected to at least two screening stages. In the first stage, a zone was screened out if it was found to not contain any safety-related equipment. In the second stage, a CDF criterion of 1×10^{-6} per year was applied. Plant information gathered for compliance with Appendix R to 10 CFR Part 50 was extensively used in the fire IPEEE. The licensee used the IPE model of internal events to quantify the CDF resulting from a fire initiating event. The conditional core damage probability was based on the equipment and systems unaffected by the fire. Initially, all fire event sequences were quantified assuming all equipment/cables in the area would fail by the fire. The CDF for each zone was obtained by multiplying the frequency of a fire in a given fire zone by the conditional core damage probability associated with that fire zone. The screening methodology applied by the licensee makes less and less conservative assumptions (e.g., equipment that may survive the fires in the area) until a fire zone is screened out, the results do not indicate a vulnerability, or a vulnerability is identified and addressed. After the screening, eight compartments remained for Unit 2 that contributed more than the screening value of 1.0×10^{-6} ; similar results were obtained for Unit 1. These compartments are:

<u>Zone Description (fire area)</u>	<u>CDF</u>
Turbine Room	2.28×10^{-5}
Cable vault or tunnel	1.12×10^{-5}
Main control room	1.00×10^{-5}
Mezzanine floor	3.43×10^{-6}
Turbine building ground floor	3.52×10^{-6}
Switchgear room	3.20×10^{-6}
Direct current (DC) panel room	2.23×10^{-6}
Cable spreading room	1.05×10^{-6}

Given that the fire CDF (7.13×10^{-5} per year) is about a factor of 30 greater than the internal events CDF (2.2×10^{-6} per year), the staff inquired why Exelon neither considered fire explicitly in the SAMA study nor considered the impact of fire CDF in its uncertainty assessment. In a RAI (NRC 2003), the staff asked Exelon to explain, for each fire area, what measures were taken to further reduce risk, and explain why these CDFs can not be further reduced in a cost-beneficial manner. While not explicitly addressing the fire areas, Exelon did list plant improvements that arose from insights from the fire study (Exelon 2003b). These included: improvements to the response time of the sprinkler heads in the reactor feedwater pump areas, yielding a 25% reduction in the fire CDF, and a planned improvement to the containment vent system by providing an alternate or redundant air supply for the containment vent valves, yielding a 17% reduction in the fire CDF (see Section G.6.2 for further discussion of this plant improvement.)

Exelon also noted that 14 other potential plant modifications were analyzed for fire CDF reduction. These modifications were principally developed based on deterministic Appendix R

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evaluations to enhance Appendix R compliance efforts. A majority of the modifications (nine) were shown to have less than a one-percent reduction in the fire CDF. For three of the modifications, a fire CDF risk reduction was not directly available. These enhancements were related to rerouting a feed to a 125 V DC bus, providing control room or alternate local control station access for select residual heat removal and reactor core isolation cooling valves, respectively. Exelon did not pursue these modifications due to the extensive design engineering and analysis work that would be needed, and because the actual benefit could not be readily measured. For two other modifications, the risk reduction was qualitatively determined to have a minimal risk benefit. These modifications included installation of relays and fuses to improve 125 V DC control power availability for 4 kV and 480 V switchgear, respectively. Although Exelon did not perform a quantitative assessment for those modifications, SAMAs 6 and 8 address bypassing major DC buses, locally starting equipment, and controlling feedwater when 125 V DC is lost; therefore, these SAMAs would be expected to provide risk reduction benefits in fire events. Based on the revised fire analyses, the staff has not identified any fire-related vulnerabilities and thus, no additional SAMAs have been identified besides those identified by the licensee that would specifically address fire-related risks.

Exelon also described three areas in which it believes significant conservatism exists in the fire CDF estimates -- initiating event frequencies, system response/fire modeling, and human reliability modeling. Removal of or reduction in the conservatism in these areas would result in a reduction of the fire CDF to about 6×10^{-6} per year which is a factor of three greater than the internal events CDF (Exelon 2003b). Exelon accounted for the contribution from external events, as well as internal flooding and uncertainty, by applying a multiplier of five to the averted cost estimates reported in the ER. Exelon characterized the result as an "upper bound averted cost estimate" (Exelon 2003b). The staff's review is described in Section G.6.2. In that review, the staff concluded that the contribution to risk from fire events could be larger than assumed in Exelon's upper bound estimate, and accordingly used a higher multiplier in its assessment of potential SAMAs.

The IPEEE uses a focused scope EPRI seismic margins analysis. This method is qualitative and does not provide the means to determine the numerical estimates of the CDF contributions from seismic initiators. The licensee expanded its Unresolved Safety Issue A-46 (NRC 1987) program to include all equipment and components on the IPEEE safe shutdown equipment list, which was developed using the EPRI seismic margins analysis methodology for the primary and secondary shutdown paths. All equipment in the seismic IPEEE scope was reviewed per procedures from the Unresolved Safety Issue A-46 program. After the resolution of the seismic outliers, Exelon estimated the plant's high confidence low probability of failure (HCLPF) to be at least 0.24g peak ground acceleration, which is less than the 0.3g review level earthquake used in the IPEEE. The plant HCLPF was originally assessed to be 0.09g. The staff estimates that if the HCLPF capacity is increased from 0.24 g to 0.3g, the resulting CDF would be reduced by about 2×10^{-6} per year. A reduction of this magnitude would have a benefit of approximately \$100K. Based on this estimation, the staff requested that Exelon confirm that all improvements addressing seismic outliers listed in Table 2.7 of NUREG-1742 (NRC 2002a) had been implemented and that Exelon identify the systems, structures, and components that limit the plant HCLPF and explain why modifications to increase seismic capacity would not be cost-beneficial when evaluated consistent with the regulatory analysis guidelines (NRC 2003). In its

1 response, Exelon stated that all the outliers listed in NUREG-1742 (e.g., enhancing
2 anchorage/support capacity) had been resolved (Exelon 2003b). Furthermore, Exelon listed the
3 Systems, structures, and components that had a HCLPF value of 0.24g or higher but had not
4 been verified to 0.3g (examples are 4 categories of cable trays, a 125V battery charger, three
5 residual heat removal service water pump room coolers, and 22 motor control centers), and
6 estimated that changes required to address these items would be in excess of \$2M. This value
7 is based on EPRI estimates of the costs to implement less extensive Seismic Qualification
8 Utility Group modifications at other plants. The staff concludes that the opportunity for seismic-
9 related SAMAs has been adequately explored and that there are no cost-beneficial, seismic-
10 related SAMA candidates.

11
12 The Quad Cities IPEEE evaluated high winds, floods and other events using the progressive
13 screening approach recommended in NUREG-1407 (NRC 1991). Based on this evaluation, the
14 licensee determined that the risk from high winds, floods and other events was negligible.
15 Additionally, the Quad Cities IPEEE demonstrated that transportation and nearby facility
16 accidents were not considered to be significant vulnerabilities at the plant.

17
18 The staff reviewed the process used by Exelon to extend the containment performance
19 (Level 2) portion of the PRA to an assessment of offsite consequences (essentially a Level 3
20 PRA). This included consideration of the source terms used to characterize fission product
21 releases for the applicable containment release category and the major input assumptions used
22 in the offsite consequence analyses. The MACCS2 code was utilized to estimate offsite
23 consequences. Plant-specific input to the code includes the Quad Cities reactor core
24 radionuclide inventory, source terms for each release category, emergency evacuation
25 modeling, site-specific meteorological data, and projected population distribution within a 80 km
26 (50 mile) radius for the year 2032. This information is provided in Appendix F of the ER
27 (Exelon 2003a).

28
29 Exelon characterized the releases for the spectrum of possible radionuclide release scenarios
30 using a set of 10 release categories, defined based on the timing and magnitude of the release.
31 Two of the categories were combined with other categories, resulting in the use of only eight
32 release categories. Each end state from the Level 2 analysis is assigned to one the release
33 categories. The process for assigning accident sequences to the various release categories
34 and selecting a representative accident sequence for each release category was described in
35 response to RAIs (Exelon 2003b and 2003c). The release categories and their frequencies are
36 presented in Table 4-5 of the ER (Exelon 2003a). Table 3-4 of the response to an RAI provides
37 a break out of the source term by release category (Exelon 2003b). The source terms used for
38 the SAMA evaluation have been updated since the Updated IPE to account for the EPU and are
39 based on the MAAP 4.0.4 computer code. The staff concludes that the assignment of release
40 categories and source terms is consistent with typical PRA practice and acceptable for use in
41 the SAMA analysis.

42
43 The core inventory input used in the MACCS2 was obtained from the MACCS2 User's Guide
44 and corresponds to the end-of-cycle values for a 3,578 MW(t) BWR plant. A scaling factor of
45 0.8264 was applied to provide a representative core inventory of 2,957 MW(t) for Quad Cities
46 (the uprated power level). All releases were modeled as occurring at ground level. The staff

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questioned the non-conservatism of this assumption and requested an assessment of the impact of alternative assumptions (e.g., releases at a higher elevation). In response to the RAI, Exelon reassessed the doses for all eight release categories assuming that all plumes originated from the top of the reactor building. The results showed that the 50-mile population dose could increase by up to about 12 percent (Exelon 2003b), which equates to approximately a 5.6 percent increase in the maximum attainable benefit. This small increase has a negligible impact on the analysis and its results.

Exelon used site-specific meteorological data, obtained from the plant meteorological tower, processed from hourly measurements for the 2000 calendar year as input to the MACCS2 code. Data from this year was selected because it contained the fewest data voids. Data voids were filled with data from other tower measurements for smaller gaps and from the Quad Cities Airport tower for larger gaps. The staff notes that previous SAMA analyses results have shown little sensitivity to year-to-year differences in meteorological data and considers use of the 2000 data in the base case to be reasonable.

The population distribution the applicant used as input to the MACCS2 analysis was estimated for the year 2032, based on the NRC geographic information system for 1990 (NRC 1997c), and the population growth rates were based on 2000 county-level census data (USCB 2001). The staff considers Exelon's methods and assumptions for estimating population reasonable and acceptable for purposes of the SAMA evaluation.

The emergency evacuation model was modeled as a single evacuation zone extending out 16 km (10 mi) from the plant. It was assumed that 95 percent of the population would move at an average speed of approximately 1.07 meters per second (2.4 miles/hour) with a delayed start time of 15 minutes (Exelon 2003a). This assumption is conservative relative to the NUREG-1150 study (NRC 1990), which assumed evacuation of 99.5 percent of the population within the emergency planning zone. The evacuation assumptions and analysis are deemed reasonable and acceptable for the purposes of the SAMA evaluation.

Much of the site-specific economic data were provided from SECPOP90 (NRC 1997c) by specifying the data for each of the 21 counties surrounding the plant, to a distance of 50 miles. In addition, generic economic data that are applied to the region as a whole were revised from the MACCS2 sample problem input when better information was available. The agricultural economic data were updated using available data from the 1997 Census of Agriculture (USDA 1998). These included per diem living expenses, relocation costs, value of farm and non-farm wealth, and fraction of farm wealth from improvements (e.g., buildings).

Exelon did not perform sensitivity analyses for the MACCS2 parameters, such as evacuation and population assumptions. However, sensitivity analyses performed as part of previous SAMA evaluations for other plants have shown that the total benefit of the candidate SAMAs would increase by less than a factor of 1.2 (typically about 20 percent) due to variations in these parameters. This change is small and would not alter the outcome of the SAMA analysis. Therefore, the staff concludes that the methodology used by Exelon to estimate the offsite consequences for Quad Cities provides an acceptable basis from which to proceed with an assessment of risk reduction potential for candidate SAMAs. Accordingly, the staff based its assessment of offsite risk on the CDF and offsite doses reported by Exelon.

G.3 Potential Plant Improvements

The process for identifying potential plant improvements, an evaluation of that process, and the improvements evaluated in detail by Exelon are discussed in this section.

G.3.1 Process for Identifying Potential Plant Improvements

Exelon's process for identifying potential plant improvements (SAMAs) consisted of the following elements:

- review of plant-specific improvements identified in the Quad Cities IPE and IPEEE and subsequent PRA revisions,
- review of SAMA analyses submitted in support of original licensing and license renewal activities for other operating nuclear power plants, and
- review of other NRC and industry documentation discussing potential plant improvements, e.g., NUREG-1560.

Based on this process, an initial set of 280 candidate SAMAs was identified, as reported in Table F-1 in Appendix F to the ER. In Phase 1 of the evaluation, Exelon performed a qualitative screening of the initial list of SAMAs and eliminated SAMAs from further consideration using the following criteria:

- the SAMA is not applicable at Quad Cities due to design differences,
- the SAMA is sufficiently similar to other SAMAs, and as such is combined with another SAMA,
- the SAMA has already been implemented at Quad Cities, and
- the SAMA has no significant safety benefit, or has implementation costs greater than any possible risk benefit.

Based on this screening, 226 SAMAs were eliminated leaving 54 for further evaluation. Of the 226 SAMAs eliminated, 63 were eliminated because they were not applicable to Quad Cities, 49 were similar and combined with other SAMAs, 82 were eliminated because they already had been implemented at Quad Cities, and 32 were eliminated because they either had no significant safety benefit or had implementation costs greater than any risk benefit. A preliminary cost estimate was prepared for each of the 54 remaining candidates to focus on those that had a possibility of having a net positive benefit. A screening cutoff of approximately \$110K, the maximum attainable benefit (MAB) if all severe accident risk could be eliminated, was then applied to the remaining candidates (see discussion in Section G.6.1 for a derivation of the MAB). Thirty-nine of the 54 SAMAs were eliminated because their estimated cost exceeded this MAB, leaving 15 candidate SAMAs for further evaluation in Phase 2. It is noted that only a set of 14 SAMAs were retained for further evaluation in the ER. One additional

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1 SAMA (Phase 1 SAMA 237) was marked for retention but was inadvertently not transferred to
2 Phase 2. This error was identified and corrected during a response to an RAI (Exelon 2003b).

3
4 In response to an RAI concerning the impact of external events and uncertainties on the SAMA
5 identification process, Exelon re-evaluated the Phase 1 SAMAs using a screening value of
6 \$500K rather than \$110K. As a result, 83 Phase 1 SAMAs were identified for further
7 consideration (rather than the 54 SAMAs originally identified). These SAMAs were
8 subsequently reassessed using the same criteria as described in the ER. Table 7-2 of the
9 response to the RAI contains the 83 SAMAs and their subsequent disposition. Seventeen of
10 the 83 SAMAs were retained for further evaluation in Phase 2 as discussed in Section G.6.2
11 (the 15 SAMAs identified through the original screening plus two additional SAMAs) (Exelon
12 2003b).

13
14 The 17 remaining SAMAs were further evaluated and subsequently eliminated in the Phase 2
15 evaluation, as described in Sections G.4 and G.6.1 below.

16 17 G.3.2 Review of Exelon's Process

18
19 Exelon's efforts to identify potential SAMAs focused primarily on areas associated with internal
20 initiating events. The initial list of SAMAs generally addressed the accident categories that are
21 dominant CDF and containment failure contributors or issues that tend to have a large impact
22 on a number of accident sequences at Quad Cities.

23
24 The preliminary review of Exelon's SAMA identification process raised some concerns
25 regarding the completeness of the set of SAMAs identified and the inclusion of plant-specific
26 risk contributors. The staff requested clarification regarding the portion of risk represented by
27 the dominant risk contributors (NRC 2003). Because a review of the importance ranking of
28 basic events in the PRA could identify SAMAs that may not be apparent from a review of the
29 top cut sets, the staff also questioned whether an importance analysis was used to confirm the
30 adequacy of the SAMA identification process. In response to the RAI, Exelon provided a
31 tabular listing of the contributors with the greatest potential for reducing risk as demonstrated by
32 the risk reduction worth (RRW) assigned to the event (Exelon 2003b). Exelon used a cutoff of
33 1.02, and stated that events below this point would influence the CDF by less than two-percent.
34 This equates to an averted cost-risk (benefit) of approximately \$2,000. Exelon also reviewed
35 the LERF-based RRW events to determine if there were additional equipment failures or
36 operator actions that should be included in the provided table. Similarly, Exelon correlated the
37 top RRW events with the SAMAs evaluated in the ER (Exelon 2003b). Based on these
38 additional assessments, Exelon concluded that the set of 280 SAMAs evaluated in the ER
39 addresses the major contributors to CDF and LERF, and that the review of the top risk
40 contributors does not reveal any new SAMAs.

41
42 The staff questioned Exelon about lower cost alternatives to the SAMAs evaluated, including
43 the use of a portable generator to power the battery chargers and backup nitrogen bottles or
44 portable air compressors as backup to instrument air (NRC 2003). In response, Exelon
45 provided estimated benefits and implementation costs for several lower cost alternatives,
46 including those in the form of potential procedural changes (Phase 2 SAMAs 1, 2, 4, 6, 7, 8, 10,
47 and 14) (Exelon 2003b). These are discussed further in Section G.6.2.

Exelon considered potential improvements to further reduce fire risk. These included an improvement to the response time of the sprinkler heads in the reactor feedwater pump areas which yielded a 25% reduction in the fire CDF. In addition, Exelon is planning to implement an improvement to the containment vent system by providing an alternate or redundant air supply for the containment vent valves which is expected to yield a 17% reduction in the fire CDF (see Phase 2 SAMA 17). Although Exelon did not evaluate specific fire modifications as part of the SAMA analysis, several of the SAMAs identified based on the internal events risk profile would also be effective in fire events, e.g., procedures for bypassing major ac buses, locally starting equipment, and controlling feedwater when 125 V DC is lost.

The staff notes that the set of SAMAs submitted is not all inclusive, since additional, possibly even less expensive, design alternatives can always be postulated. However, the staff concludes that the benefits of any additional modifications are unlikely to exceed the benefits of the modifications evaluated and that the alternative improvements would not likely cost less than the least expensive alternatives evaluated, when the subsidiary costs associated with maintenance, procedures, and training are considered.

The staff concludes that Exelon used a systematic and comprehensive process for identifying potential plant improvements for Quad Cities, and that the set of potential plant improvements identified by Exelon is reasonably comprehensive and therefore acceptable. This search included reviewing insights from the IPE and IPEEE and other plant-specific studies, reviewing plant improvements considered in previous SAMA analyses, and using the knowledge and experience of its PRA personnel. While explicit treatment of external events in the SAMA identification process was limited, it is recognized that the implementation of plant modifications for fire and seismic events and the absence of external event vulnerabilities reasonably justifies examining primarily the internal events risk results for this purpose.

G.4 Risk Reduction Potential of Plant Improvements

Exelon evaluated the risk-reduction potential of the 17 Phase 2 SAMAs that were applicable to Quad Cities. A majority of the SAMA evaluations were performed in a bounding fashion in that the SAMA was assumed to completely eliminate the risk associated with the proposed enhancement. Such bounding calculations overestimate the benefit and are conservative.

Exelon used model re-quantification to determine the potential benefits. The CDF and population dose reductions were estimated using the 2002B Update of the Quad Cities PRA. The changes made to the model to quantify the impact of SAMAs are detailed in Section F.6 of Appendix F to the ER (Exelon 2003a) and in the response to the RAI (Exelon 2003b). Table G-5 lists the assumptions considered to estimate the risk reduction for each of the 17 Phase 2 SAMAs, the estimated risk reduction in terms of percent reduction in CDF and population dose, and the estimated total benefit (present value) of the averted risk as used in the staff's assessment. The determination of the benefits for the various SAMAs is further discussed in Section G.6.1.

Table G-5. SAMA Cost/Benefit Screening Analysis

Phase 2 SAMA	Assumptions	% Risk Reduction		Total Benefit (\$)		Cost (\$)
		CDF	Population Dose	Baseline ¹	Best Estimate ²	
1 - Provide means for alternate safe shutdown makeup pump room cooling a - Revise procedures to use fire protection system as backup b - Develop procedures to open doors and use portable fans to extend safe shutdown makeup pump run time	Eliminate all failures associated with safe shutdown makeup pump room cooling	12	11	123,000	24,600	1a) 25,000 1b) 50,000
2 - Develop procedures to use Fire protection system as a containment spray source	Assign complete success to the drywell spray effectiveness in Level 2 for all sequences except Class II, IV, and V	0	15	107,000	36,800	50,000
3 - Extend direct current power availability in a station black-out (SBO) a - Use fuel cells to extend DC power availability in an SBO b - Use portable generators as battery charges during an SBO	Change the 4-hour offsite AC recovery time to 8 hours.	6	3	47,000		3a) >50,000 3b) 50,000
4 - Develop/enhance procedures to direct a 4 kV bus cross-tie. Investigate installation of hardware that would perform an automatic cross-tie to the opposite 4 kV bus given the failure of the dedicated diesel generator.	Reduce the operator action human error probability by a factor of 100	<1	<1	8,000		25,000
5 - Provide a redundant and diverse source of cooling for the diesel generators ³	Eliminate all diesel generator cooling water failures	0	0	0		>50,000

Table G-5. SAMA Cost/Benefit Screening Analysis (contd)

Phase 2 SAMA	Assumptions	% Risk Reduction		Total Benefit (\$)		Cost (\$)
		CDF	Population Dose	Baseline ¹	Best Estimate ²	
6 - Allow for powering specific loads given an ac bus failure a - Provide procedures and hardware for bypassing major ac buses b - Provide procedures for locally starting equipment	Eliminate all DC power failures as severe accidents	35	25	320,000	320,000	6a) >250,000 6b) 100,000
7 - Develop procedures to delete high drywell pressure signal from shutdown cooling isolation to allow initiation of shutdown cooling when the drywell is at elevated pressure	Set the basic event "shutdown cooling isolates on high drywell pressure" to zero	<1	<1	8,000		25,000
8 - Develop procedures to control feedwater flow without 125 V DC power to prevent tripping feedwater on high/low level	Reduce all DC power failures by 50%	18	13	167,000	167,000	75,000
9 - Remove the low pressure coolant injection loop select logic or install a bypass switch to allow use of the "A" loop for injection in the event of a "B" injection path failure ²	Change the probability of failure to manually open the low pressure coolant injection A injection valve from 1.0 to 0.0	0	0	0		>50,000
10 - Develop procedures to stop reactor depressurization at 100 psig and demonstrate reactor core isolation cooling operability following depressurization	Eliminate all reactor core isolation cooling failures associated with suppression pool cooling	21	19	215,000	72,000 ⁴	100,000
11 - Provide an alternate means of opening a pathway to the reactor pressure vessel for standby liquid control injection	Set the random and common cause failure of the explosive valves to zero	1	3	26,000		>100,000

Table G-5. SAMA Cost/Benefit Screening Analysis (contd)

Phase 2 SAMA	Assumptions	% Risk Reduction		Total Benefit (\$)		Cost (\$)
		CDF	Population Dose	Baseline ¹	Best Estimate ²	
2 - Enrich boron to reduce the time required to achieve shutdown, thereby increasing time available for successful activation of standby liquid control	Reduce the human error probabilities for boron initiation and reactor pressure vessel water level control by 50%	<1	<1	7,000		>50,000
13 - Add a rupture disk to the hardened vent to provide passive overpressure relief	Set vent failure modes to zero	7	7	72,000		>100,000
14 - Develop or enhance existing procedures to control containment venting within a narrow band of pressure	Eliminate all Class II sequences with successful containment venting	23	21	236,000	78,000 ⁴	100,000
15 - Provide hardware modification and procedural guidance to permit inter-unit cross-tie capability for turbine building closed cooling water	Set turbine building closed cooling water initiating event frequency and all turbine building closed cooling water component failures to 0.0	6	5	57,000		>50,000
16 - Bypass main steam isolation valve in turbine trip ATWS scenarios	Reduce human error probability for operator failure to bypass main steam isolation valve low reactor pressure vessel level interlock (or ATWS) from 0.91 to 0.01.	5	7	60,000		>100,000
17 - Improve instrument air reliability, thereby increasing ability to vent containment ⁵	Set vent failure modes to zero	7	7	72,000	28,000	17a) >50,000 17b) 50,000
a - Allow cross connection of uninterruptable compressed air supply to opposite unit						
b - Provide backup bottles or portable air compressors to open valves when instrument air is lost						

Note: SAMAs in bold were judged to be cost-beneficial.

Table G-5. SAMA Cost/Benefit Screening Analysis (contd)

- 1 Values are based on Exelon averted cost estimates reported in the ER, but are increased by a factor of 10 to account for additional risk reduction benefits in external events.
- 2 Values based on Exelon's more detailed re-evaluation of cost estimates, but are increased by a factor of 10 to account for additional risk reduction benefits in external events.
- 3 This SAMA was retained for further analysis because it did not meet any of the Phase 1 screening criteria discussed in Section G.3.1, but in the Phase 2 assessment was found to have no noticeable impact on CDF or population dose.
- 4 Revised benefit is based on a factor of three reduction from the baseline benefit. The staff expects that the actual benefit would be greater than this value, and above the estimated implementation cost.
- 5 This SAMA was retained for further analysis as a low cost alternative to major instrument air modifications (EC335806 and EC335807) that were approved for implementation but subsequently canceled due to the large scope of equipment changes. Although this SAMA has a negative net value, Exelon plans to implement this modification independent of the SAMA evaluation.

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The staff has reviewed Exelon's bases for calculating the risk reduction for the various plant improvements and concludes that the rationale and assumptions for estimating risk reduction are reasonable and generally conservative (i.e., the estimated risk reduction is higher than what would actually be realized). Accordingly, the staff based its estimates of averted risk for the various SAMAs on Exelon's risk reduction estimates reported in the ER, but applied a multiplier of 10 to these values to account for benefits in external events as discussed in Section G.6.2

G.5 Cost Impacts of Candidate Plant Improvements

Exelon estimated the costs of implementing the 17 candidate SAMAs through the application of engineering judgment and review of other plants' estimates for similar improvements. The cost estimates conservatively did not include the cost of replacement power during extended outages required to implement the modifications, nor did they include recurring maintenance and surveillance costs or contingency costs associated with unforeseen implementation obstacles. Cost estimates typically included procedures, engineering analysis, training, and documentation, in addition to any hardware.

The staff reviewed the bases for the applicant's cost estimates. For certain improvements, the staff also compared the cost estimates (presented in Table 7-3 of the response to the RAI) to estimates developed elsewhere for similar improvements, including estimates developed as part of other licensees' analyses of SAMAs for operating reactors and advanced light-water reactors. The cost estimates provided in the response to the RAI were typically in the form of ranges. The staff reviewed these ranges and found them to be consistent with estimates provided in support of other plants' analyses. In response to an RAI, Exelon provided more specific values, typically at the upper end of the previously provided ranges. For purposes of evaluating specific SAMAs, the staff selected values from the range to represent a reasonable or typical cost.

The staff concludes that the cost estimates provided by Exelon, as adapted by the staff (see Section G.6.2), are sufficient and appropriate for use in the SAMA evaluation.

G.6 Cost-Benefit Comparison

Exelon's cost-benefit analysis and the staff's review are described in the following sections.

G.6.1 Exelon Evaluation

The methodology used by Exelon was based primarily on NRC's guidance for performing cost-benefit analysis, i.e., NUREG/BR-0184, *Regulatory Analysis Technical Evaluation Handbook* (NRC 1997d). The guidance involves determining the net value for each SAMA according to the following formula:

$$\text{Net Value} = (\text{APE} + \text{AOC} + \text{AOE} + \text{AOSC}) - \text{COE}$$

where,

APE = present value of averted public exposure (\$)
 AOC = present value of averted offsite property damage costs (\$)
 AOE = present value of averted occupational exposure costs (\$)
 AOSC = present value of averted onsite costs (\$)
 COE = cost of enhancement (\$).

If the net value of a SAMA is negative, the cost of implementing the SAMA is larger than the benefit associated with the SAMA and it is not considered cost-beneficial. Exelon's derivation of each of the associated costs is summarized below.

Averted Public Exposure (APE) Costs

The APE costs were calculated using the following formula:

APE = Annual reduction in public exposure (Δ person-rem/year)
 x monetary equivalent of unit dose (\$2,000 per person-rem)
 x present value conversion factor (10.76 based on a 20-year period with a 7 percent discount rate).

As stated in NUREG/BR-0184 (NRC 1997d), it is important to note that the monetary value of the public health risk after discounting does not represent the expected reduction in public health risk due to a single accident. Rather, it is the present value of a stream of potential losses extending over the remaining lifetime (in this case, the renewal period) of the facility. Thus, it reflects the expected annual loss due to a single accident, the possibility that such an accident could occur at any time over the renewal period, and the effect of discounting these potential future losses to present value. For the purposes of initial screening, Exelon calculated an APE of approximately \$36,000 for the 20-year license renewal period, which assumes elimination of all severe accidents.

Averted Offsite Property Damage Costs (AOC)

The AOCs were calculated using the following formula:

AOC = Annual CDF reduction
 x offsite economic costs associated with a severe accident (on a per-event basis)
 x present value conversion factor.

For the purposes of initial screening which assumes all severe accidents are eliminated, Exelon calculated an annual offsite economic risk of about \$2,800 based on the Level 3 risk analysis. This results in a discounted value of approximately \$30,200 for the 20-year license renewal period.

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Averted Occupational Exposure (AOE) Costs

The AOE costs were calculated using the following formula:

$$\begin{aligned} \text{AOE} = & \text{Annual CDF reduction} \\ & \times \text{occupational exposure per core damage event} \\ & \times \text{monetary equivalent of unit dose} \\ & \times \text{present value conversion factor.} \end{aligned}$$

Exelon derived the values for averted occupational exposure from information provided in Section 5.7.3 of the regulatory analysis handbook (NRC 1997d). Best estimate values provided for immediate occupational dose (3300 person-rem) and long-term occupational dose (20,000 person-rem over a 10-year cleanup period) were used. The present value of these doses was calculated using the equations provided in the handbook in conjunction with a monetary equivalent of unit dose of \$2,000 per person-rem, a real discount rate of 7-percent, and a time period of 20 years to represent the license renewal period. For the purposes of initial screening, which assumes all severe accidents are eliminated, Exelon calculated an AOE of approximately \$800 for the 20-year license renewal period.

Averted Onsite Costs (AOSC)

Averted onsite costs (AOSC) include averted cleanup and decontamination costs and averted power replacement costs. Repair and refurbishment costs are considered for recoverable accidents only and not for severe accidents. Exelon derived the values for AOSC based on information provided in Section 5.7.6 of the regulatory analysis handbook (NRC 1997d).

Exelon divided this cost element into two parts – the Onsite Cleanup and Decontamination Cost, also commonly referred to as averted cleanup and decontamination costs, and the replacement power cost.

Averted cleanup and decontamination costs (ACC) were calculated using the following formula:

$$\begin{aligned} \text{ACC} = & \text{Annual CDF reduction} \\ & \times \text{present value of cleanup costs per core damage event} \\ & \times \text{present value conversion factor.} \end{aligned}$$

The total cost of cleanup and decontamination subsequent to a severe accident is estimated in the regulatory analysis handbook to be $\$1.5 \times 10^9$ (undiscounted). This value was converted to present costs over a 10-year cleanup period and integrated over the term of the proposed license extension. For the purposes of initial screening, which assumes all severe accidents are eliminated, Exelon calculated an ACC of approximately \$26,000 for the 20-year license renewal period.

Long-term replacement power costs (RPC) were calculated using the following formula:

1 RPC = Annual CDF reduction
 2 x present value of replacement power for a single event
 3 x factor to account for remaining service years for which replacement power is
 4 required
 5 x reactor power scaling factor

6
 7 Exelon based its calculations on the value of 912 MW(e). Therefore, Exelon applied a power
 8 scaling factor of 912 MW(e)/910 MW(e) to determine the replacement power costs. For the
 9 purposes of initial screening, which assumes all severe accidents are eliminated, Exelon
 10 calculated an RPC of approximately \$17,300 for the 20-year license renewal period.

11
 12 Using the above equations, Exelon estimated the total present dollar value equivalent
 13 associated with completely eliminating severe accidents at Quad Cities to be about \$110K.

14 Exelon's Results

15
 16
 17 If the implementation costs were greater than the MAB of \$110K, then the SAMA was screened
 18 from further consideration. Thirty-nine of the 54 SAMAs surviving the initial Phase 1 screening
 19 were eliminated from further consideration in this way leaving 15 for final analysis. A more
 20 refined look at the costs and benefits was performed for the 15 SAMAs, and none were found
 21 to be cost-beneficial. The Phase 1 screening was revisited using a screening value of \$500K
 22 rather than \$110K to account for the potential impact of external events, and two additional
 23 SAMAs were identified.

24
 25 Exelon applied a multiplier of five to the averted cost estimates (for internal events) for each
 26 SAMA to account for the potential impact of external events and uncertainties. As a result,
 27 seven of the 17 SAMAs were found to be potentially cost-beneficial. Exelon performed a more
 28 detailed assessment of each of the seven SAMAs to more realistically estimate the risk
 29 reduction and implementation costs for each SAMA. Based on this assessment, Exelon
 30 concluded that none of the seven SAMAs would be cost-beneficial.

31 **G.6.2 Review of Exelon's Cost-Benefit Evaluation**

32
 33
 34 The cost-benefit analysis performed by Exelon was based primarily on NUREG/BR-0184 (NRC
 35 1997d) and was executed consistent with this guidance.

36
 37 In response to an RAI, Exelon considered the uncertainties associated with the internal events
 38 CDF (see Table G-6 below). Since Exelon does not currently have an uncertainty analysis for
 39 the Quad Cities PRA, they estimated the uncertainty distribution by reviewing representative
 40 distributions for several plants (Exelon 2003b). Exelon used the results of the LaSalle Risk
 41 Methods Integration and Evaluation Program PRA to obtain the Quad Cities 95th percentile
 42 value. The ratio of the 95th percentile CDF to the mean CDF value in the LaSalle study is 4.5.
 43 The 2.2×10^{-6} per year point estimate mean CDF for Quad Cities was multiplied by this ratio,
 44 yielding a 95th percentile value of 1.0×10^{-5} per year for Quad Cities. This value and an error
 45 factor of eight are used to obtain the median value, and subsequently the 5th percentile value. If

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the 95th percentile value of the CDF were utilized in the cost-benefit analysis instead of the mean CDF value, the estimated benefits would increase by about a factor of five.

Table G-6. Uncertainty in the calculated CDF for Quad Cities

Percentile	CDF (per year)
95th	1.0×10^{-5}
mean	2.2×10^{-6}
median	1.25×10^{-6}
5th	1.6×10^{-7}

In the IPEEE, Exelon reported a fire CDF of 7.13×10^{-5} per year. This is approximately 30 times higher than the internal events CDF of 2.2×10^{-6} per year. Due to the large contribution from fire events, the staff asked Exelon to consider the impact on the SAMA identification and screening process by including the risk from external events. In response to the RAI, Exelon stated that the methodology used to determine the fire CDF is judged to be highly conservative, particularly in the areas of initiating event frequencies, fire response modeling and human reliability analysis. In Attachment A to its response, Exelon discusses the conservatism it believes exists in the model in each of these areas, and the approximate reduction that the conservatism affords. Exelon's rationale and the staff's assessment are summarized below.

For initiating events, Exelon refers to a recently issued NRC report concerning a revised fire events database (NRC 2002b). Exelon states that the NRC data would support the use of lower fire initiating event frequencies than used in the Quad Cities IPEEE. Based on a comparison of the initiating event frequencies from the report and from the Quad Cities model for several fire areas, Exelon states that a factor of two reduction in the initiating event frequency portion of the fire CDF can be made as a reasonable assumption to provide a more accurate comparison to the internal events CDF. Exelon essentially argues that reductions in initiating event frequencies in these fire areas directly translate into similar reductions in specific equipment ignition frequencies. A staff review of the NRC report verified that the initiating frequencies were lower than those originally reported in the Quad Cities IPEEE, however, the data is only provided for fire areas and does not support the determination of ignition frequencies for specific equipment. In addition, less significant fires were screened from the data. Therefore, the data represent the fire ignition frequencies for more severe fires. These data are not directly comparable to the ignition frequencies in the IPEEE. Although the staff believes that reductions in the ignition frequencies have occurred, it does not believe that the evidence provided by the licensee is sufficient to justify a factor of two reduction. This is especially true for the risk-significant fires where ignition frequencies are typically low and the development of the ignition frequency is typically more rigorous.

For system fire response modeling, Exelon states that the Quad Cities fire model typically utilized bounding approaches regarding the immediate effects of the fire (e.g., all cables in a

1 tray are always failed for a cable tray fire, and all failed cables lead to failure states of the
2 associated equipment). Severity factors were utilized for the purposes of distinction (size and
3 consequence of fire). The complement of the severity factor was also maintained in the
4 analysis such that the total frequency was always preserved. In addition, Exelon repeats its
5 discussion regarding lower initiating event frequencies. The staff finds that there are three
6 points presented in support of this reduction factor: lower ignition frequencies, lower severity
7 factors and bounding approaches regarding the fire's immediate effects. The staff's view on
8 lower ignition frequencies is discussed above. For severity factors, a review of the NRC report
9 did not find evidence that it supported a reduction in severity factor. The report states "Fire
10 severity, risk implications, and duration of power operation fire events were not updated from
11 the initial study." As a result the staff can not support this contribution to the system fire
12 response modeling reduction. The final point is the claim that the bounding approaches were
13 used regarding the fire's immediate effects. A review of the Quad Cities IPEEE Revision 1
14 submittal found that detailed fire modeling practices were used for risk-significant contributors.
15 Given these observations, the staff believes that the proposed reduction factor is not supported.
16

17 For human reliability analysis and level of detail, Exelon provides examples of what it believes
18 are simplified human reliability analysis modeling and lack of sufficient level of detail in the
19 model, and concludes that such factors can easily lead to an additional factor of three reduction
20 in the fire CDF. The IPEEE Revision 1 submittal states that the fire PRA model incorporated all
21 of the operator actions included in the plant's internal events PRA. Actions in the main control
22 room were not considered adversely impacted by postulated fire events outside the control
23 room. For fires in the control room, actions with a required response time of 30 minutes or less
24 were considered failed. All actions outside the control room were set to 1.0 except for two.
25 These two actions were considered as applicable and not modified from their internal-events
26 values. The IPEEE submittal also states, "The extensive use of a human error probability of
27 1.0 for potential operator actions outside the control room is conservative but does not have a
28 significant impact on the overall analysis results. This is because these events do not appear in
29 the dominant cutsets for the analysis." Although the staff believes that the consideration of
30 additional actions would likely reduce the calculated risk, we do not believe that the factor of
31 three reduction due to human reliability analysis and level of detail is fully supported.
32

33 In addition to the above discussion, Exelon noted that a large oil fire involving the reactor
34 feedwater pumps was the dominant risk contributor from the IPEEE fire study. In response to
35 this insight, a modification was performed at Quad Cities to improve the response time of the
36 sprinkler heads in the reactor feed pump area, and the modification results in a 25% reduction
37 in fire risk. Exelon also noted that the installation of a modification to provide alternate or
38 redundant air supply for the containment vent valves (addressed by Phase 2 SAMA 17) in the
39 Fall 2003 has been estimated to reduce the fire CDF by 17 percent. However, Exelon notes
40 that the combined benefit of this modification with the sprinkler head modification would likely
41 be less than the sum of the benefits from each of these modifications.
42

43 As a result of the improvements in ignition frequency, fire response modeling, and human
44 reliability analysis, Exelon states that it believes the fire CDF can be reduced by a factor of 12
45 from 7.13×10^{-5} per year to 6.1×10^{-6} per year. As such, the fire CDF would be about three times
46 the internal events CDF. Based on this assessment, Exelon applied a multiplier of five to the

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1 averted cost estimates (for internal events) for each SAMA, and characterized the result as an
2 upper bound averted cost estimate. These values could be considered to account for SAMA
3 benefits in internal events, external events, and internal floods. These values would also
4 represent the impact of uncertainties in internal event frequencies (i.e., the impact if the CDF
5 was increased from the mean value of 2.2×10^{-6} per year to the 95th percentile value of 1.0×10^{-5}
6 per year).

7
8 The staff agrees that the Quad Cities IPEEE fire analysis contains numerous conservatisms
9 and that a more realistic assessment could result in a substantially lower fire CDF. In the staff's
10 view, the factor of 12 reduction in CDF claimed by Exelon represents the maximum reduction
11 that could be justified. At this level, the fire CDF would be three times the internal events CDF,
12 and the benefits of SAMAs in external events would be accommodated by applying a multiplier
13 of five to the internal events benefits. However, the staff believes that the information provided
14 by Exelon is not sufficient to support the full reduction and that the reduction in fire CDF may be
15 much smaller than claimed by Exelon, closer to a factor of two to three. Given a factor of three
16 reduction in the IPEEE fire CDF, the resulting fire CDF would be about a decade higher than
17 the internal events CDF. This would justify use of a multiplier of 10 rather than five to represent
18 the additional SAMA benefits in external events. Consideration of uncertainties could result in
19 further increases in this multiplier.

20
21 In view of the large relative contribution to risk from fire events at Quad Cities, the staff
22 increased the averted cost estimates reported in the ER (which are based on consideration of
23 only internal events) by a factor of 10 to obtain a baseline estimate of the benefits for each
24 SAMA. This implicitly assumes that each SAMA would offer the same percentage reduction in
25 external event CDF and population dose as it offers in internal event CDF and population dose.
26 While this provides only a crude approximation of the potential benefits, such an adjustment
27 was considered appropriate given the large risk contribution from external events relative to
28 internal events and the lack of information from the licensee on which to base a more precise
29 risk reduction estimate for external events. The baseline benefit values are shown in Table G-5
30 for the 17 Phase 2 SAMAs. To account for a potentially greater contribution from external
31 events and the impact of uncertainties, the staff also considered the impact that further
32 increases in the multiplier would have on the identification and dispositioning of candidate
33 SAMAs, as described below.

34
35 As shown in Table G-5, the baseline benefits exceed the estimated implementation costs for
36 seven of the Phase 2 SAMAs (1, 2, 6, 8, 10, 14, and 17). Exelon re-examined each of these
37 SAMAs to ensure that the averted cost estimates from the internal events analysis appropriately
38 represent the potential benefit rather than the maximum benefit. This included re-examining
39 the assumptions used in the initial screening analysis, as well as recognizing existing model
40 limitations that could lead to over-estimation of the averted costs. In some cases, the
41 implementation costs were also refined to better represent the actual costs that would be
42 incurred. The results of this reassessment are provided in Table 7-4 of the RAI response
43 (Exelon 2003b), and summarized below. The staff considered this additional information and
44 where appropriate, developed revised estimates of the benefits for these SAMAs. These are
45 reported as "best estimate" values in Table G-5.

- 1 • SAMA 1 involves improving the existing procedural guidance for use of the fire
2 protection system as a backup for providing safe shutdown makeup pump room cooling.
3 The staff initially estimated the benefit of this SAMA to be \$123,000 per unit based on
4 Exelon's risk reduction estimate reported in the ER and a factor of 10 adjustment to
5 account for external events. Based on additional information provided by Exelon, the
6 benefit would be about a factor of five lower, or about \$24,600 per unit, if a more
7 realistic human error probability was used for the operator action to utilize the fire
8 protection system as a backup means of safe shutdown makeup pump room cooling.
9 Exelon states that the current failure probability for this action is 0.11, which is based on
10 a lack of clear symptom-based direction for subsequent losses of service water following
11 initial use of the safe shutdown makeup pump. However, all the dominant cutsets that
12 include this human error probability result from the loss of service water as an initiating
13 event. The licensee states that the current procedural direction for using the Fire
14 protection system to recover when service water is lost as an initiating event is very
15 clear and states that a more realistic human error probability for these scenarios is a
16 factor of five lower. The staff finds this rationale to be reasonable and concludes that
17 the benefit of this SAMA would more realistically be about \$24,600. Exelon estimated
18 the cost of implementing this SAMA to be about \$25,000 to \$50,000 per unit, including
19 the cost of engineering analysis and procedure development. The staff expects the
20 costs to be towards the low end of this range because this appears to be an
21 enhancement to current procedures as opposed to the development of new procedures,
22 and does not appear to require additional engineering analysis. As an alternative,
23 Exelon also considered developing procedural guidance to open safe shutdown makeup
24 pump room doors and use portable fans to extend safe shutdown makeup pump run
25 time. A thermal analysis would be needed to demonstrate the viability of this strategy.
26 The costs and benefits associated with this alternative would be higher than those for
27 the fire system procedure modification due to the required thermal analysis. The staff
28 concludes that this SAMA would have a slightly negative net value. However, the costs
29 and benefits are comparable, and the SAMA could be cost-beneficial given a more
30 detailed assessment of its benefits in external events, or when uncertainties are taken
31 into account.
32
- 33 • SAMA 2 involves enhancing the drywell spray system by developing procedural
34 guidance to use the fire protection system as an alternative source of water. The staff
35 initially estimated the benefit of this SAMA to be \$107,000 per unit based on Exelon's
36 risk reduction estimate reported in the ER and a factor of 10 adjustment to account for
37 external events. Exelon states that two classes of scenarios account for much of the
38 calculated averted cost and that these scenarios would not benefit from SAMA 2. In one
39 scenario class, Exelon states that power would not be available to the drywell spray
40 valves precluding any benefit from the proposed improvement. The other scenario class
41 does not credit the recovery of the low pressure coolant injection pumps for the drywell
42 spray function even though these pumps are available. The staff finds this rationale to
43 be reasonable. When credit for the SAMA is eliminated for these two scenarios, the
44 total benefit is reduced to \$36,800 per unit. Exelon estimated the cost of implementing
45 this SAMA to be about \$25,000 to \$50,000 per unit, including the cost of engineering
46 analysis, procedure development, and training. The staff expects the costs to be at the

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upper end of this range because of the need for engineering analysis to support procedure development. The staff concludes that this SAMA has a negative net value. However, the costs and benefits are generally comparable, and the SAMA could be cost-beneficial given a more detailed assessment of its benefits in external events, or when uncertainties are taken into account.

- SAMA 6 involves two options for improving the plant's response to the loss of 125 V DC power. These are: (a) the installation of hardware and development of procedures for bypassing major DC buses, and (b) the development of procedures for locally starting equipment using temporary cables to feed DC from switchgear from the other unit. Based on Exelon's risk reduction estimate reported in the ER and a factor of 10 adjustment to account for external events, the staff estimates that SAMA 6 has a benefit of approximately \$320,000 per unit. Exelon states that alternative feeds are already proceduralized for those buses that can be fed from either unit, and that bypassing the other DC buses would require additional hardware, including buses, distribution cabinets, and breakers. Exelon estimates that the costs associated with option 6a (hardware, engineering analysis, procedure development, and training) would exceed \$250,000 per unit. The staff finds this position to be reasonable given the extent of the associated hardware modifications. For the second alternative, Exelon states that locally starting equipment without DC power is not a trivial action due to personnel hazard that results when the DC powered protection and interlocks are also not available. Exelon concludes that preparing procedural direction to bypass major DC buses, providing instructions for local start, and providing training for the recommended approaches would lead to overall implementation costs that would easily exceed \$200,000 per unit. The staff believes that the cost estimate may be overstated, and may more reasonably be estimated at \$100,000 per unit. The staff notes that Exelon identified several modifications for potential fire CDF reduction in response to RAIs, including the installation of relays and fuses to improve 125 V DC control power availability for 4 kV and 480 V switchgear, respectively (see Section G.2.2). However, the licensee stated that these were not pursued due to the extensive design engineering and analysis (Exelon 2003b). The staff believes that locally starting equipment could be effective in recovering some of these fire-related events. The staff believes that the licensee review of the protection and interlock requirements for the 4 kV and 480 VAC breakers would benefit from the design similarities within each class of breakers and that standard sets of precautions and processes could be developed. It is further believed that considerable savings in engineering analysis would be achieved due to the similarities between the units. As such, the costs of SAMA 6b are expected to be lower than estimated by Exelon. The staff concludes that when these lower costs are taken into consideration, SAMA 6b would be cost-beneficial.
- SAMA 8 increases the functionality of feedwater during loss of 125 V DC scenarios through the development of procedures to control feedwater without 125 V DC. Based on Exelon's risk reduction estimate reported in the ER and a factor of 10 adjustment to account for external events, the staff estimates that SAMA 8 has a benefit of approximately \$167,000 per unit. Exelon originally estimated that the cost of implementing this SAMA would be about \$50,000 to \$100,000 per unit, including the

cost of engineering analysis, procedure development, and training. In its revised assessment, Exelon indicates that the cost would be \$100,000 per unit. Exelon states that the difficulty of controlling feedwater without DC power is not with the feedwater control system but with the leakage past the closed feedwater regulation valves. Exelon explained that the operators would need to trip two of the three reactor feed pumps (RFPs) to reduce flow and would attempt to control reactor vessel level on the remaining pump. However, the loss of 125 V DC results in the loss of control power and protective functions to the RFPs. In addition, due to the leakage past the closed feedwater control valves, the remaining RFP would need to be cycled on and off to maintain level. Without DC power, the tripping of the two RFPs and the cycling of the remaining RFP have to be performed locally at the breaker. It is further stated that these compensating actions are difficult such that procedures would require significant development work and engineering analysis. The NRC staff believes that procedural direction and training addressing the precautions and actions for timely local tripping of two RFPs and the local operation of the remaining pump would be an effective means of improving the likelihood of success of these difficult compensatory actions. The NRC staff also believes that developing guidance for these actions prior to the event will be far more effective than attempting to mitigate a loss of 125 V DC without such guidance. The staff expects the costs to be within the range originally provided by Exelon, but less than the upper end of this range because the implementation issues appear to be well understood and the engineering analysis does not appear to be extensive. The staff concludes that SAMA 8 would be cost-beneficial.

- SAMA 10 involves the development of operating procedures to terminate reactor depressurization prior to loss of the steam-driven reactor core isolation cooling pump (e.g., 100 psig), and supporting analyses to establish that reactor core isolation cooling can run reliably following depressurization. The staff initially estimated the benefit of this SAMA to be \$215,000 per unit based on Exelon's risk reduction estimate reported in the ER and a factor of 10 adjustment to account for external events. In response to an RAI, Exelon argued that the risk reduction would be about a factor of three less if operator recovery of reactor pressure vessel injection following venting (which is not credited in the PRA) were taken into account. Exelon states that current procedures allow considerable flexibility in implementing containment venting and providing long term injection. Numerous alternate injection systems are identified in the current emergency operating procedures and there is significant time available for the Emergency Response Organization to develop a strategy to utilize this equipment following venting. Exelon identified several specific alternatives for providing long-term injection and the associated procedures, including using low pressure coolant injection pumps with an inventory source from the condensate storage tank, using condensate pumps with inventory provided by the hotwell with makeup to the hotwell provided by standby coolant supply and using the fire protection system pumps through the residual heat removal system. Exelon concludes that given these considerations, its original benefit estimate is high by at least a factor of three. SAMA 14 addresses a similar improvement associated with providing procedural enhancements for the control of containment venting in order to avoid the adverse impacts on low pressure emergency core cooling injection systems. The estimated benefits for SAMA 14 are similar to those for SAMA

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10, and Exelon also argued that the benefits ascribed to SAMA 14 are high by a factor of three for the same reasons as stated for SAMA 10.

Exelon's justification for the factor of three reduction is a judgement that if the numerous alternatives available for injection were credited in the PRA the associated CDF would be reduced by a factor of three or more. The staff believes that some risk improvement would be achieved if these strategies were credited in the PRA, but based on the quantitative rationale provided by Exelon was not able to reach a conclusion that a factor of three reduction was appropriate. Exelon originally estimated that the cost of implementing SAMA 10 or 14 would be about \$50,000 to \$100,000 per unit, including the cost of engineering analysis, procedure development, and training, which could be extensive. In its revised assessment Exelon indicates that the cost would be \$100,000 per unit. The staff considers this estimate to be reasonable. The staff notes that without additional credit for operator action, SAMA 10 or 14 would be cost-beneficial, whereas with the full reduction in benefits claimed by Exelon (i.e., a benefit of \$72,000 rather than \$215,000 for SAMA 10) both of these SAMAs would have a negative net value. The staff expects that the actual benefit would be higher than claimed by Exelon, and close to or greater than the estimated implementation costs for these SAMAs. Accordingly, the staff concludes that SAMAs 10 and 14 are cost-beneficial.

It should be noted that since both SAMAs 10 and 14 address a similar safety function, the implementation of either SAMA might reduce the risk reduction potential to a level at which the remaining SAMA would not be cost-beneficial.

- SAMA 17 involves the use of a cross connection of uninterruptable compressed air supply to the opposite unit. The lower cost alternative to this SAMA is the use of backup bottles or portable air compressors. Based on Exelon's risk reduction estimate reported in the ER and a factor of 10 adjustment to account for external events, the staff originally estimated the benefit associated with this SAMA to be about \$72,000. This estimate was based on assuming a perfect vent. Exelon provided a revised benefit estimate based on a refinement of the modeling approach used to estimate the benefit. Specifically, the revised estimate assumes that the instrument air recovery is perfect. The staff considers this assumption to be more representative of the benefits offered by this SAMA. Based on the revised estimate, the staff estimates the benefit for this SAMA to be \$28,000 per unit. Although the estimated implementation costs (\$50,000) are higher than the estimated benefit, Exelon plans to implement this modification.

Based on the staff's review of the information provided by Exelon in response to the RAI, the staff has determined that six SAMAs are potentially cost-beneficial (Phase 2 SAMAs 1,2, 6, 8, 10, and 14).

The staff also considered the impact that further increases in the contribution from external events or analysis uncertainties would have on the dispositioning of the 10 Phase 2 SAMAs that were screened out (i.e., the unshaded SAMAs in Table G-5). When Exelon's averted cost estimates reported in the ER are increased by a factor of 10, SAMA 3 comes close to being cost-beneficial, with an estimated benefit of \$47,000 and an estimated implementation cost of

\$50,000 per unit. The low cost alternative explored in SAMA 3 involves the use of portable diesel generators to provide backup power to the battery chargers. Based on staff estimates produced as part of the resolution of Generic Safety Issue 189, "Susceptibility of Ice Condenser and Mark III Containments to Early Failure from Hydrogen Combustion During a Severe Accident," (NRC 2002c) the cost for use of a portable generator as backup power was estimated at about \$200,000 per unit. Even if the implementation costs are somewhat lower, it is unlikely that SAMA 3 will be cost-beneficial at Quad Cities.

Several other SAMAs have estimated benefits within a factor of two of the estimated implementation costs, i.e., Phase 2 SAMAs 13, 15, and 16. The benefits for these SAMAs are estimated to range from \$57,000 to \$72,000 and the implementation costs are estimated to be greater than \$100,000. However, each of these SAMAs involve hardware modifications as well as procedure changes. The cost range for hardware modifications provided by Exelon is greater than \$100,000, up to \$1million or more. Although Exelon did not provide details on the hardware modifications needed for these SAMAs, the staff believes that such modifications would be significantly greater than the minimal hardware cost provided by Exelon. Therefore, the staff does not believe that these SAMAs would be cost-beneficial at Quad Cities.

Exelon also performed a sensitivity analysis that addressed variations in discount rate. The use of a three-percent real discount rate (rather than seven percent used in the baseline) results in an increase in the maximum attainable benefit of approximately 28 percent. The results of the sensitivity study are bounded by the baseline averted cost estimates adopted by the staff for each SAMA.

The staff concludes that the costs of all of the SAMAs assessed would be higher than the associated benefits, with the exception of the six SAMAs discussed above.

G.7 Conclusions

Exelon compiled a list of 280 SAMA candidates using the SAMA analyses as submitted in support of licensing activities for other nuclear power plants, NRC and industry documents discussing potential plant improvements, and the plant-specific insights from the Quad Cities IPE, IPEEE, and current PRA model. A qualitative screening removed SAMA candidates that (1) were not applicable at Quad Cities due to design differences, (2) were sufficiently similar to other SAMAs, and therefore combined with another SAMA, (3) had already been implemented at Quad Cities, or (4) had no significant safety benefit or had implementation costs greater than any possible risk benefit. A total of 226 SAMA candidates were eliminated based on the above criteria, leaving 54 SAMA candidates for further evaluation.

Using guidance in NUREG/BR-0184 (NRC 1997d), the current PRA model, and a Level 3 analysis developed specifically for SAMA evaluation, a MAB of about \$110K, representing the total present dollar value equivalent associated with completely eliminating severe accidents at Quad Cities, was derived. Thirty-nine of the 54 SAMAs were screened from further evaluation because their implementation costs were greater than this MAB. Exelon performed a revised screening based on consideration of the potential impact of external events and uncertainties, and two additional SAMAs were identified. For the 15 SAMA candidates and two additional

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alternatives identified during the re-screening, a more detailed assessment and cost estimate were developed as shown in Table G-5. Exelon applied a multiplier of five to the averted cost estimates (for internal events) for each SAMA, and characterized the result as an upper bound averted cost estimate. The baseline benefits exceeded the estimated implementation costs for seven of the Phase 2 SAMAs. Exelon re-examined each of these SAMAs to ensure that the averted cost estimates from the internal events analysis appropriately represent the potential benefit rather than the maximum benefit. As a result of this reassessment, the cost-benefit analyses showed that none of the candidate SAMAs were cost-beneficial.

The staff reviewed the Exelon analysis and concluded that the methods used and the implementation of those methods were sound. The treatment of SAMA benefits and costs, the generally large negative net benefits, and the inherently small baseline risks support the general conclusion that the SAMA evaluations performed by Exelon are reasonable and sufficient for the license renewal submittal. The unavailability of a seismic and fire PRA model precluded a detailed quantitative evaluation of SAMAs specifically aimed at reducing risk of these initiators; however, to account for external events, the staff increased the estimated internal events benefits by factor of ten. Based on this evaluation, seven SAMAs would have a positive net value. When more realistic assumptions are used, this list is reduced to four SAMAs that would be cost-beneficial (SAMAs 6, 8, 10, and 14), and two additional SAMAs that are close to being cost-beneficial and could be cost-beneficial given a more detailed assessment of their benefits in external events, or when uncertainties are taken into account (SAMAs 1 and 2). The staff believes that these SAMAs could be effective in recovering some of the fire-related events. Since SAMA 10 and 14 address a similar safety function, implementation of either SAMA might reduce the residual risk to a level at which the remaining SAMA would not likely be cost-beneficial. Improvements realized as a result of the IPEEE process at Quad Cities, and implementation of these cost-beneficial SAMAs would minimize the likelihood of identifying further cost-beneficial enhancements. It is also noted that, although the SAMA is not cost-beneficial, Exelon plans to implement SAMA 17 independent of this SAMA evaluation.

Based on its review of the Exelon SAMA analysis, the staff concurs that none of the candidate SAMAs are cost-beneficial, except as noted above. This is based on conservative treatment of costs and benefits. This conclusion is consistent with the low residual level of risk indicated in the Quad Cities PRA and the fact that Quad Cities has already implemented many plant improvements identified from the IPE and IPEEE processes. Given the potential risk reduction and the relatively modest implementation costs of the six SAMAs identified above, the staff concludes that further evaluation of these SAMAs by Exelon is warranted. However, these SAMAs do not relate to adequately managing the effects of aging during the period of extended operation. Therefore, they need not be implemented as part of license renewal pursuant to 10 CFR Part 54.

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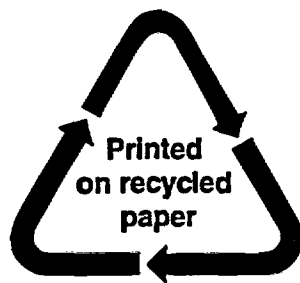
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11. ABSTRACT <i>(200 words or less)</i> This draft supplemental environmental impact statement (SEIS) has been prepared in response to an application submitted to the Nuclear Regulatory Commission (NRC) on January 3, 2003, by Exelon Generation Company, LLC (Exelon) to renew the operating licenses for Quad Cities Nuclear Power Station, Units 1 and 2, for an additional 20 years under 10 CFR Part 54. This draft SEIS includes the staff's analysis that considers and weighs the environmental effects of the proposed action, the environmental effects of alternatives to the proposed action, and alternatives available for reducing or avoiding adverse effects. It also includes the staff's recommendation regarding the proposed action. The NRC staff's preliminary recommendation is that the Commission determine that the adverse environmental impacts of license renewal for Quad Cities Nuclear Power Station, Units 1 and 2 are not so great that preserving the option of license renewal for energy-planning decisionmakers would be unreasonable. This recommendation is based on (1) the analysis and findings in the Generic Environmental Impact Statement for License Renewal of Nuclear Plants (NUREG-1437); (2) the Environmental Report submitted by Exelon; (3) consultation with other Federal, State, and Local agencies; (4) the staff's own independent review; and (5) the staff's consideration of public comments.						
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