U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

NUREG-1437
Supplement 40

Generic Environmental Impact Statement for License Renewal of Nuclear Plants

Supplement 40

Regarding Kewaunee Power Station

Draft Report for Comment

Office of Nuclear Reactor Regulation

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Draft Report for Comment

Manuscript Completed: January 2010
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Office of Nuclear Reactor Regulation

Proposed Action	Issuance of a renewed operating license, DPR-43, for Kewaunee Power Station, in Kewaunee County, Wisconsin, near the town of Kewaunee.
Type of Statement	Draft Supplemental Environmental Impact Statement
Agency Contact	Vanice Perin U.S. Nuclear Regulatory Commission Office of Nuclear Reactor Regulation Mail Stop O-11F1 Washington, D.C. 20555-0001 Phone: 301-415-8143 E-mail: Vanice.Perin@nrc.gov
Comments	Any interested party may submit comments on this supplemental environmental impact statement. Please specify NUREG-1437, Supplement 40, draft, in your comments. Comments must be received by April 21, 2010. Comments received after the expiration of the comment period will be considered if it is practical to do so, but assurance of consideration of late comments will not be given. Comments may be submitted e-mail to KewauneeEIS.Resource@nrc.gov or mailed to: Chief, Rulemaking, Directives, and Editing Branch Division of Administrative Services Office of Administration Mail Stop TWB-05-B01M U.S. Nuclear Regulatory Commission Washington, D.C. 20555-0001

ABSTRACT

This draft supplemental environmental impact statement (SEIS) has been prepared in response to an application submitted by Dominion Energy Kewaunee, Inc. (DEK) to renew the operating license for Kewaunee Power Station (KPS) for an additional 20 years.

This draft SEIS includes the preliminary analysis that evaluates the environmental impacts of the proposed action and alternatives to the proposed action. Alternatives considered include replacement power from new supercritical coal-fired generation and natural gas combined-cycle generation; and a combination of alternatives that included natural gas combined-cycle generation, conservation/efficiency, wood-fired generation, and wind power; and not renewing the operating license (the no-action alternative).

The preliminary determination is that the adverse environmental impacts of license renewal for KPS are not so great that preserving the option of license renewal for energy-planning decision makers would be unreasonable.

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BACKGROUND

By letter dated August 12, 2008, Dominion Energy Kewaunee, Inc. (DEK) submitted an application to the U.S. Nuclear Regulatory Commission (NRC) to issue a renewed operating license for Kewaunee Power Station (KPS) for an additional 20-year period.

The following document and the review it encompasses are requirements of NRC regulations implementing Section 102 of the National Environmental Policy Act (NEPA), of the *United States Code* (42 U.S.C. 4321), in Title 10 of the *Code of Federal Regulations* (CFR), Part 51 (10 CFR Part 51). In 10 CFR 51.20(b)(2), the Commission indicates that issuing a renewed power reactor operating license requires preparation of an Environmental Impact Statement (EIS) or a supplement to an existing EIS. In addition, 10 CFR 51.95(c) states that the EIS prepared at the operating license 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).

Upon acceptance of DEK's application, NRC began the environmental review process described in 10 CFR Part 51 by publishing in 73 Federal Registrar Notice 59678, October 9, 2009, a Notice of Intent to prepare an EIS and conduct scoping. We held a public scoping meeting on October 22, 2008, in the Town of Carlton, Wisconsin, and conducted a site audit at KPS in late May 2009. During the preparation of this draft SEIS for KPS, we reviewed DEK's environmental report and compared it to the GEIS, consulted with other agencies, conducted a 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), and considered public comments received during the scoping process.

PROPOSED ACTION

DEK initiated the proposed Federal action—issuance of a renewed power reactor operating license—by submitting an application for license renewal of KPS, for which the existing license (DPR-43) expires December 21, 2013. NRC's Federal action is the decision whether or not to renew the license for an additional 20 years.

PURPOSE AND NEED FOR ACTION

The purpose and need for the proposed action (issuance of a renewed license) is to provide an option that allows for power generation capability beyond the term of a current nuclear power plant operating license, and to meet future system generating needs, as determined by State, utility, and, where authorized, Federal (other than NRC) decision makers. This definition of purpose and need for action reflects the Commission's recognition that, unless there are findings in the safety review required by the Atomic Energy Act of 1954 or findings in the NEPA environmental analysis that would lead the NRC to not grant a license renewal, 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. If the renewed license is issued, State regulatory agencies and DEK will ultimately decide whether the plant will continue to operate based on factors such as the need for power or other matters within the State's jurisdiction or the purview of the owners. If the operating license is not renewed, then the facility must be shut down on or before December 21, 2013, when the current operating license expires.

ENVIRONMENTAL IMPACTS OF LICENSE RENEWAL

The SEIS evaluates the potential environmental impacts of the proposed action. The environmental impacts from the proposed action can be SMALL, MODERATE, or LARGE. The NRC has established a process for identifying and evaluating the significance of any new and significant information on the environmental impacts of license renewal of KPS. The NRC did not identify any 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 nor the NRC staff's review has identified any new issue applicable to KPS that has a significant environmental impact. Therefore, the NRC staff relies upon the conclusions of the GEIS for all the Category 1 issues applicable to KPS.

LAND USE

SMALL. The NRC did not identify any Category 2 impact issues for land use, nor did the staff identify any new or significant information during the environmental review. Therefore, there are no impacts beyond those discussed in the GEIS.

AIR QUALITY

SMALL. The NRC did not identify any Category 2 issues for air quality impacts, nor did the staff identify any new or significant information during the environmental review. Therefore, for plant operation during the license renewal term, there are no impacts beyond those discussed in the GEIS.

GROUND WATER USE AND QUALITY

SMALL. The NRC did not identify any Category 2 issues for groundwater impacts, nor did the staff identify any new or significant information during the environmental review. Therefore, for plant operation during the license renewal term, there are no impacts beyond those discussed in the GEIS.

SURFACE WATER USE AND QUALITY

SMALL. The NRC did not identify any Category 2 issues for impacts to surface water use and quality, nor did the staff identify any new or significant information during the environmental review. Therefore, for plant operation during the license renewal term, there are no impacts beyond those discussed in the GEIS.

AQUATIC RESOURCES

SMALL. The NRC identified Category 2 issues related to impingement, entrainment and heat shock all associated with the use of a once-through cooling system. NRC staff believes that the total impact from impingement, entrainment and heat shock on aquatic resources would be SMALL through the period of license renewal.

TERRESTRIAL RESOURCES

SMALL. The NRC did not identify any Category 2 issues for terrestrial resources, nor did the staff identify any new or significant information during the environmental review. Therefore, there are no impacts beyond those discussed in the GEIS.

THREATENED AND ENDANGERED SPECIES

SMALL. Impacts to threatened and endangered species during the period of extended operation is a Category 2 issue. However, operation of the KPS site and its associated transmission lines is not expected to adversely affect any threatened or endangered species during the license renewal term. Therefore, the NRC staff concludes that adverse impacts to threatened or endangered species during the period of extended operation would be SMALL. The NRC staff finds several adequate mitigation measures currently in place at the KPS site and along its transmission corridors. They include: nest construction and placement for the peregrine falcon, environmental review checklists, environmental evaluation forms, and best management practices.

HUMAN HEALTH

SMALL. With regard to Category 1 human health issues during the license renewal term—microbiological organisms (occupational health), noise, radiation exposures to public, and occupational radiation exposures—the NRC staff did not identify any new or significant information during the environmental review. Therefore, there are no impacts beyond those discussed in the GEIS.

Electromagnetic fields—acute effects (electric shock) is a Category 2 human health issue. The NRC staff evaluated the potential impacts for electric shock resulting from operation of KPS and its associated transmission lines. The NRC staff concludes that the potential impacts from electric shock during the renewal period would be SMALL.

For electromagnetic fields—chronic effects, the NRC staff considers the GEIS finding of “uncertain” still appropriate and will continue to follow developments on this issue.

SOCIOECONOMICS

SMALL. Category 2 socioeconomic impacts include housing impacts, public services (public utilities), offsite land use, public services (public transportation), and historic and archaeological resources. DEK has indicated they have no plans to add non-outage employees during the license renewal period; therefore non-outage employment levels at KPS would remain relatively unchanged with no additional demand for public water and sewer services. Because non-outage employment levels at KPS would remain relatively unchanged during the license renewal period, there would be no land use impacts related to population or tax revenues, and no transportation impacts.

No impacts to known historic and archaeological resources are expected from the continued operation of KPS during the license renewal term. DEK has indicated no plans to engage in activities that could result in changes to the plant or any ground disturbing activities associated with license renewal at KPS. Based on the review of the Wisconsin Historical Society files, archaeological surveys, assessments, and other information, the potential impacts of continued operations and maintenance on historic and archaeological resources at KPS would be SMALL.

With respect to environmental justice, an analysis of minority and low-income populations residing within a 50-mile (80-kilometer) radius of KPS indicated there would be no disproportionately high and adverse impacts to these populations from the continued operation of KPS during the license renewal period. Based on recent monitoring results, concentrations of contaminants in native leafy vegetation, soils and sediments, surface water, and fish in areas surrounding KPS have been low (at or near the threshold of detection) and seldom above background levels. Consequently, no disproportionately high and adverse human health impacts would be expected in special pathway receptor populations in the region as a result of subsistence consumption of fish and wildlife.

SEVERE ACCIDENT MITIGATION ALTERNATIVES

Since KPS had not previously considered alternatives to reduce the likelihood or potential consequences of a variety of highly uncommon but potentially serious accidents, NRC regulation 10 CFR 51.53(c)(3)(ii)(L) requires that KPS evaluate Severe Accident Mitigation Alternatives (SAMAs) in the course of license renewal review. SAMAs are potential ways to reduce the risk or potential impacts of uncommon but potentially severe accidents, and may include changes to plant components, systems, procedures, and training.

Based on our review of potential SAMAs, we conclude that KPS made a reasonable, comprehensive effort to identify and evaluate SAMAs. Based on the review of the SAMAs for KPS, and the plant improvements already made, we conclude that none of the potentially cost-beneficial SAMAs relate to adequately managing the effects of aging during the period of extended operation; therefore, they need not be implemented as part of the license renewal pursuant to 10 CFR Part 54.

ALTERNATIVES

We considered the environmental impacts associated with alternatives to license renewal. These alternatives include other methods of power generation and not renewing the KPS operating license (the no-action alternative). Replacement power options considered were supercritical coal-fired generation, natural gas combined-cycle generation, and as part of the combination alternative, conservation/efficiency, wood-fired generation, and wind power. Wherever possible, we evaluated potential environmental impacts for these alternatives located both at the KPS site and at some other unspecified alternate location. We evaluated each alternative using the same impact areas that we used in evaluating impacts from license renewal. The results of this evaluation are summarized in the table on the following page.

COMPARISON OF ALTERNATIVES

The NRC notes that the impacts of license renewal for KPS are similar to or smaller than the impacts of the alternatives considered in all resource areas, with the exception of no action. No action, however, would necessitate additional action on the part of other entities to either replace or offset the power produced by KPS, and thus would result in additional impacts similar to those discussed in this document.

The coal-fired alternative is the least environmentally favorable alternative, due to its impact on air quality and human health from nitrogen oxides, sulfur oxides, particulate matter, polycyclic aromatic hydrocarbons, carbon monoxide, carbon dioxide, and mercury. Construction impacts to aquatic, terrestrial, and potentially historic and archaeological resources are also factors that contribute toward the coal-fired alternative being the least environmentally favorable alternative. The gas-fired alternative would have slightly lower air emissions, and impacts to aquatic, terrestrial, and historic and archaeological resources would vary depending upon location of the plant.

RECOMMENDATION

Our preliminary determination is that the adverse environmental impacts of license renewal for KPS are not so great that preserving the option of license renewal for energy planning decision makers would be unreasonable. This determination is based on (1) the analysis and findings in the GEIS; (2) information submitted in DEK's Environmental Report; (3) consultation with other Federal, State, and local agencies; (4) a review of other pertinent studies and reports; and (5) a consideration of public comments received during the scoping process.

Alternative	Impact Area						
	Air Quality	Ground Water	Surface Water	Aquatic and Terrestrial Resources	Human Health	Socioeconomics	Waste Management
KPS License Renewal	SMALL	SMALL	SMALL	SMALL	SMALL to MODERATE	SMALL	SMALL
Supercritical coal-fired at KPS site	MODERATE	SMALL	SMALL	MODERATE	SMALL	SMALL to LARGE	MODERATE
Supercritical coal-fired at an alternate site	MODERATE	SMALL	SMALL	MODERATE	SMALL	SMALL to LARGE	MODERATE
Gas-fired at KPS site	MODERATE	SMALL	SMALL	SMALL to MODERATE	SMALL	SMALL to MODERATE	SMALL
Gas-fired at an alternative site	MODERATE	SMALL	SMALL to MODERATE	SMALL to MODERATE	SMALL	SMALL to MODERATE	SMALL
Combination of Alternatives #1	MODERATE	SMALL	SMALL to MODERATE	SMALL to LARGE	SMALL to MODERATE	SMALL to LARGE	SMALL
No Action Alternative	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL to MODERATE	SMALL

ABBREVIATIONS AND ACRONYMS

AADT	average annual daily traffic
ACC	cleanup and decontamination costs
ACHP	Advisory Council on Historic Preservation
ADAMS	Agencywide Documents Access and Management System
AEA	Atomic Energy Act of 1954
AEC	U.S. Atomic Energy Commission
AEO	Annual Energy Outlook
AEP	area of potential effect
AFW	auxiliary feedwater
ALARA	as low as reasonably achievable
AOC	Averted Offsite Property Damage Costs
AOCs	Areas of Concern
AOE	Averted Occupational Exposure
AOSC	Averted onsite costs
APE	Averted Public Exposure
AQCR	air quality control region
ATC	American Transmission Company
ATWS	anticipated transient without scram
AVD	AVD Archaeological Services, Inc.
BPJ	best professional judgment
BTA	best technology available
Btu/ft3	British thermal units per cubic feet
Btu/kWh	British thermal units per kilowatt hour
Btu/lb	British thermal units per pound
CAA	Clean Air Act
CAIR	Clean Air Interstate Rule
CAMR	Clean Air Mercury Rule
CDF	core damage frequency
CDM	clean development mechanism

CEQ	Council on Environmental Quality
CET	containment event tree
cfd	cubic feet per day
CFR	*Code of Federal Regulations*
cfs	cubic feet per second
CFT	core flood tank
CH_4	methane
CO	carbon monoxide
CO_2	carbon dioxide
CST	condensate storage tank
CVCS	chemical and volume control system
CWA	Clean Water Act
DBA	design-basis accident
DEK	Dominion Energy Kewaunee, Inc.
DG	diesel generator
	diesel-engine generator
DOE	Department of Energy
DOT	Department of Transportation
ECCS	emergency core cooling system
EDG	emergency diesel generator
EIA	Energy Information Administration
EIS	environmental impact statement
ELF	extremely low frequency
EMF	electromagnetic fields
EMS	environmental management system
EPA	Environmental Protection Agency
ER	environmental report
F&O	Fact & Observation
FERC	Federal Energy Regulatory Commission

FES	final environmental statement
FIPs	Federal Implementation Plans
FIVE	fire-induced vulnerability evaluation
fps	foot per second
FR	final regulations
FSAR	final safety analysis report
FV	Fussell-Vesely
gCeq/kWh	grams conversion equivalent per kilowatt-hour
GE	General Electric Company
GEIS	generic environmental impact statement
GHG	greenhouse gas
GLFC	Great Lakes Fishery Commission
GLWQA	Great Lakes Water Quality Agreement
gpd	gallons per day
gpm	gallons per minute
GWh	gigawatt hours
HAP	hazardous air pollutants
HCLPF	high confidence in low probability of failure
HEP	human error probability
HFC	hydrofluorocarbons
HFE	hydrofluorinated ethers
HFO	high winds, floods, and other
Hg	mercury
HVAC	heating, ventilation, and air conditioning
Hz	hertz
IAEA	International Atomic Energy Agency
IEEE	Institute of Electrical and Electronics Safety Code
IJC	International Joint Commission
IPA	integrated plant assessment

IPCC	Intergovernmental Panel on Climate Change
IPE	individual plant examination
IPEEE	individual plant examination of external events
ISLOCA	interfacing systems loss-of-coolant accident
J	joule
KPS	Kewaunee Power Station
kV	kilovolt
kW	kilowatt
kWh	kilowatt-hours
LaMPs	Lakewide Management Plans
LERF	large early release frequency
LLMW	low-level mixed waste
LMMB	Lake Michigan Mass Balance Study
LOCA	loss of coolant accident
Lpd	liters per day
m/s	meters per second
m^3/s	cubic meters per second
MAAP	Modular Accident Analysis Program
MACCS2	MELCOR Accident Consequence Code System 2
MACT	Maximum Achievable Control Technology
MCC	motor control center
	movement control center
mgd	millions of gallons per day
Midwest RPO	Midwest Regional Planning Organization
MISO	Midwest Independent Transmission System Operator
MIT	Massachusetts Institute of Technology
MMACR	Modified Maximum Averted Cost Risk
mrem	milliroentgen equivalent man

mSv	mean square voltage
MT	metric tons
MW	megawatts
MWd/MTU	megawatt days per metric ton of uranium
MWe	megawatts-electric
MWh	megawatt hours
MWt	megawatts-thermal
N_2O	nitrous oxide
NAS	National Academy of Sciences
NCDC	National Climatic Data Center
NCore	national core
NEA	Nuclear Energy Agency
NEPA	National Environmental Policy Act
NES	Nalco Environmental Sciences
NESC	National Electric Safety Code
NF_3	nitrogen trifluoride
ng	nanograms
NHPA	National Historic Preservation Act
NIEHS	National Institute of Environmental Health and Sciences
NIRS/WISE	Nuclear Information and Resource Service/World Information Service on Energy
NOAA	National Oceanic and Atmospheric Administration
NOx	Nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
NRHP	National Register of Historic Places
NSR	New Source Review
NUREG/BR	nuclear regulatory brochure
NWS	National Weather Service
ODCM	offsite dose calculation manual

PBNP	Point Beach Nuclear Plant
PCBs	polychlorinated biphenyls
PDS	plant damage state
PFC	perfluorocarbons
PIC	Proposal for Information Collection
PILOT	payment in lieu of taxes
PMNP	platform mounted nuclear plant
PORV	power-operated relief valve
	plant-operated relief valve
POST	Parliamentary Office of Science and Technology
ppt	parts per thousand
PRA	probabilistic risk assessment
PWR	pressurized water reactor
RAI	request for additional information
RAP	remedial action program
RCP	reactor coolant pump
RCRA	Resource Conservation and Recovery Act
RCS	reactor coolant system
rem	roentgen equivalent man
REMP	radiological environmental monitoring program
RHR	residual heat removal
RLE	Review Level Earthquake
RO	reverse osmosis
ROI	region of interest
ROW	right of way
RPC	replacement power cost
RPO	regional planning organizations
RWST	refueling water storage tank
SAMA	severe accident mitigation alternative
SAR	safety analysis report

SBO	station blackout
SCR	selective catalytic reduction
SEIS	supplemental environmental impact statement
SER	safety evaluation Report
SF_6	sulfur hexafluoride
SGTR	steam generator tube rupture
SHPO	State Historic Preservation Officer
SMA	seismic margins assessment
SO_2	sulfur dioxide
SOx	sulfur oxides
SP	sampling points
SPDES	State Pollutant Discharge Elimination System
SR	supporting requirement
STC	source term category
Sv	sievert
TER	Technical Evaluation Report
TWh	terawatt-hours
USFWS	U.S. Fish and Wildlife Service
U.S.C.	*United States Code*
USCB	U.S. Census Bureau
USGCRP	United States Global Change Research Program
VCT	volume control tank
WDHS	Wisconsin Department of Health Services
WDNR	Wisconsin Department of Natural Resources
WET	Whole Effluent Toxicity
WHS	Wisconsin Historical Society
WOG	Westinghouse Owner's Group
WPDES	Wisconsin pollutant discharge elimination system
WPSC	Wisconsin Public Service Corporation

1.0 PURPOSE AND NEED FOR ACTION

Under the U.S. Nuclear Regulatory Commission's (NRC's) environmental protection regulations in Title 10, Part 51, of the *Code of Federal Regulations* (10 CFR 51), which implement the National Environmental Policy Act (NEPA), issuance of a new nuclear power plant operating license requires the preparation of an environmental impact statement (EIS).

The Atomic Energy Act of 1954 (AEA) originally specified that licenses for commercial power reactors be granted for up to 40 years with an option to renew for up to another 20 years. The 40-year licensing period was based on economic and antitrust considerations rather than on the technical limitations of the nuclear facility.

The decision to seek a license renewal rests entirely with nuclear power facility owners and typically is based on the facility's economic viability and the investment necessary to continue to meet NRC safety and environmental requirements. The NRC makes the decision to grant or deny a license renewal application based on whether or not the applicant has demonstrated that the environmental and safety requirements in the NRC's regulations can be met during the period of extended operation.

1.1 PROPOSED FEDERAL ACTION

Dominion Energy Kewaunee, Inc. (DEK) initiated the proposed federal action by submitting an application for license renewal of the Kewaunee Power Station (KPS). KPS's current license, DPR-43, expires on December 21, 2013. The NRC's Federal action is the decision whether or not to renew the license for an additional 20 years.

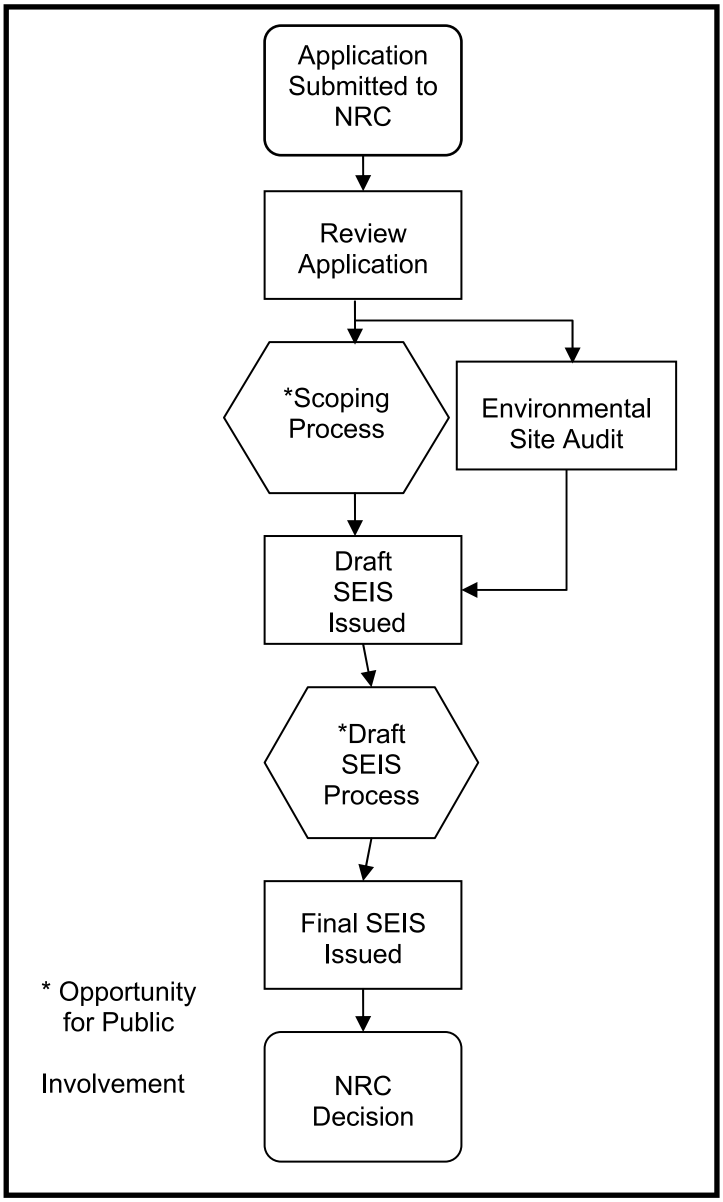
1.2 PURPOSE AND NEED FOR PROPOSED FEDERAL ACTION

The purpose and need for the proposed action (issuance of a renewed 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. These needs may be determined by State, utility, and, where authorized, Federal decision makers other than the NRC. This definition of purpose and need reflects the Commission's recognition that, unless there are findings in the safety review required by the AEA or findings in the NEPA environmental analysis that would lead the NRC to not grant a license renewal, the NRC does not have a role in the energy-planning decisions of State regulators and utility officials as to whether or not a particular nuclear power plant should continue to operate.

If the renewed license is issued, State regulatory agencies and DEK will ultimately decide whether the plant will continue to operate. This decision will be based on factors such as the need for power or other matters within the State's jurisdiction, or the purview of the owners. If the operating license is not renewed, then the facility must be shut down on or before the expiration date of the current operating license: December 21, 2013.

1.3 MAJOR ENVIRONMENTAL REVIEW MILESTONES

Figure 1-1. Environmental Review Process. *The environmental review provides opportunities for public involvement.*



DEK submitted an environmental report (ER) (DEK, 2008) as part of its license renewal application in August 2008 (DEK, 2008a). After reviewing the application for sufficiency, the NRC staff published a Notice of Acceptability and Opportunity for Hearing on October 1, 2008, in the *Federal Register* (Volume 73, p. 57154, (73 FR 57154)). The NRC published another notice on October 9, 2008, in the *Federal Register* (73 FR 59678) on its intent to conduct scoping, thereby beginning the 60-day scoping period.

A preliminary site audit was conducted during October 21–22, 2008 (NRC, 2009b). The objectives of the preliminary audit were to tour KPS's general vicinity and gain familiarity with the ecological, historical, and cultural resources in the area.

The agency held two public scoping meetings on October 22, 2008, in the town of Carlton, Wisconsin. The NRC report entitled, "Environmental Impact Statement Scoping Process Summary Report for Kewaunee Power Station," dated April 2009, presents the comments received during the scoping process (NRC, 2009a). Appendix A to this draft supplemental EIS presents the comments considered to be within the scope of the environmental license renewal review and the associated NRC responses.

To independently verify information provided in the ER, the NRC staff conducted a site audit at KPS from May 26–28, 2009. During the site audit, staff met with plant personnel, reviewed specific documentation, toured the facility, and met with interested State and local agencies. The agency published a summary of that site audit and a list of the attendees in a report entitled, "Summary of Site Audit Related to the Review of the License Renewal Application for Kewaunee Power Station," dated August 12, 2009 (NRC, 2009c).

Upon completion of the scoping period and site audit, the staff compiled its findings in this draft supplemental environmental impact statement (SEIS), as shown in Figure 1-1. This document is made available for public comment for 75 days. During this time, NRC staff will host public meetings and collect public comments. Based on the information gathered, the staff will amend the draft SEIS findings as necessary and publish the final SEIS.

The safety review is conducted simultaneously with the environmental review. The staff documents the findings of the safety review in a safety evaluation report (SER). The Commission considers the findings in both the SEIS and the SER in its decision to either grant or deny the issuance of a new license.

1.4 GENERIC ENVIRONMENTAL IMPACT STATEMENT

The NRC performed a generic assessment of the environmental impacts associated with license renewal to improve the efficiency of the license renewal process. The *Generic Environmental Impact Statement* (GEIS) *for License Renewal of Nuclear Power Plants*, NUREG-1437 (NRC, 1996) documented the results of the NRC staff's systematic approach to evaluate the environmental consequences of renewing the licenses of individual nuclear power plants and operating them for an additional 20 years. NRC staff analyzed in detail and resolved those environmental issues that could be resolved generically in the GEIS.

The GEIS establishes 92 separate issues for NRC staff to consider. Of these issues, NRC staff determined that 69 are generic to all plants (Category 1) while 21 issues do not lend themselves to generic consideration (Category 2). Two other issues remained uncategorized: environmental justice and chronic effects of electromagnetic fields, which must be evaluated on a site-specific basis. A list of all 92 issues can be found in Appendix B.

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 or not 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 for impacts was established using the Council on Environmental Quality (CEQ) terminology for "significant." The NRC established three levels of significance for potential impacts: SMALL, MODERATE, and LARGE, as defined below.

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.

> ***Significance*** indicates the importance of likely environmental impacts and is determined by considering two variables: **context** and **intensity**.
>
> ***Context*** is the geographic, biophysical, and social context in which the effects will occur.
>
> ***Intensity*** refers to the severity of the impact, in whatever context it occurs.

The GEIS includes a determination of whether or not the analysis of the environmental issue could be applied to all plants and whether or not additional mitigation measures would be warranted (Figure 1-2). Issues are assigned a Category 1 or a Category 2 designation. As set forth in the GEIS, Category 1 issues are those that meet the following criteria:

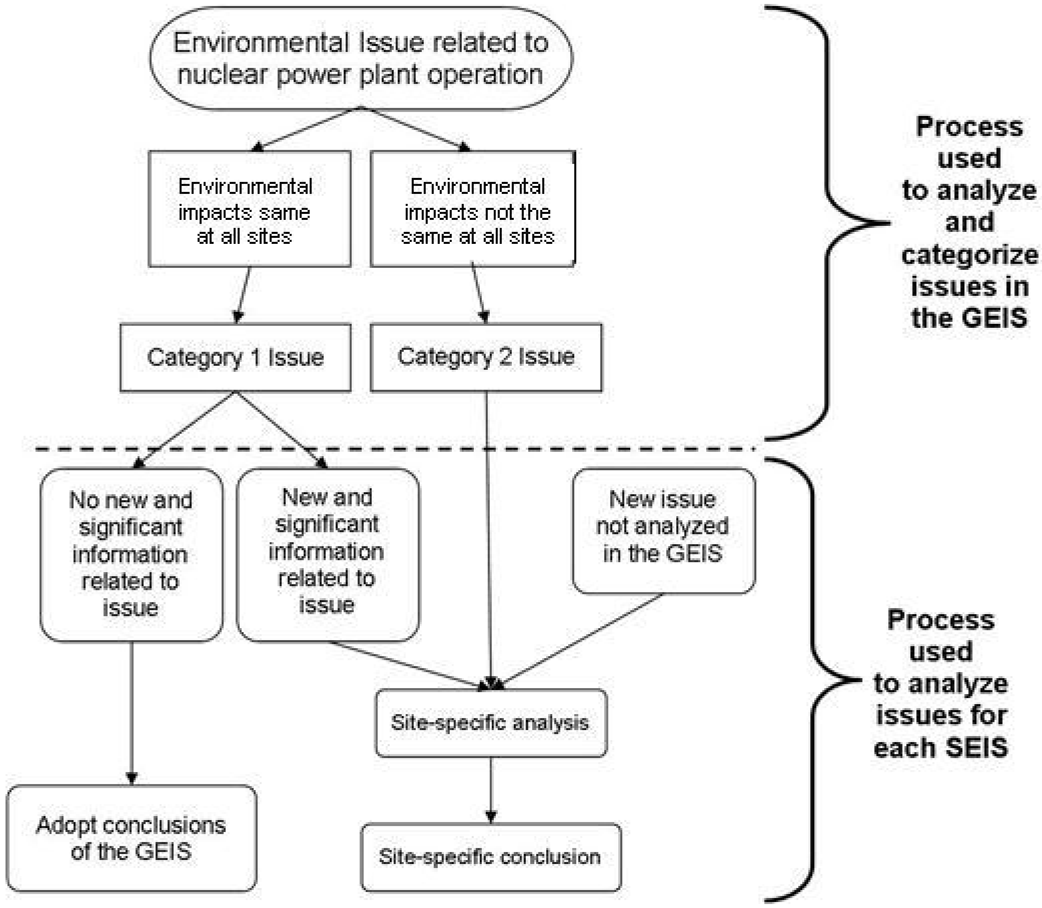
(1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristics.

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

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

For generic issues (Category 1), no additional site-specific analysis is required in this supplemental EIS unless new and significant information is identified. The process for identifying new and significant information is presented in Chapter 4. Site-specific issues (Category 2) are those that do not meet one or more of the criteria of Category 1 issues and, therefore, additional site-specific review for these issues is required. The results of that site-specific review are documented in the SEIS.

Figure 1-2. Environmental Issues Evaluated during License Renewal. *Ninety-two issues were initially evaluated in the GEIS. A site-specific analysis is required for 23 of those 92 issues.*



1.5 SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

The SEIS presents an analysis that considers the environmental effects of the continued operation of KPS, alternatives to license renewal, and mitigation measures for minimizing adverse environmental impacts. Chapter 8 contains analysis and comparison of the potential environmental impacts from alternatives and Chapter 9 presents the preliminary recommendation to the Commission on whether or not the environmental impacts of license renewal are so great that preserving the option of license renewal would be unreasonable. The recommendation will be made after consideration of comments received during the public scoping period and on the draft SEIS.

In the preparation of this SEIS for KPS, the NRC staff:

- reviewed the information provided in the DEK ER;
- consulted with other Federal, State, and local agencies;

- conducted an independent review of the issues during site audit; and
- considered the public comments received during the scoping process and on the draft SEIS.

New information can be identified from a number of sources, including the applicant, NRC, other agencies, or public comments. If a new issue is revealed, then it is first analyzed to determine whether or not it is within the scope of the license renewal evaluation. If it is not addressed in the GEIS, then the NRC determines its significance and documents its analysis in the SEIS.

New and significant information either: (1) identifies a significant environmental issue not covered in the GEIS, or (2) was not considered in the analysis in the GEIS and leads to an impact finding that is different from the finding presented in the GEIS.

1.6 COOPERATING AGENCIES

During the scoping process, no Federal, State, or local agencies were identified as cooperating agencies in the preparation of the SEIS.

1.7 CONSULTATIONS

The Endangered Species Act (ESA) of 1973, as amended, the Magnuson-Stevens Fisheries Management Act of 1996, as amended, and the National Historic Preservation Act (NHPA) of 1966 require that Federal agencies consult with applicable State and Federal agencies and groups prior to taking action that may affect endangered species, fisheries, or historic and archaeological resources, respectively. Below are the agencies and groups with whom NRC consulted. Consultation documents are included in Appendix E.

Table 1-1. Consultation Correspondences. *List of the consultation documents sent by the NRC to other agencies, based on NEPA requirements.*

Recipient	Date of Letter
U.S. Fish and Wildlife Service (L. Clemency) ML082610748	September 30, 2008
Advisory Council on Historic Preservation (D. Klima) ML082610168	October 8, 2008
Wisconsin Historical Society (S. Banker) ML082670685	October 10, 2008
Wisconsin Coastal Management Program (K. Angel) ML082680027	October 10, 2008
Wisconsin Department of Natural Resources (R. Kazmierczak) ML082661119	October 10, 2008
Menominee Indian Tribe of Wisconsin (T. Virden) ML082800098	October 16, 2008[a]

[a] Similar letters were sent to 23 other Native American Tribes listed in Section 1.8 and Appendix E.

1.8 CORRESPONDENCE

During the course of the environmental review, the NRC staff contacted the following Federal, State, regional, local, and tribal agencies. Appendix E contains a chronological list of all the documents sent and received during the environmental review.

Advisory Council on Historic Preservation, Washington, D.C.

Bad River Band of Lake Superior Tribe of Chippewa Indians, Odanah, Wisconsin

Bay Mills Indian Community, Brimley, Minnesota

Bureau of Indian Affairs, Ft. Snelling, Minnesota

Citizen Potawatomi Nation, Shawnee, Oklahoma

Forest County Potawatomi Community of Wisconsin, Crandon, Wisconsin

Grand Traverse Band of Ottawa and Chippewa Indians, Suttons Bay, Minnesota

Hannahville Indian Community, Wilson, Minnesota

Ho-Chuck Nation, Black River Falls, Wisconsin

Huron Potawatomi, Inc., Fulton, Minnesota

Keweenaw Bay Indian Community, Baraga, Minnesota

Little Traverse Bay Bands of Odawa Indians, Harbor Springs, Minnesota

Little River Band of Ottawa Indians, Manistee, Minnesota

Lac Vieux Desert Band of Lake Superior Chippewa Indians, Watersmeet, Minnesota

Lac Courte Oreilles Band of Lake Superior Chippewa Indians of Wisconsin, Hayward, Wisconsin

Lac du Flambeau Band of Lake Superior Chippewa Indians of Wisconsin, Lac du Flambeau, Wisconsin

Menominee Indian Tribe of Wisconsin, Keshena, Wisconsin

Oneida Tribe of Indians Wisconsin, Oneida, Wisconsin

Pokagon Band of Potawatomi Indians, Dowagiac, Minnesota

Prairie Band Potawatomi Nation, Mayetta, Kansas

Red Cliff Band of Lake Superior Chippewa Indians of Wisconsin, Bayfield, Wisconsin

Stockbridge Munsee Community of Wisconsin, Bowler, Wisconsin

Sault Ste. Marie Tribe of Chippewa Indians of Michigan, Sault Ste. Marie, Minnesota

Sokagon Chippewa Community, Mole Lake Band of Lake Superior Chippewa Indians, Crandon, Wisconsin

St. Croix Chippewa Indians of Wisconsin, Webster, Wisconsin

U.S. Fish and Wildlife Service, Green Bay, Wisconsin

U.S. Fish and Wildlife Service, New Franken, Wisconsin

Wisconsin Coastal Management Program, Madison, Wisconsin

Wisconsin Historical Society, Madison, Wisconsin

Wisconsin Department of Natural Resources, Green Bay, Wisconsin

A list of persons who received a copy of this draft SEIS is provided below:

Chris L. Funderburk, Director, Nuclear Licensing and Operations Support Dominion Resources Services, Inc.	William R. Matthews, Senior Vice President – Nuclear Operations Innsbrook Technical Center	Alan J. Price Vice President – Nuclear Engineering Innsbrook Technical Center
Michael J. Wilson, Director Nuclear Safety & Licensing Dominion Energy Kewaunee, Inc.	William D. Corbin, Director – Nuclear Engineering Innsbrook Technical Center	Kewaunee Resident Inspectors Office U.S. Nuclear Regulatory Commission
Thomas L. Breene Dominion Energy Kewaunee, Inc., Kewaunee Power Station	Paul C. Aitken Supervisor – License Renewal Project Innsbrook Technical Center	Lillian M. Cuoco, Esq. Senior Counsel Dominion Resources Services, Inc.
Stephen E. Scace, Site Vice President Dominion Energy Kewaunee, Inc.	David R. Lewis, Pillsbury Winthrop Shaw Pittman	Ken Paplham Board Supervisor, Town of Carlton
Jeff Kitsembel, P.E. Public Service Commission of Wisconsin	Richard Gallagher, Senior Scientist, License Renewal Dominion Resources Services, Inc	Ronald Kazmierczak, Regional Director, Wisconsin Department of Natural Resources
Kathleen Angel, Federal Consistency and Coastal Hazards Coordinator, Wisconsin Coastal Management Program	Steven Ugoretz, Environmental Analyst, Wisconsin Department of Natural Resources	David Siebert, Director Office of Energy Wisconsin Department of Natural Resources
David A. Heacock, President and Chief Nuclear Officer Dominion Energy Kewaunee, Inc.		

1.9 STATUS OF COMPLIANCE

DEK is responsible for complying with all NRC regulations and other applicable Federal, State, and local requirements. A description of some of the major Federal statutes can be found in Appendix E of the GEIS.

There are numerous permits and licenses issued by Federal, State, and local authorities for activities at KPS, as shown in Table 1-2.

1 **Table 1-2. Licenses and Permits.** *Existing environmental authorizations for KPS.*

Permit and Applicable Statute	Number	Dates	Responsible Agency
License to Operate (Atomic Energy Act (42 USC 2011, et seq.), 10 CFR 50.10)	DPR-43	Issued: Not Listed Expires: 12/21/13	NRC
Approval (10 CFR 20.2002 Disposal of Contaminated WWTF Sludge)	N/A	Issued: 11/13/95 Expires: Not Listed	NRC
Registration (49 USC 5108, Hazardous materials shipments)	062706 552 0750Q	Expires: 06/30/09	Department of Transportation (DOT)
Notification of Regulated Waste Activity (Federal Resource Conservation and Recovery Act, 42 USC 6912; Ch. 291 Wisconsin Statutes)	EPA ID# WID00713016	Issued: Not Listed Expires: Not Listed	Environmental Protection Agency (EPA)
Permit for construction of water intake and discharge structures in Lake Michigan (33 USC 403)	NCCOD-S 69-10	Issued: 12/12/68 Expires: Not Listed	U.S. Army Corps of Engineers (USACE)
Permit for construction of water intake and discharge structures in Lake Michigan (Ch. 283 Wisconsin Statutes)	2-WP-2570	Issued: 12/04/67 Expires: Not Listed	Wisconsin Department of Natural Resources (WDNR)
Permit to construct and operate (Ch. 281 Wisconsin Statutes)	3430 (Note: Current WPDES permit authorizes discharges.)	Issued: 11/26/85 Expires: Not Listed	WDNR
Letter Approval (Note: Continued authorization via WPDES permit.) (Ch. 283 Wisconsin Statutes)	N/A	Issued: 08/05/92 Expires: Not Listed	WDNR
Individual WPDES permit (Clean Water Act (33 USC Section 1251 et seq.), Ch. 283 Wisconsin Statutes	WI-00001571-06	Issued: Not Listed Expires: 06/30/10	WDNR
General WPDES Industrial Storm Water Discharge Permit (Clean Water Act (33 USC Section 1251 et seq.), Ch. 283 Wisconsin Statutes)	WI-S049158-2	Issued: Not Listed Expires: 03/31/06 (Authorization continues. Automatically reissued when new permit becomes available.)	WDNR
Air Pollution Control Operation Permit (Federal Clean Air Act (42 USC 7401 et seq.), Ch. 285 Wisconsin Statutes)	431022790-F11 (Note: DEK is considering conversion of this permit to a “Type A Registration Operation Permit,” Air Pollution Control Permit Number ROP-A01, issued by the WDNR.)	Issued: Not Listed Expires 06/19/07 (Note: A timely renewal application was submitted. Authorization continues under “Application shield” clause of s.285.62(8), statutes)	WDNR
Registration (Ch. 280 and 281 Wisconsin Statutes)	ID# 43104061	Issued: Not Listed Expires: Not Listed	WDNR
High-Capacity Well Approval (Ch. 281 Wisconsin Statutes)	Approval #s 52802, 52803	Issued 01/26/68 Expires: Not Listed	WDNR

Permit and Applicable Statute	Number	Dates	Responsible Agency
Aboveground Storage Tank Registration (Ch. 101.09 Wisconsin Statutes	Owner ID: 83035, Site ID: 679179, Tank ID: 463455	Issued: Not Listed Expires: Not Listed	Wisconsin Department of Commerce
Underground Storage Tank Registration (Federal Resource Conservation and Recovery Act (42 USC 6901 et seq.), Ch. 101.09 Wisconsin Statutes)	Owner ID: 383035 Site ID: 679179 Tank IDs: 285236, 2852239, 406492, 771175, 978062	Issued: Not Listed Expires 05/28/06 (285236, 2852239, 978062) (Timely renewal application was submitted.) Expires 10/28/08 (406492, 771175)	Wisconsin Department of Commerce
Radioactive waste transport permit (South Carolina Radioactive Waste Transportation and Disposal Act (S.C. Code of Laws 13-7-110 et seq.)	0044-48-08	Issued: Not Listed Expires: 12/31/08	South Carolina Department of Health and Environmental Control
License to ship radioactive material (Tennessee Code Annotated 68-202-206)	T-WI003-L08	Issued: Not Listed Expires: 12/31/08	Tennessee Department of Environment and Conservation
Site Access Permit (R313-26 of Utah Radiation Control Rules)	0704004220	Issued: Not Listed Expires: 6/28/08	Utah Department of Environmental Quality

1.10 REFERENCES

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

73 FR 57154, October 1, 2008, U.S. Nuclear Regulatory Commission, Washington, D.C., “Notice of Acceptance for Docketing of the Application and Notice of Opportunity for Hearing Regarding Renewal of Facility Operating License No. DPR-43 for an Additional 20-Year Period; Dominion Energy Kewaunee, Inc.; Kewaunee Power Station,” *Federal Register.* Volume 73, No. 191, pp. 57154-57156. Washington, D.C.

73 FR 59678, October 9, 2008, U.S. Nuclear Regulatory Commission, Washington, D.C., “Dominion Energy Kewaunee, Inc., Kewaunee Power Station; Notice of Intent To Prepare an Environmental Impact Statement and Conduct Scoping Process,” *Federal Register.* Volume 73, No. 197, pp. 59678-59679. Washington, D.C.

Dominion Energy Kewaunee, Inc. (DEK). 2008: “Applicant’s Environmental Report – Operating License Renewal Stage. Appendix E of Application for Renewed Operating License, Kewaunee Power Station,” Docket No. 50-305. August 2008. Agencywide Documents Access and Management System (ADAMS) Accession No. ML082341039.

Dominion Energy Kewaunee, Inc. (DEK). 2008a: “Application for Renewed Operating License, Kewaunee Power Station.” Docket No. 50-305. August 2008. ADAMS Accession Nos. ML082341020, ML082341038, ML082420854.

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

Endangered Species Act of 1973 (ESA), 16 USC 1531, et seq.

Magnuson-Stevens Fishery Conservation and Management Act, as amended by the Sustainable Fisheries Act of 1996, 16 USC 1855, et seq.

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

National Historic Preservation Act (NHPA), 16 USC 470, et seq.

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). 2009a: “Environmental Impact Statement Scoping Process Summary Report for Kewaunee Power Station,” dated April 6, 2009. ADAMS Accession No. ML090770880.

U.S. Nuclear Regulatory Commission (NRC). 2009b: “Kewaunee Power Station, October 21–22, 2008, Site Audit Summary.” ADAMS Accession No. ML092180137.

U.S. Nuclear Regulatory Commission (NRC). 2009c: “Kewaunee Power Station, May 26–28, 2009, Site Audit Summary.” ADAMS Accession No. ML092050144.

2.0 AFFECTED ENVIRONMENT

Kewaunee Power Station (KPS) is a one-unit pressurized-water reactor (PWR) power plant located on the west-central shore of Lake Michigan in Kewaunee County, Wisconsin. KPS is approximately 30 miles east-southeast of Green Bay and 8 miles south of the city of Kewaunee. The KPS site boundary encompasses approximately 908 acres. Structures, facilities, and parking lots occupy approximately 60 acres, and approximately 450 acres are used for agriculture. The balance remains in a mixture of woods, fields in various stages of succession, small wetlands and watercourses, and open areas. The site includes approximately 2 miles of continuous frontage on the western shore of Lake Michigan. For purposes of the evaluation in this report, the "affected environment" is the environment that currently exists at and around KPS and its associated transmission lines' rights of way. Because existing conditions are at least partially the result of past construction and operation at the plant, the impacts of the past and ongoing actions and how they have shaped the environment are presented here. The facility and its operation are described in Section 2.1 and the affected environment is presented in Section 2.2.

2.1 FACILITY DESCRIPTION

This assessment of the affected environment begins with a description of KPS, which is the source of potential environmental effects. Figures 2.1 and 2.2 present the 50-mile and 6-mile vicinity maps around KPS, respectively. With the exception of a highway traversing the site (State Route 42), town roads, and the Sandy Bay Cemetery, a 1.13-acre cemetery that is owned and maintained by the town of Carlton, all property within the site boundary is owned and operated by Dominion Energy Kewaunee, Inc. (DEK) as shown in Figure 2.3.

Figure 2-1. Kewaunee Power Station 50-Mile Radius

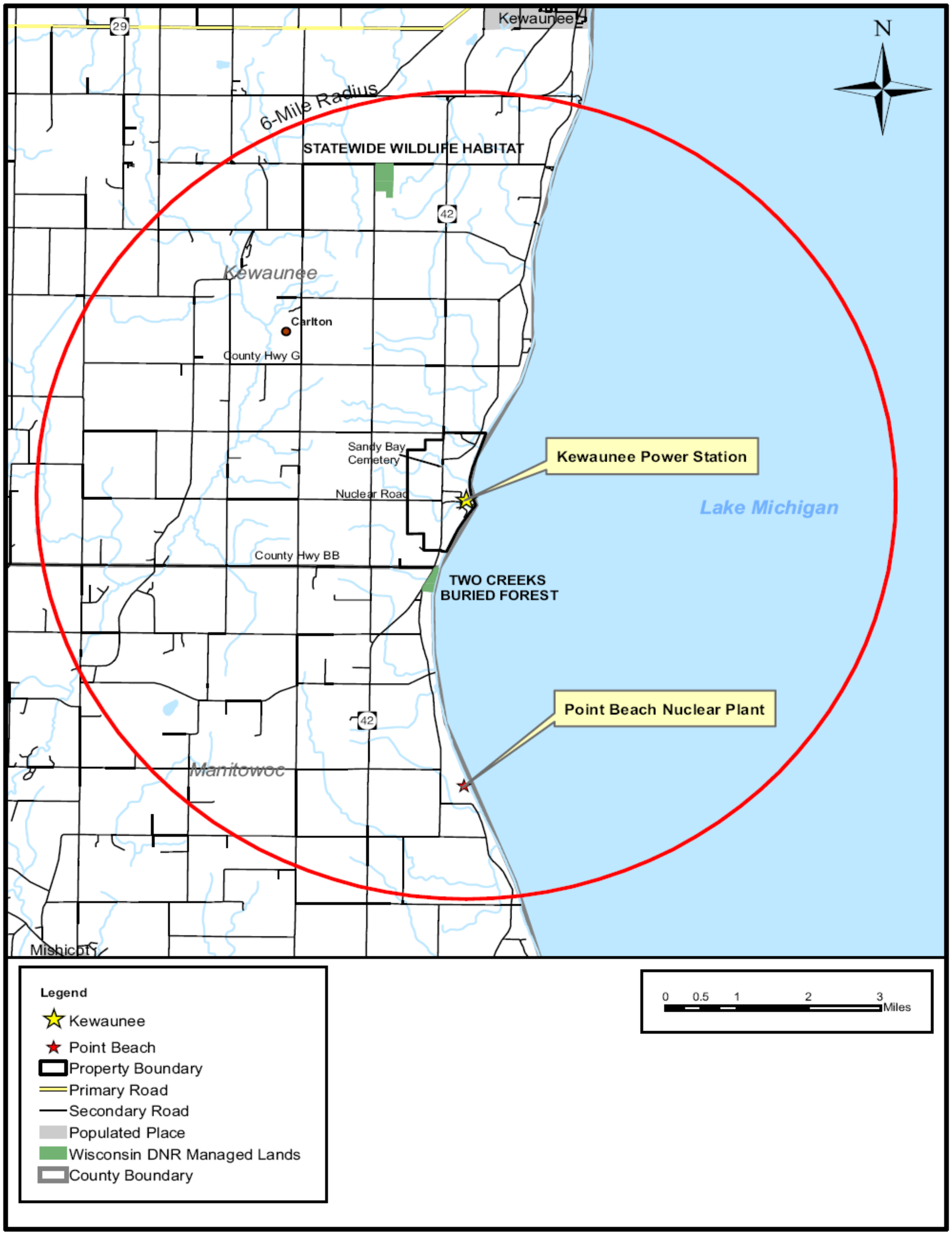


Figure 2-2. Kewaunee Power Station 6-Mile Radius

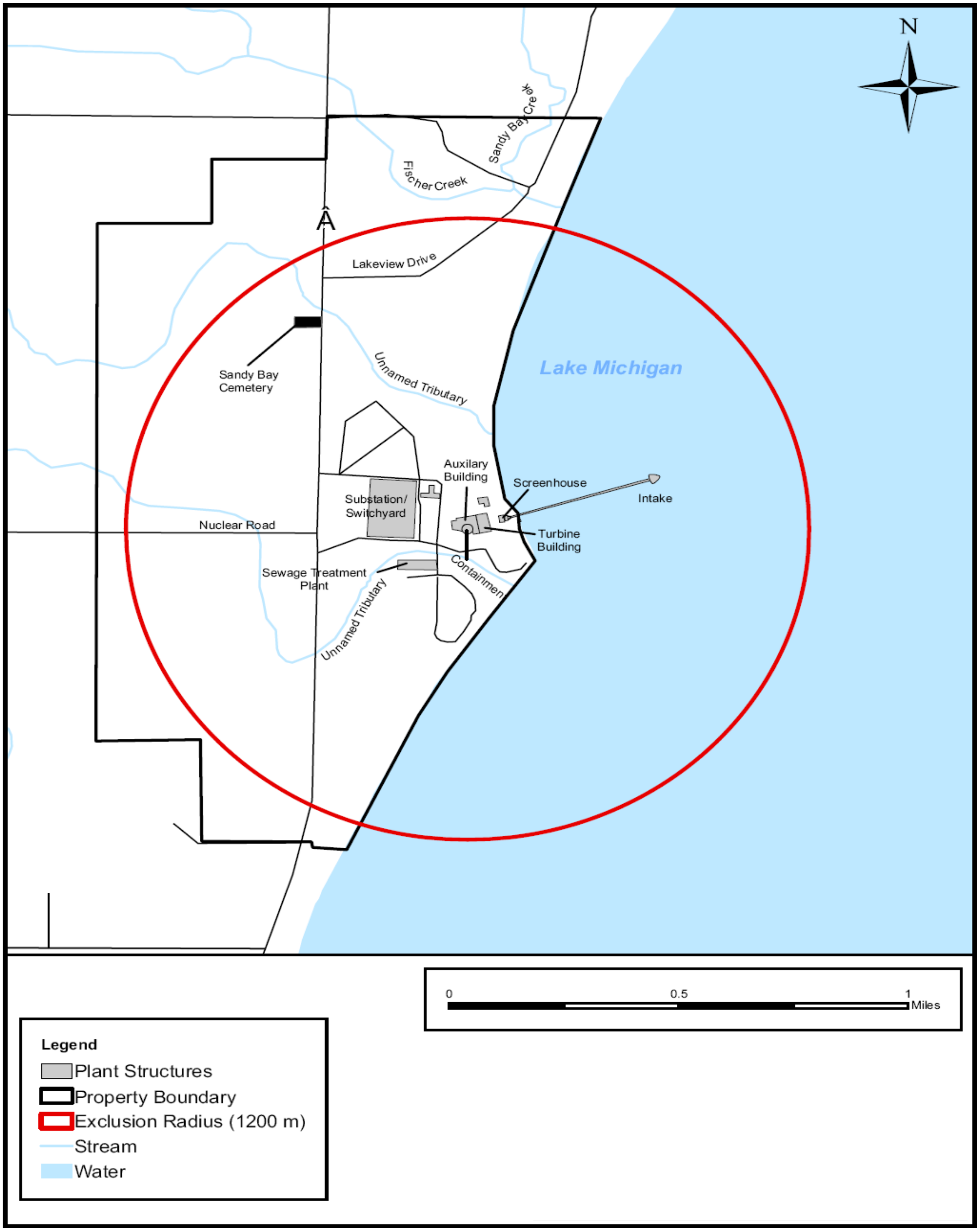


Figure 2-3. Kewaunee Power Station Site Map

2.1.1 Reactor and Containment Systems

KPS is a single-unit, two-loop closed cycle PWR with a turbine-generator. The reactor and turbine-generator were furnished by Westinghouse Electric Corporation. Pioneer Services and Engineering supported design and construction of the unit. The reactor is housed in double containment consisting of a cylindrical steel shell surrounded by a reinforced concrete cylindrical shield building.

The KPS fuel is slightly enriched (less than 5 weight percent) uranium dioxide with an average burnup for the peak rod of 17,500 megawatt days per metric ton uranium. KPS was originally licensed for a thermal output of 1,650 megawatts-thermal (MWt) and gross electrical output of 535 megawatts-electric (MWe). In 2004, the plant received a license amendment that increased the thermal output to 1,722 MWt and a gross electrical output of 590 MWe (DEK, 2008).

In a PWR power generation system, reactor heat is transferred from the primary coolant to a lower pressure secondary coolant loop, allowing steam to be generated in the steam supply system. Each of the primary coolant loops contain one steam generator, two reactor coolant pumps, and interconnected piping. Reactor coolant is pumped from the reactor through the steam generators and back to the reactor. Each steam generator has a heat exchanger that produces superheated steam at a constant pressure over the reactor’s operating power range. Coolant flows through the tubes as steam is generated on the lower pressure shell side. The steam then flows from the steam generator to the turbine unit that turns the electrical generator.

2.1.2 Radioactive Waste Management

KPS's radioactive waste system collects, treats, stores, and disposes of radioactive and potentially radioactive wastes that are byproducts of plant operations. The byproducts are activation products resulting from the irradiation of reactor water and impurities therein (principally metallic corrosion products) and fission products resulting from defective fuel cladding or uranium contamination within the reactor coolant system. Operating procedures for the radioactive waste system ensure that radioactive wastes are safely processed and discharged from the plant within the limits set forth in Title 10 of the *Code of Federal Regulations* (CFR) Part 20 (10 CFR 20), “Standards for Protection against Radiation” (DEK, 2008).

Radioactive wastes resulting from plant operations are classified as liquid, gaseous, or solid. Radioactive liquid wastes are generated from liquids received directly from portions of the reactor coolant system or that were contaminated by contact with liquids from the reactor coolant system. Radioactive gaseous wastes are generated from gases or airborne particulates vented from reactor and turbine equipment containing radioactive material. Radioactive solid wastes are solids from the reactor coolant system, solids that contacted reactor coolant system liquids or gases, or solids used in the reactor coolant system or the power conversion system.

Reactor fuel that has exhausted a certain percentage of its fissile uranium content is referred to as spent fuel. Spent fuel assemblies are removed from the reactor core and replaced with fresh fuel assemblies during routine refueling outages. Spent fuel assemblies are stored in the spent fuel pool. In addition to the spent fuel pool, spent nuclear fuel is expected to be stored in dry casks, located onsite, during the license renewal term.

The KPS offsite dose calculation manual (ODCM) contains the methodology and parameters used to calculate offsite doses resulting from radioactive gaseous and liquid effluents, and the gaseous and liquid effluent monitoring alarm and trip setpoints. The methodology is used to ensure that radioactive material discharged from the plant meets regulatory dose limits. ODCM also contains the radioactive effluent controls and radiological environmental monitoring activities and descriptions of the information that is included in the annual environmental operating report and annual radioactive effluent release report (DEK, 2008c).

2.1.2.1 *Radioactive Liquid Waste*

The KPS liquid waste disposal system collects, holds, treats, processes, stores, and monitors all radioactive liquid wastes. The system is divided into subsystems so that liquid waste from various sources can be segregated and processed (DEK, 2008). Prior to discharge, the waste is sampled and analyzed to determine if it meets radiological release criteria. The waste is discharged under controlled conditions and monitored by a radiation detector. The release is terminated if the radiation level in the liquid waste exceeds a preset limit. Liquid releases to the environment are limited to the maximum extent possible to satisfy the dose objectives in Appendix I to 10 CFR Part 50, “Domestic Licensing of Production and Utilization Facilities” and the dose limits in 10 CFR Part 20 (DEK, 2008).

The U.S. Nuclear Regulatory Commission (NRC) staff reviewed the KPS annual radioactive effluent release reports for liquid effluents from 2004 through 2008 (DEK 2005, 2006, 2007, 2008a, 2009). Based on the liquid waste processing system’s performance from 2004 through 2007, the liquid discharges for 2008 are typical of previous years. Variations on the amount of radioactive effluents released from year to year are expected based on the overall performance of the plant and the number and scope of outages and maintenance activities. The radioactive liquid wastes reported by KPS are reasonable and no unusual trends were noted.

2.1.2.2 *Radioactive Gaseous Waste*

The KPS gaseous waste disposal system processes and disposes of radioactive gaseous effluent to the atmosphere. The system receives and processes gases from plant systems and components, which include the reactor coolant system, the chemical volume control system, cover gases in waste-holding tanks, and gases vented from plant components. The processed gases are routed to a vent that is monitored by a radiation monitor and released into the atmosphere (DEK, 2008).

KPS discharges gaseous waste in accordance with the procedures and methodology described in the ODCM. The radioactive gaseous waste system is used to reduce radioactive materials in gaseous effluents before discharge, per dose limits in 10 CFR Part 20 and dose design objectives in Appendix I to 10 CFR Part 50. The NRC staff reviewed the KPS radioactive effluent release reports for gaseous effluents from 2004 through 2008 (DEK 2005, 2006, 2007, 2008a, 2009). Based on the gaseous waste processing system’s performance from 2004 through 2007, the gaseous discharges for 2008 are typical of previous years. Variations on the amount of radioactive effluents released from year to year are expected based on the overall performance of the plant and the number and scope of outages and maintenance activities. The radioactive gaseous wastes reported by KPS are reasonable and no unusual trends were noted.

2.1.2.3 *Radioactive Solid Waste*

The radioactive solid waste management program at KPS is designed to safely collect, process, store, and prepare radioactive wet and dry solid waste materials for shipment to an offsite waste processor or for disposal.

Solid wastes consist mainly of dry active waste such as contaminated paper, plastic, wood, metals, and spent resin. Solid wastes are collected, analyzed, packaged, and shipped from the site according to the KPS solid radioactive waste process control program. The solid wastes are prepared in accordance with the requirements in 10 CFR 61, "Licensing Requirements for Land Disposal of Radioactive Waste" for waste form and classification, as well as disposal site-specific regulations (DEK, 2008).

The State of South Carolina's licensed low-level radioactive waste disposal facility, located in Barnwell, has limited the access from radioactive waste generators located in States that are not part of the Atlantic Low-Level Waste Compact. Wisconsin is not a member of the Atlantic Low-Level Waste Compact and this has had a minimal effect on KPS's ability to handle its radioactive solid low-level waste. KPS uses an offsite vendor to perform volume reduction of its waste and based on the generation rate and volume reduction practices, KPS has adequate storage capacity for its radioactive waste during the license renewal term.

KPS also generates and stores very small quantities of low-level mixed waste (LLMW). LLMW is waste that exhibits hazardous characteristics and contains low levels of radioactivity.

The NRC Staff reviewed the 2004 through 2008 KPS low-level radioactive waste reports (DEK 2005, 2006, 2007, 2008a, 2009). The solid waste volumes and radioactivity amounts generated in 2008 are typical of previous annual waste shipments made by KPS. Variations in the amount of radioactive solid waste generated and shipped from year to year are expected based on the overall performance of the plant and the number and scope of outages and maintenance activities. The volume and activity of radioactive solid wastes reported by KPS are reasonable and no unusual trends were noted.

No plant refurbishment activities were identified by the applicant as necessary for the continued operation of KPS through the license renewal term. Routine plant operational and maintenance activities currently performed will continue during the license renewal term. Based on the past performance of the radioactive waste system, and the lack of any planned refurbishment activities, similar amounts of radioactive solid waste are expected to be generated during the license renewal term.

2.1.3 Nonradioactive Waste Management

The Resource Conservation and Recovery Act (RCRA) governs the disposal of solid and hazardous waste. RCRA regulations are contained in 40 CFR, *Protection of the Environment*, Parts 239 through 299 (40 CFR 239, et seq.). Parts 239 through 259 of 40 CFR contain regulations for solid (nonhazardous) waste, and Parts 260 through 279 contain regulations for hazardous waste. RCRA Subtitle C establishes a system for controlling hazardous waste from “cradle to grave,” and Subtitle D encourages States to develop comprehensive plans to manage nonhazardous solid waste and mandates minimum technological standards for municipal solid waste landfills (EPA, 2007).

In Wisconsin, RCRA regulations are administered by the Waste and Materials Management Program of the Wisconsin Department of Natural Resources (WDNR). The Waste and Materials Management Program has many administrative codes and state statutes that govern the regulation of solid and hazardous waste. Chapter 289 of the Wisconsin State statutes and chapters NR 500 and NR 502, among others, of the Wisconsin administrative code address general solid waste management requirements, including storage, transportation, transfer, and incineration. Chapter 291 of the Wisconsin State statutes and chapters NR 660 through NR 666, NR 668, and NR 670 of the Wisconsin administrative code address the identification, generation, minimization, transportation, and final treatment, storage, or disposal of hazardous wastes.

Nonradiological waste streams generated at KPS include used oil, hazardous and nonhazardous solvents and degreasers, laboratory wastes, unused expired chemicals, asbestos wastes, paint strippers, universal wastes, antifreeze, one-time only (i.e., project specific wastes, point-source discharges) regulated under the Wisconsin Pollutant Discharge Elimination System (WPDES), sanitary waste, including sewage, and general plant trash (DEK, 2009e).

2.1.3.1 *Hazardous Waste*

Hazardous waste means solid waste, or a combination of solid wastes, which, because of its quantity, concentration, or physical, chemical, or infectious characteristics, may cause or contribute to an increase in mortality or serious illness. Such waste may also pose a significant present or potential hazard to human health or the environment if it is not properly treated, stored, transported, disposed of, or otherwise handled (40 CFR Part 261, “Identification and Listing of Hazardous Waste”).

KPS generates a small amount of hazardous waste each year, primarily consisting of unused expired laboratory chemicals and hazardous solvents and degreasers (DEK, 2009e). KPS is classified as a “small quantity generator” of hazardous waste because the plant generates less than 2,205 pounds (1,000 kg) of hazardous waste in one month; no more than 13,228 lbs (6,000 kg) of hazardous waste may be accumulated on site at any one time; and accumulated hazardous waste is stored in aboveground tanks or containers for no more than 180 or 270 days, depending on the distance the waste is transported for disposal (EPA, 2007a). During the KPS site audit in May 2009, NRC staff toured the warehouse where hazardous and universal wastes are safely and properly collected, sorted, packaged, and temporarily stored until offsite disposal. NRC staff also reviewed the DEK hazardous waste procedures documented in the

"Kewaunee Power Station Hazardous Waste Plan" (DEK, 2009e) and determined that they are consistent with applicable RCRA regulations.

2.1.3.2 *General Plant Trash*

As part of routine plant maintenance and operations, KPS generates solid waste, as defined by RCRA. General plant trash includes paper, garbage, and construction waste. In 2008 KPS generated approximately 256 tons (232 metric tons (MT)) of general plant trash, and over the past five years it has generated approximately 1,000 tons (907 MT) of trash (DEK, 2009e). The majority of KPS trash is collected in a compactor dumpster to minimize volume and trips to the Kewaunee County landfill in West Kewaunee (DEK, 2008). The recycling program at KPS is discussed below in Section 2.1.3.6.

2.1.3.3 *Universal Waste*

Universal waste is hazardous waste that is generated in a variety of settings and by a vast community and poses collection and management problems. Universal waste often is not appropriately managed under existing hazardous waste regulations. The Environmental Protection Agency (EPA) classifies several hazardous wastes as universal wastes including batteries, certain pesticides, mercury-containing devices, and fluorescent lamps (40 CFR Part 273, "Standards for Universal Waste Management"). KPS is a small-quantity handler of universal waste (i.e., the facility cannot accumulate more than 11,000 pounds (5,000 kg) of universal waste at any one time). KPS generates common operational wastes such as lighting ballasts containing polychlorinated biphenyls (PCBs), lamps, and batteries. From 2006 through 2008, KPS generated approximately 8 tons (16,000 lbs (7,257 kg)) of universal waste (DEK, 2009e). Common universal waste is packaged together and stored in the onsite warehouse until disposed of offsite by a licensed disposal company.

2.1.3.4 *Low-Level Mixed Waste*

As previously discussed in Section 2.1.2.3, LLMW contains both low-level radioactive waste and RCRA hazardous waste (40 CFR Part 266, "Storage, Treatment, Transportation, and Disposal of Mixed-Waste"). KPS generates very small quantities of LLMW. From 2006 through 2008, LLMW at KPS consisted of Agitene (a cleaning solvent), paint residue, and excess caustic from testing and repair of caustic standpipe pumps. KPS generated 23 pounds (10.4 kg) of mixed waste in 2006, 25 pounds (11.4 kg) in 2007, and 14 pounds (6.4 kg) in 2008. As permitted by WDNR regulations, Agitene was disposed of by diluting it in the used oil stream and sent to the boiler fuel oil tank, as approved by the WDNR air permit for KPS (DEK, 2009c).

2.1.3.5 *Permitted Discharges*

KPS generates two types of wastewater—industrial effluents and sanitary liquid wastes, both of which are discharged to Lake Michigan according to the KPS WPDES Permit No. WI-0001571-07-0, as enforced by WDNR (radioactive liquid waste is addressed in Section 2.1.2.1 of this report). A hypochlorinating system intermittently injects sodium hypochlorite into the condenser inlet waterboxes to clean and defoul the condenser of biological organisms and prevent the build-up of zebra mussels (Dreissena polymorpha) within the cooling system (DEK, 2008). This normal operational process generates chemical and biocide liquid wastes that are combined with the plant cooling water discharge. KPS cooling water is discharged to Lake Michigan within the plant's WPDES permit limitations. Section 2.1.7.3 of this report provides more information on KPS WPDES permit and effluent limitations.

KPS operates a permitted (WDNR Permit No. 3430) onsite sewage treatment facility to treat sanitary wastewater generated by the plant. As stated above, the sewage treatment facility discharges through a WPDES-permitted outfall to an unnamed tributary that flows to Lake Michigan. The sewage treatment facility has a design capability of 20,000 gallons per day (gpd) (75,708 liters per day (Lpd)); however, routine sewage processing is approximately 11,000 gpd (41,640 Lpd). During outage periods when more workers are onsite, this number approaches the design capacity (DEK, 2009e). Digested sanitary sludge is periodically transferred to a sludge holding tank where it is concentrated and sent for disposal to a WDNR-approved sewage treatment facility in Green Bay (DEK, 2008).

2.1.3.6 *Pollution Prevention and Waste Minimization*

Currently, KPS implements a waste minimization program that consists of steps such as segregating hazardous and nonhazardous wastes, choosing nonhazardous substitutes when possible, recycling or reclaiming appropriate waste materials, monitoring expired chemicals to determine minimum stocking requirements to reduce recurring excess, finding alternate uses for excess materials, or returning unused materials to the manufacturer. KPS also implements a recycling program for common waste materials such as paper, plastic, and metal. From 2006 through 2008, KPS recycled 289.4 tons (263 MT) of non-metal materials (i.e., paper, plastic, and cardboard) and 71.5 tons (65 MT) of metal.

In support of nonradiological waste minimization efforts, the EPA Office of Pollution Prevention and Toxics established a clearinghouse that provides information regarding waste management and technical and operational approaches to pollution prevention. The EPA clearinghouse can be used as a source for additional opportunities for waste minimization and pollution prevention at KPS, as appropriate (EPA, 2008f).

The EPA also encourages the use of environmental management systems (EMSs) for organizations to assess and manage the environmental impact associated with their activities, products, and services in an efficient and cost-effective manner. EPA defines an EMS as "a set of processes and practices that enable an organization to reduce its environmental impacts and increase its operating efficiency." EMSs help organizations fully integrate a wide range of environmental initiatives, establish environmental goals, and create a continuous monitoring process to help meet those goals. The EPA Office of Solid Waste especially advocates the use of EMSs at RCRA-regulated facilities to improve environmental performance, compliance, and pollution prevention (EPA 2008f).

2.1.4 Plant Operation and Maintenance

Maintenance activities conducted at KPS include inspection, testing, and surveillance to maintain the current licensing basis of the facility and to ensure compliance with environmental and safety requirements. Various programs and activities currently exist at KPS to maintain, inspect, test, and monitor the performance of facility equipment. These maintenance activities include inspection requirements for reactor vessel materials, boiler and pressure vessel in-service inspection and testing, maintenance structures monitoring program, and maintenance of water chemistry.

Additional programs include those implemented to meet technical specification surveillance requirements, those implemented in response to NRC generic communications, and various periodic maintenance, testing, and inspection procedures. Certain program activities are performed during the operation of the unit, while others are performed during scheduled refueling outages. Nuclear power plants must periodically discontinue the production of electricity for refueling, periodic in-service inspection, and scheduled maintenance. KPS refuels at 18-month intervals.

2.1.5 Power Transmission Systems

As stated in the Environmental Report for the license renewal of KPS (DEK, 2008):

> In 1999, the Wisconsin legislature passed Act 9, which encouraged utilities with service areas in Wisconsin to transfer ownership and operation of transmission assets to an independent transmission company. In response to the Act, WPSC [Wisconsin Public Service Corporation] and WP&L [Wisconsin Power and Light Company (owners of KPS at the time)] transferred ownership of their transmission lines to the American Transmission Company (ATC).
>
> ATC, DEK, and Midwest Independent Transmission System Operator (MISO) have a three-party Generator to Transmission Interconnection Agreement for KPS filed with the Federal Energy Regulatory Commission (FERC), whereby ATC transferred operation of its facilities to the MISO. In doing so, ATC acts in the capacity of the transmission system operator and MISO is the independent system operator.

KPS is connected to the regional grid via two 138-kilovolt (kV) and two 345-kV transmission lines, which total 80.6 miles (129.7 km) in length. Transmission lines considered in scope for license renewal are those constructed to connect the facility to the transmission system (10 CFR 51.53(c)(3)(ii)(H)); therefore, the four lines (Line F-84, Line Y-51, Line R-304, and Line Q-303) are considered in scope and are discussed below in detail.

All four transmission lines originate at the KPS switchyard and are shown in Figure 2.4. Line F-84, which is a 138-kV transmission line, connects from the KPS site substation to the East Krok Substation, and travels a total distance of 8.2 miles (13.2 km). Line Y-51, which is also a 138-kV transmission line, connects from the KPS site to the Shoto Substation, which is 16.2 miles (26.1 km) in total length. Line R-304, a 345-kV transmission line, is the longest transmission line associated with the KPS site, and connects from the KPS site to the North

Appleton substation, traveling a total distance of 50.6 miles (81.4 km). Finally, line Q-303, also a 345-kV transmission line, travels a total distance of 5.6 miles (9.0 km), connecting from the KPS site substation to the Point Beach Nuclear Plant substation (DEK, 2008).

All transmission lines associated with the KPS site have rights of way (ROWs) with an average width of 150 feet (45.7 m). Additionally, there is a 50-foot (15-m) minimum buffer between the ROWs and any waterways and wetlands; however, buffers can vary up to 200 feet (61 m), based on agreements with the landowners or the State. These transmission lines ROWs total 75 miles (121 km) of corridor, and account for an area of approximately 1270 acres (514 ha). The substation on the KPS site, the switchyards off site, and transmission towers (poles) occupy approximately 10 acres (4 ha). Ecosystem land types along the transmission line ROWs are comprised of approximately 84 percent farmland, 7 percent woodland, 2 percent wetlands, and 7 percent scrubland (DEK, 2008).

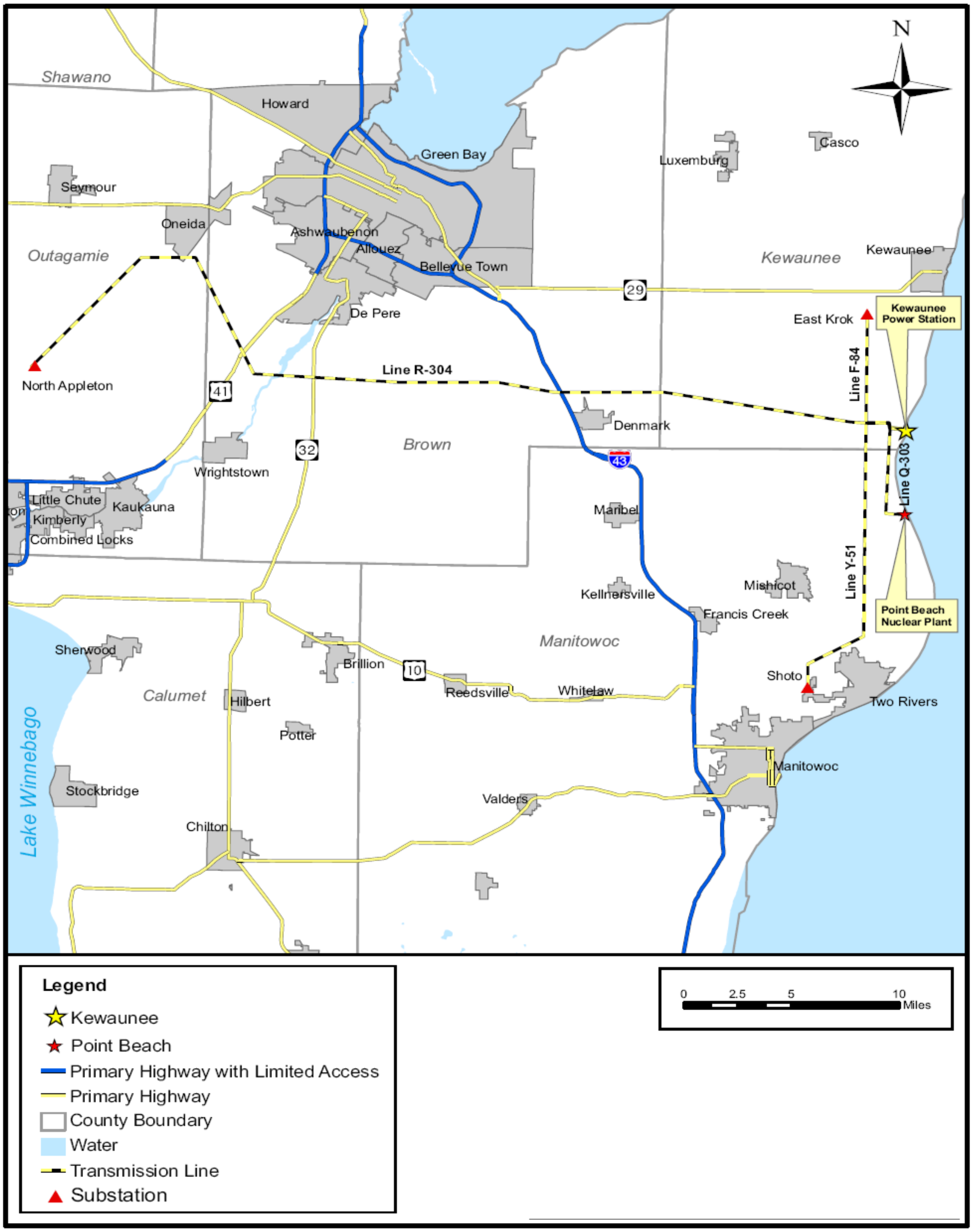


Figure 2-4. Kewaunee Power Station Transmission Line System

2.1.6 Cooling and Auxiliary Water Systems

KPS uses a once-through heat dissipation system that withdraws water from, and discharges it to, Lake Michigan. Unless otherwise noted, the discussion of the cooling-water system is adapted from the environmental report (ER) (DEK, 2008), or information gathered by the NRC at the site audit.

Water is withdrawn from Lake Michigan via an intake structure located approximately 1,600 feet (488 m) from the shore east-northeast of KPS. The circulating water intake structure consists of a cluster of three inlets that are submerged at a depth of 15 feet (4.6 m). Each inlet is 22 feet (6.7-m) in diameter and contains 2- by 2-foot (0.6- by 0.6-m) trash grills to prevent the intake of debris. Surface water velocity at the intake inlets is less than 1 foot per second (fps) or 0.3 meters per second (m/s) when the plant is running at full power. The three intake inlets are each reduced to 6-foot (1.8-m) diameter steel pipes, which join to one 10-foot (3-m) diameter steel pipe buried approximately 3 feet (0.9 m) below the lake bottom. The buried intake pipe brings water to a 56.5- by 25-foot (17.2- by 7.6-m) onshore forebay, which contains a 38.5-foot (11.7-m)-long weir for overflow. Water velocity within the forebay ranges from 0.22 to 0.88 m/s (0.72 to 2.9 fps) at maximum flow and from 0.10 to 0.5 m/s (0.33 to 1.6 fps) at minimum flow (NES, 1976b). From the forebay, water passes through four 10-foot (3-m)-wide by 36-foot (11-m)-long woven wire traveling screens with 3/8-inch (0.95-cm) mesh and automatic backwash that extend from the forebay bottom to 10 feet (3 m) above water level (NES, 1976b). During normal operation, the screens are automatically rotated every 4 hours for a 45-minute duration, or for a 10-minute duration during a 6-inch (15-cm) pressure drop (NES, 1976b). Any fish and debris that are automatically backwashed from the traveling screens are returned to the lake via the 10-foot (3-m) diameter discharge tunnel.

Once taken in, water is pumped by two vertical dry-pit circulating water pumps, each designed to supply 210,000 gallons per minute (gpm) (468 cubic feet per second (cfs) or 13.2 cubic meters per second (m^3/s)). Normal flow rate throughout the cooling system is approximately 400,000 gpm (891 cfs or 25.2 m^3/s). In the winter months, the reduced temperature of the lake requires less water for cooling, such that the flow rate is reduced to approximately 287,000 gpm (639 cfs or 18.1 m^3/s) (AEC, 1972). Generally, higher flow rates are employed from May through November, and lower flow rates are employed from December through April (NES, 1976b).

Water is returned to Lake Michigan via a 10-foot (3-m) diameter concrete discharge tunnel after passing through the condenser. The discharge tunnel connects to a discharge structure located on the shoreline, just south of the forebay. During periods of sub-freezing weather, a recirculating pump routes water to the intake inlet grills and traveling screens to prevent icing.

In addition to the circulating water intake, two auxiliary water intake tees are located 50 and 100 feet (15 and 30 m) shoreward of the circulating water intake. Each tee has a 30-inch (76-cm), screened opening approximately 1 foot (0.3 m) above the lake bottom. The screen cover plates on the openings prevent entrainment of debris and aquatic organisms. Each auxiliary water intake can supply water in excess of 24,000 gpm (53.5 cfs or 1.5 m^3/s).

Cooling water is intermittently treated with sodium hypochlorite to prevent micro- and macro-fouling within the cooling system in accordance with limits specified in the KPS WPDES Permit (WDNR, 2005).

2.1.7 Facility Water Use and Quality

Both the KPS circulating water system and the service water system draw water from, and discharge to, Lake Michigan. Onsite ground water wells also supply water for cooling water makeup and for the plant equipment water system. The following sections detail water use at KPS.

2.1.7.1 *Ground Water Use*

Ground water use at KPS is relatively minor compared to the total amount of water used for operations. Specifically, KPS uses ground water for cooling, stand-by cooling, and for the plant equipment water system (DEK, 2008). The plant draws onsite groundwater from two wells installed at depths of 310 feet (94 m) and 320 feet (98 m). WDNR permits groundwater withdrawals from these wells, which averaged a total annual pump rate of 3,339,176 gallons per year (6.4 gpm or 4.0 x 10-4 m^3/s) from 1977 to 1989 (DEK, 2009a). In 1995, this withdrawal rate increased to an average total pump rate of 25 gpm (1.6 x 10-3 m^3/s) to 61 gpm (3.9 x 10-3 m^3/s) (DEK, 2009a). An additional 14 wells were installed in 2007 for ground water monitoring purposes (STS, 2007).

2.1.7.2 *Surface Water Use*

KPS withdraws 401,200 gpm (894 cfs or 25.3 m^3/s) from Lake Michigan when both pumps are operating. Because KPS uses a once-through cooling system, consumptive water losses are minimal and the majority of the cooling water withdrawn is discharged directly back to Lake Michigan in a manner complying with the plant’s WPDES Wastewater Discharge Permit No. WI-00001571-06 issued by WDNR in 2005 (WPDES, 2005).

The intake structure is designed to pump lake water into the system via a 10-foot diameter (3 m) pipe. Normal lake elevation at the intake is 577 feet (176 m). During summer operations, when two of the plant’s circulating water pumps are in service, the water level is approximately 571 feet (174 m). During winter operations, when only one circulating water pump is in service, the water level is approximately 574 feet (175 m). Because the circulating water pump requires a level of at least 566 feet (172.5 m), low level procedures are activated for the plant if the water level decreases to 567.5 feet (173 m) (DEK, 2008d).

2.1.7.3 *Dredging*

KPS does not conduct any maintenance dredging activities and does not plan to initiate any during the license renewal term (DEK, 2008).

2.2 AFFECTED ENVIRONMENT

KPS is located on approximately 908 acres of land owned and operated by DEK, on the west-central shore of Lake Michigan in Kewaunee County, Wisconsin, as shown in Figure 2.1-2. Of the 908 acres, 450 acres are currently used for agriculture. The developed portion of the site consisting of the power plant structure, reactor containment, and associated buildings, maintenance facilities, parking lots, and roads occupies approximately 60 acres of the site. The balance of land remains in a mixture of woods, fields in various stages of succession, small wetlands and watercourses, and open areas (DEK, 2008).

2.2.1 Land Use

The immediate area around KPS is completely enclosed by a security fence, with access to the station controlled at a security gate. The exclusion area, as defined by 10 CFR 100.3, surrounds the plant site as shown in Figure 2.1-3. The plant site can be accessed by road on the west side or from Lake Michigan on the east. Road access to the plant site is from State Highway 42 (DEK, 2008). The Two Creeks Buried Forest State Natural Area, a unit of the Ice Age National Scientific Reserve, is located approximately one mile south of the KPS property. The Reserve is a separate affiliated area of the National Park Service.

2.2.2 Air Quality and Meteorology

KPS is located in Carlton, Wisconsin, approximately 27 miles (44 km) southeast of Green Bay on the western shore of Lake Michigan, in the eastern part of Wisconsin. Slightly rolling topography of the region was formed by continental glaciers that slowly moved across Wisconsin for lengthy periods of time, leaving behind ground moraine of till, sand and gravel.

The climate of Wisconsin is continental and belongs to “Dfb” type of the Köppen climate classification: hot summers with very cold winters and evenly distributed precipitation throughout the year. The growing season is significantly longer in the eastern part of Wisconsin (from late April–early May to late September–early October), due to the influence of Lake Michigan, than in central and northern parts of Wisconsin. The growing season in southwestern parts of the State has the same duration. The first fall freezes usually occur in mid-October, later than in northern and central parts of Wisconsin, because of the close proximity to Lake Michigan.

The dominant wind direction throughout the State of Wisconsin is from the west. However, wind direction in the vicinity of the KPS is strongly influenced by Lake Michigan. There are onshore and offshore winds at the KPS location. Onshore winds are northeastern winds that blow from Lake Michigan toward the land, while southwestern winds that blow from the land to Lake Michigan are defined as offshore winds. There are seasonal wind direction variations such as northeast wind occurrences in the spring and northwestern winds in winter that comprise the majority of the winds at KPS. The average annual wind speed for the National Weather Service Station located in Green Bay, Wisconsin, (27 miles (44 km) northwest of KPS) is 9.9 miles per hour (mph) (8.9 knots).

Wisconsin belongs to the Midwestern Regional Climate Center of the National Oceanic and Atmospheric Administration (NOAA). Historical data compiled by NOAA National Climatic Data Center (NCDC) from 1971 to 2000 30-year period indicates that mean annual temperature in Kewaunee County is 44.1°F (6.7°C) and ranges from 68.6°F (20.3°C) in July to 18°F (7.78°C) in January (NCDC, 2009a). According to the Center’s historic climate data for the Kewaunee 3 NW, WI Station, which is located approximately 8 miles (approximately 13 km) from KPS, annual precipitation is 30.30 inches (approximately 77 cm), with June–September period being the wettest (NCDC, 2009). Precipitation is distributed according to the demands of the seasons with the majority of the precipitation occurring during the growing, freeze-free period; however, occasionally droughts do occur in the area. Severe weather is typical for Wisconsin. Floods have caused the most damage to the people and property in the State. According to the data recorded by NCDC, 935 floods occurred in the State of Wisconsin from 1950 to 2008 (NCDC, 2009b). Two flood events were reported in Kewaunee County: the flood of June 1996, which affected several counties of Eastern Wisconsin and caused $56 million in property damages, and the flood of March 2007, caused by heavy snowfall, which did not cause any damages. Seven tornadoes hit Kewaunee County between 1950 and 2009 (NCDC, 2009c).

2.2.2.1 *Regional Air Quality Impacts*

Kewaunee County, where KPS is located, belongs to the Lake Michigan Intrastate Air Quality Control Region (Wisconsin) (AQCR) designated by the EPA and codified in 40 CFR 81.67 and Chapter 404.03 of the Wisconsin Administrative Code. Seventeen counties of the State of Wisconsin belong to the Lake Michigan Intrastate AQCR. Three counties among them, Door County, Manitowoc County and Sheboygan County, constitute subregion I and are located next to or in the close proximity to Kewaunee County and are currently designated by the EPA as 8-hour ozone non-attainment areas (EPA, 2008). Kewaunee County is a maintenance county for 8-hour ozone and is in attainment for all other criteria pollutants (EPA, 2009).

WDNR implements the Air Management Program and coordinates the ambient air quality monitoring network in the State of Wisconsin. Kewaunee County is part of the Northeastern Air Region of the WDNR. The closest KPS WDNR ozone monitoring station within the Kewaunee County is located in the city of Kewaunee and has been in operation since 1994. In October 2006, the EPA issued final amendments to the ambient air monitoring regulations for criteria pollutants (40 CFR Parts 53 and 58) containing the requirement to establish National Core (NCore) multi-pollutant higher-sensitivity monitoring stations throughout the country. The Mayville WDNR monitoring site, located approximately 78 miles (126 km) southwest of KPS, is proposed for this purpose.

KPS stationary emission sources that do not require the facility to secure a Title V permit are: three standby emergency power supply diesel generators, one space heating boiler, and several insignificant emission units that are listed in the KPS Air Pollution Control Operation Permit. KPS is recognized as a Synthetic Minor facility, non-Part 70 by WDNR due to the quantities of emissions and restrictions on the hours of operation of its stationary sources of criteria pollutants (DEK, 2009d). The generators are tested periodically to ensure their continued ability to perform their intended function. There are procedures in place to ensure continuous monitoring, sampling, and filtering of the oil.

KPS operates a meteorological system that consists of weather instruments mounted on a primary 197-foot (60-m) high tower and 33-foot (10-m) backup tower, which provides alternative measurements and serves as a secondary data source in the event of sensor failure on the primary tower. There are wind sensors mounted on the primary tower that allow for the calculation of horizontal wind direction standard deviation. The sensors are located at 10 and 60 meters height. Vertical temperature differentials are measured with redundant sensor pairs between both levels. Ambient temperature sensors are located at the 10-meter level.

Precipitation is measured at ground level. The backup tower measures ambient temperature, wind speed, direction, and standard deviation at the 33-foot (10-m) level in the event of primary tower failure.

There is an established real time review and data quality assurance program for meteorological data. The quality control process involves routine daily inspection of the meteorological data and biweekly review, comparison and processing of the data by the meteorological staff of the Dominion Weather Center. The quality assured meteorological data is then incorporated into the Annual Radioactive Release Reports (DEK, 2009d).

Sections 101(b)(1), 110, 169(a)(2) and 301(a) of the Clean Air Act as amended (42 USC 7410, 7491(a)(2), 7601(a)) established Mandatory Class I Federal Areas where visibility is important. There are no Mandatory Class I Federal areas in the State of Wisconsin or in close proximity to KPS. The Mandatory Class I Federal Areas closest to KPS are Seney Wilderness Area, Michigan, located 149 miles northeast from KPS, and Isle Royale National Park, Michigan, located 255 miles northwest from KPS. Therefore, no adverse impacts on Class I areas are anticipated from the KPS operation.

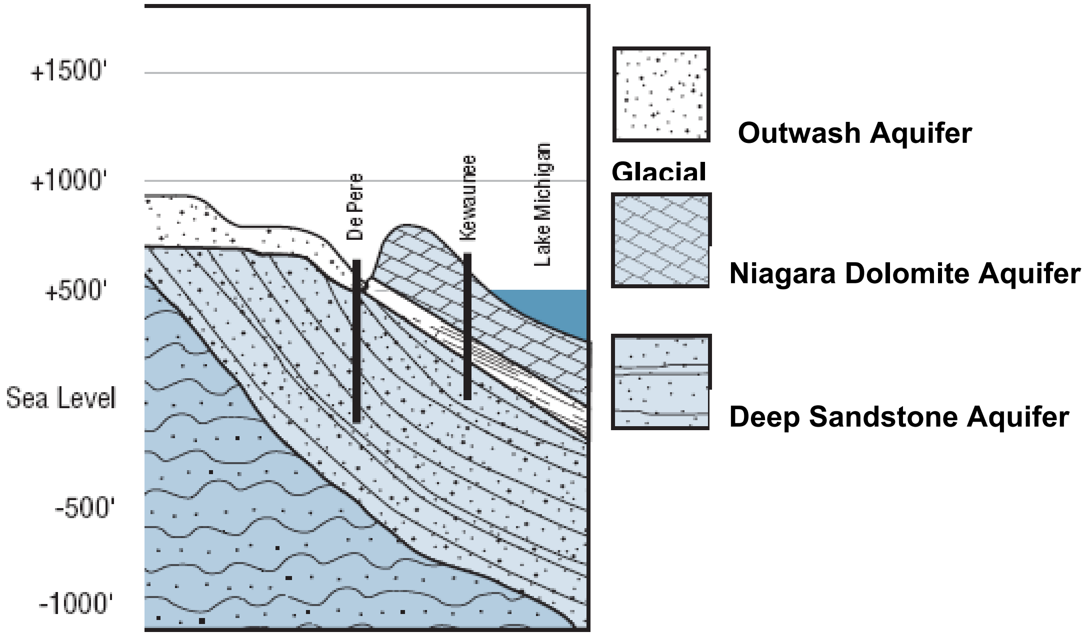
2.2.3 Ground Water Resources

The soil profile at the KPS site consists of glacial drift made up primarily of silty clay, ranging from 60 to 150 feet (18 to 46 m) thick. Underlying the glacial material is a 350-foot (107-m) to 600-foot (183-m) thick layer of sedimentary bedrock. The water table underneath the KPS site ranges from 10 to 30 feet (3 to 9 m) below land surface and slopes east toward Lake Michigan (STS, 2007).

The three principal aquifers beneath the site are the Glacial Outwash Aquifer, the Niagara Dolomite Aquifer, and the Deep Sandstone Aquifer. An additional minor aquifer, the St. Peter Sandstone Aquifer, is of limited ground water use. About half of local wells are screened in the Glacial Outwash Aquifer, which is made up of sand and gravel layers, the largest of which is not continuous at the site (STS, 2007). Wells screened in this aquifer have a flow rate of approximately 17 gpm (1.1 x 10-3 m^3/s). The other half of local wells are screened in the Niagara Dolomite Aquifer, the uppermost bedrock aquifer along the Lake Michigan coastline. Wells screened in this aquifer typically have a depth between 30 and 60 feet (9 to 18 m) and have a flow rate of approximately 13 gpm (8.2 x 10-4 m^3/s). Wells pumped within this aquifer have been known to affect the water levels of nearby wells, and those near the shoreline of Lake Michigan may induce water flow from the lake into the aquifer (DEK, 2007b). The two groundwater wells used by KPS draw water from the Niagara Dolomite Aquifer at depths of 310 feet (94 m) and 320 feet (98 m) (DEK, 1968).

The third and deepest major aquifer, the Deep Sandstone Aquifer, is between 1,200 and 1,700 feet (366 to 518 m) and includes the Dresbach, Franconia, and Trempealeu formations. This aquifer is separated from the Niagara Dolomite by 800 feet (244 m) of shale and dolomite strata. Water in the Deep Sandstone Aquifer is not potable because it is too saline (DEK, 2007b). Figure 2.5 illustrates the primary aquifers beneath KPS.

Figure 2-5. Primary aquifers beneath the Kewaunee Power Station Site



Source: WDNR, 2009f

2.2.3.1 *Kewaunee Power Station Water Supply Wells*

KPS has two high capacity onsite wells screened in the Niagara Dolomite Aquifer (DEK, 1968). These wells are permitted for ground water withdrawal by WDNR. The first well (BE601) is 310 feet (94 m) in depth and 10 inches (25.4 cm) in diameter. The second well (BE602) is 320 feet (98 m) in depth and 10 inches (25.4 cm) in diameter (DEK, 2007a).

Together, both wells yield an average total of 25 gpm (1.6 x 10-3 m^3/s) to 61 gpm (3.9 x 10-3 m^3/s). The highest recorded monthly average yield occurred in January 2008 at 52.6 gpm (3.3 x 10-3 m^3/s). The KPS wells typically do not withdraw ground water during the summer months (See Table 2-1) (DEK, 2009a).

Table 2-1. Potable Water Usage (Gallons) at Kewaunee Power Station

Month	Well	Well	Total Usage	Average Usage	Average Usage	Average Usage
	1A	1B		Per Day	Per Hour	Per Min
Sep-07	2,109,465	284	2,109,749	72,750	3,031	50.5
Oct-07	2,391,263	17,339	2,408,602	72,988	3,041	50.7
Nov-07	2,139,279	0	2,139,279	71,309	2,971	49.5
Dec-07	1,858,387	435	1,858,822	58,816	2,451	40.8
Jan-08	2,247,797	0	2,247,797	72,558	3,023	50.4
Feb-08	2,193,619	0	2,193,619	75,696	3,154	52.6
Aug-08	0	0	0	0	0	0.0
Sep-08	36,977	490,822	527,799	15,093	629	10.5
Oct-08	29,988	0	29,988	968	40	0.7
Nov-08	2	0	2	0	0	0.0
Dec-08	72,999	60,415	133,414	3,814	159	2.6
Jan-09	0	615	615	20	1	0.0
Feb-09	11	0	11	0	0	0.0
Mar-09	1,628,170	0	1,628,170	58,070	2,420	40.3
Apr-09	624,874	1,135,966	1,760,840	58,776	2,449	40.8

Source: DEK 2009a.

2.2.3.2 *Kewaunee Power Station Ground Water Monitoring*

KPS monitors groundwater for the possible infiltration of radionuclides such as tritium. As tritium decays, it emits a low-energy beta particle that cannot travel far into either tissue or air. Tritium is a product of manmade sources, as well as natural processes.

The KPS Groundwater Monitoring Program includes 14 monitoring wells, including the two high capacity wells onsite (DEK, 2009b). The ground water monitoring wells were installed in 2007 for use in tritium assessment at the plant site. This assessment concluded that the most likely potential tritium release to ground water is contained in the sand backfill beneath the site, and that the migration of this potential release would likely follow the water table east toward Lake Michigan (STS, 2007).

2.2.4 Surface Water Resources

In accordance with the Federal Water Pollution Control Act (or the Clean Water Act (CWA)), KPS effluent discharges are regulated by the Wisconsin Pollutant Discharge Elimination System (WPDES) Permit No. WI-00001571-06 issued and enforced by the WDNR. Section 402 of the CWA states that the NPDES (National Pollutant Discharge Elimination System) prohibits discharges of pollutants from any point source into the nation's waters except as allowed under an NPDES permit. The purpose of this permit is to regulate wastewater discharge to preserve the water quality of the surrounding water bodies. As of the most recent permit issued, there have been no notices of violation for the KPS site. Information in this section is from the most recent KPS WPDES permit, a copy of which is included in the applicant's license renewal environmental report. The most recent renewal of this permit became effective August 1, 2005, and expires June 30, 2010.

Table 2-2 shows the quantitative effluent limitations regulated under the WPDES permit, or the residual concentrations of permitted chemical additives that may be discharged to Lake Michigan. In accordance with this permit, any new chemical additives introduced, or current dosages increased, must first be reviewed and approved by the WDNR.

Table 2-2. Wisconsin Pollutant Discharge Elimination System Effluent Limitations for Kewaunee Power Station

Sample	Total Suspended Solids (mg/L)			Total Residual Chlorine (lbs/day)	Oil and Grease (Hexane or Freon) (mg/L)		Discharge Flow (MGD)
Point No.	Monthly Average	Daily Max.	Weekly Max.	Daily Max.	Monthly Average	Daily Max.	
Outfall 001	30	100	NLR	180	10	15	494*
Outfall 002	NLR	NLR	NLR	NLR	NLR	NLR	3.96
Outfall 003	30	NLR	45	NLR	NLR	NLR	0.01
SP101	30	100	NLR	NLR	15	20	0.01
SP201	30	100	NLR	NLR	15	20	0.06
SP301	30	100	NLR	NLR	15	20	0.03
SP501	30	100	NLR	NLR	15	20	0.14

NLR: No Limit Required

*580 MGD (summer); 380 MGD (winter)

The permit outlines the effluent limitations and monitoring requirements of the three different discharge outfalls, as well as five additional sampling points. In addition to the effluent limitations shown in Table 2-2, the permit describes the minimum number of sampling events required for each outfall. Flow monitoring requirements are outlined for certain outfalls, as well as required pH monitoring, with pH levels expected to be between 6.0 and 9.0 year-round.

Outfall 001 discharges condenser cooling water and process wastewater and is sampled prior to discharge to Lake Michigan. Daily temperature averages at this outfall are recorded. Outfall 002 monitors recirculated water from Outfall 001 to prevent icing of the intake. Only flow rate is monitored at this outfall. Outfall 003 samples the sewage treatment plant effluent prior to its discharge to an unnamed tributary to Lake Michigan. Both Outfall 001 and 003 are required to undergo both acute and chronic Whole Effluent Toxicity (WET) testing two to three times per quarter. The permittee (DEK) is required to investigate any occurrences of serious or repeated toxicity found during these WET tests.

Five additional sampling points are regulated by the WPDES permit. SP101 samples the steam generator blowdown to Outfall 001. SP201 samples the floor drains to Outfall 101. SP301 samples the service water treatment lagoon overflow to Outfall 101. SP501 samples the reverse osmosis discharge wastewater to Outfall 101. SP601 monitors the flow of Lake Michigan water or water pumped from the turbine building basement in case of circulating water system failure near the Outfall 101 discharge structure.

KPS implements a Storm Water Pollution Prevention Plan onsite to reduce the amount of pollution discharged through storm water runoff. The purpose of this plan is to eliminate any contact discharged storm water may have with potentially contaminating materials. There are seven designated storm water outfalls onsite. Discharge monitoring of these outfalls is regulated by a “Tier 2” WPDES permit (Permit No. WI-S067857-2) (DEK, 2009f).

Sanitary wastewater is treated at the site’s sewage treatment plant, which was installed in 1986. Typical plant operations require the plant to treat approximately 11,000 gpd (7.6 gpm; 4.8 x 10-4 m^3/s); however, the plant is capable of treating up to 20,000 gallons (75.7 m^3) of sewage per day. The system discharges approximately 7.6 gpm (4.8 x 10-4 m^3/s). Solids are disposed of at an offsite facility after onsite treatment (DEK 2008).

2.2.5 Aquatic Resources

KPS is located on the west-central shore of Lake Michigan. Lake Michigan constitutes a total area of 67,900 mi^2 (175,800 km^2) and a total volume of 1,180 mi^3 (4,920 km^3) and is the third largest of the Great Lakes by area and second largest by volume (EPA, 1992). The lake’s average depth is 279 feet (85 m) and maximum depth is 925 feet (282 m) (GLC, 2000). The lake surface lies at an average of 577 feet (176 m) above mean sea level (AEC 1972). The Lake Michigan drainage basin encompasses over 45,000 mi^2 (72,400 km^2) and major tributaries include the Fox-Wolf, Grand, and Kalamazoo rivers (DEK, 2008; GLC, 2000). Lake Michigan flows through the Straits of Mackinac into Lake Huron at a recharge rate of once every 100 years (GLC, 2000). Lake Michigan has a low salinity level of less than 0.1 parts per thousand (ppt) (DEK, 2008).

Lake Michigan is used for a variety of purposes, including commercial and recreational boating, sport and commercial fishing, and tourism. The major changes and modifications that have had the greatest effect on aquatic resources of Lake Michigan include lakefront industrial, urban, and residential development; water quality impairment from industrial, municipal, agricultural, navigational, recreational water uses, overfishing, and invasion of exotic species (EPA, 2008e). The Lake Michigan ecosystem continues to experience profound changes because of development, impacts of invasive species, and pollution. In the 2008 Lakewide Management Plan (EPA, 2008d), Lake Michigan’s status was described as mixed with a slight, but continuing decline in water quality.

There have been a series of milestones in the management of the Great Lakes. In 1955, the Canadian/U.S. Convention on Great Lakes Fisheries created the Great Lakes Fishery Commission (GLFC), which coordinates fisheries research and facilitates cooperative fishery management among the State, provincial, tribal, and Federal agencies. The GLFC is responsible for implementing the Joint Strategic Plan for Management of Great Lakes Fisheries (GLFC, 1997). Eight States bordering the Great Lakes, the Province of Ontario, two intertribal agencies, and several Federal agencies are signatory to this management plan and work together to rehabilitate native lake species, control exotic species, prevent and manage fishery disease, coordinate law enforcement, produce new research, publish state-of-the-lake reports, and determine total allowable catch and allocation agreements and fish stocking levels (GLFC, 2009).

In 1972, the first Great Lakes Water Quality Agreement (GLWQA) was signed between the International Joint Commission (IJC) of Canada and the United States. Both countries pledged to address the deterioration of Great Lakes water quality from point source and non-point source pollution. A new GLWQA was signed in 1978 that outlined additional commitments to restore and maintain the “chemical, physical, and biological integrity” of the Great Lakes by seeking to eliminate persistent toxic substances (IJC 2006). In 1987, the GLWQA established processes and basic commitments for developing and implementing remedial action programs (RAPs) in geographic areas of concern (AOCs) and within the context of existing Lakewide Management Plans (LaMPs) (EPA and Environment Canada, 1997).

Forty-two AOCs have been identified across the Great Lakes basin, ten of which are in the Lake Michigan basin (EPA, 2008d). The closest AOC in relation to KPS is the Lower Green Bay and Fox-Wolf River AOC, which suffers from eutrophication, degradation of phytoplankton and zooplankton populations, and has consumption advisories for mallard ducks and 12 species of fish (EPA, 2008e). Water contaminants of concern in this area include phosphorus, suspended solids, PCBs, ammonia, and various pesticides. Sediment contaminants include PCBs, cadmium, mercury, lead, and pesticides (EPA, 2008d). The Great Lakes Binational Toxics Strategy was created in 1997 for the purpose of reducing the environmental threats posed by persistent toxic substances such as those mentioned above (EPA and Environment Canada, 1997). By 2006, as a result of this effort, deliberate mercury use and mercury releases were reduced by 50 percent in the United States, dioxin/furan releases were reduced by 75 percent in the United States, and less PCB-containing equipment use was documented (EPA and Environment Canada, 2007).

The EPA conducted a study from 1994 to 2000, called the Lake Michigan Mass Balance Study (LMMB), which focused on the pathways of four major chemicals: PCBs, representative of conservative organic compounds; atrazine, a widely-used herbicide representative of reactive, biodegradable compounds; trans-nonachlor, a component of the pesticide chlordane, representative of persistent, bioaccumulative compounds; and mercury, also a persistent, bioaccumulative compound in the atmosphere, tributaries, lake water, sediments, and food webs of Lake Michigan and its basin. The Great Lakes Binational Toxics Strategy was implemented within the last three years of the LMMB study. Because the Great Lakes Binational Toxics Strategy has reported successes at reducing levels of toxins in all categories the Strategy addresses, actual levels of toxins may now be further reduced than the LMMB indicates. Therefore, only general trends for toxin levels identified in the LMMB are discussed.

PCBs are organochlorines that were once widely used for industrial purposes until the EPA banned them from use in 1979 in all but completely enclosed systems due to their environmental and health effects. PCBs have been linked to reproductive problems and deformities in fish and wildlife. Trans-nonachlor is a component of the pesticide chlordane that can rapidly bioaccumulate. During the LMMB, PCB and trans-nonachlor trends indicated that levels are declining overall. Levels of dissolved and particulate PCBs in the atmosphere, Lake Michigan tributaries, the Lake Michigan Water column, and sediments were generally highest in the southern portion of the Lake Michigan basin and near urbanized and industrialized areas (McCarty et al., 2004). However, trans-nonachlor concentrations were higher in rural, agricultural areas with decreasing concentrations northward (McCarty et al., 2004). This trend may be a result of historical application, since this chemical is no longer produced in the United States (McCarty et al., 2004). The WDNR advises against eating lake trout (larger than 27 inches (69 cm)) within Lake Michigan due to the risk of high PCB levels (WDNR, 2009). The WDNR also advises against eating brown trout (larger than 25 inches (64 cm)), Chinook salmon (larger than 36 inches (91 cm)), and lake trout (23 to 27 inches (58 to 69 cm)) more than once every two months due to the potential for elevated PCB levels (WDNR, 2009).

Atrazine is one of the most widely-used herbicides in the United States and is most commonly applied to corn crops in spring months within the Lake Michigan basin. The chemical does not bioaccumulate, but persists in the water column due to its slow decay rate. Atrazine concentrations were found to be highly seasonal, corresponding to agricultural application during the spring months, and regionally, were elevated in areas of high agricultural production. Tributaries were found to be the most prevalent source of atrazine, though levels in the Lake Michigan water column were generally persistent with a slow decay rate of one percent per year. Results suggested that lake-wide levels of atrazine in Lake Michigan may be increasing under present loads (Brent et al., 2001).

Mercury is a persistent metal that can bioaccumulate and cause reproductive and growth effects in fish and wildlife. Vapor, particulate, and precipitate were all major contributors of mercury to Lake Michigan, with seasonal patterns—the highest concentrations were observed in summer months—and regional patterns, with Chicago having significantly higher concentration of mercury in both particulate and vapor phases. Mercury levels in Lake Michigan tributaries were comparable to previously recorded levels in other Midwestern rivers and well below the nationwide criteria for water quality. Levels were highest in the Fox River, which had concentrations averaging up to 2.7 times higher than other tributaries (McCarty et al., 2004a). Water column levels of mercury in Lake Michigan were lower than measured levels in tributaries and generally well mixed within the water column (McCarty et al., 2004a). Mercury levels in trout and coho salmon were found to exceed the EPA guidelines for unrestricted consumption and at levels that warrant consumption advisories for these species (McCarty et al., 2004a). As of 2009, no consumption advisories exist for fish in Lake Michigan bordering Kewaunee or its neighboring counties (WDNR, 2009).

In the near vicinity of KPS, Lake Michigan is shallow with depths of 15 to 20 feet (4.6 to 6.1 m) 1,600 feet (488 m) offshore of the intake structure (DEK, 2008). Near shore substrate consists mainly of cobble and gravel, and bottom sediment consists mainly of hard red clay and fine to medium sand (AEC, 1972; EA Engineering, 2007). The depth reaches over 600 feet (82 m) in the central part of the lake, referred to as the Chippewa Basin (EA Engineering, 2007).

The native fish community consists of deepwater species including the bloater (*Coregonus hoyi*), lake herring (*Coregonus artedii*), and lake whitefish (*Coregonus clupeaformis*), predators, including lake trout (*Salvelinus namaycush*) and walleye (*Stizostedion vitreum*), and intermediate predators, such as white bass (*Morone chrysops*) and yellow perch (*Perca flavescens*). Demersal species such as white sucker (*Catostomus commersoni*) and freshwater drum (*Aplodinotus grunniens*), small forage species such as the emerald shiner (*Notropis atherinoides*), and sunfish family species such as pumpkinseed (*Lepomis gibbosus*) and smallmouth bass (*Micropterus dolomieui*) are also characteristic of the native fish community near KPS (EA, Engineering 2007; UWSGI, 2002b).

Preoperational monitoring indicated that the fish population in Lake Michigan near the KPS site was primarily composed of alewife (*Alosa pseudoharengus*), lake trout (*Salvelinus namaycush*), and rainbow smelt (*Osmerus mordax*) (AEC, 1972). Lake chub, yellow perch, white suckers, longnose dace, and slimy sculpin were also captured during 1971 fish collections (AEC, 1972). The most prevalent sport fish in the area was lake trout, most of which had been recently stocked in Wisconsin waters by Federal or State agencies (AEC, 1972).

Catch data for the period of 1971 through 1975 for the KPS Clean Water Act Section 316(a) Demonstration (NES, 1976a) included both preoperational and operational data. Alewife was the most prevalent species, constituting 65 percent of total catch. Other recorded species included rainbow smelt, yellow perch, lake trout, lake chub, white sucker, longnose dace, and longnose sucker. Sport fishing species included lake trout, rainbow trout, brown trout, brook trout, coho salmon, and Chinook salmon, the abundance of which was attributed to the activity of stocking in the KPS area. The 316(a) Demonstration did not identify any significant increases or decreases in fish densities. (NES, 1976a)

The Lake Michigan biological community has changed numerous times since the mid-nineteenth century as a result of introduced fish and invertebrate species. Major introductions include the common carp (*Cyprinus carpio*) and brown trout (*Salmo trutta*) in the 1890s (EA Engineering, 2007), the rainbow smelt in the early 1900s (Crowder, 1980; UWSGI, 2002c), the sea lamprey (*Petromyzon marinus*) in the late 1930s (USGS, 2008), the alewife in the 1950s (EA Engineering, 2007; Crowder, 1980), and the round goby in the 1990s (EA Engineering, 2007). Two dreissenid mussels, the zebra mussel (*Dreissena polymorpha*) and the quagga mussel (*Dreissena bugensis*), have also invaded Lake Michigan beginning in the 1990s (Brandt, 2004; EA Engineering, 2007).

Common carp were brought to North America as a farmed food source in the late 1800s, and spread to the Great Lakes beginning in 1983 (UWSGI, 2002a). Carp are particularly abundant near the southeastern shore of Lake Michigan and lower Green Bay and can reproduce quickly and outcompete native fish species due to their large size and voracious appetite (EPA, 2008c; UWSGI, 2002a). Brown trout were introduced to North America in 1883 and to Wisconsin, specifically, in 1887 (UWSGI, 2002). Brown trout have not negatively affected native species because brown trout adapt readily to degraded habitats and are regularly harvested as game fish (UWSGI, 2002).

The sea lamprey entered the Great Lakes via ship canals and locks from the Atlantic Ocean in the 1930s (USGS, 2008). Sea lamprey is a primitive fish that feeds parasitically on the blood of host fish during part of its life cycle (USGS, 2008). Within Lake Michigan, common host fish include lake trout, whitefish, and other top predator species (EA Engineering, 2007). Prey species in the Great Lakes are smaller than natural prey species in the Atlantic Ocean, which makes Great Lakes prey species more likely to be killed from a sea lamprey attack or die of secondary infection from wounds (DEK, 2008; USGS, 2008). Approximately 40 to 60 percent of lake trout attacked by sea lamprey die from loss of blood (USGS, 2008). A combination of overfishing and sea lamprey predation are attributed to the lake trout's (*Salvelinus namaycush*) extirpation from lakes Michigan, Ontario, Eerie, and Huron (USGS, 2008). Sea lamprey predation, in combination with overfishing and other factors, has led to the extinction of the longjaw cisco (*Coregonus alpenae*), the deepwater cisco (*C. johannae*), and the blackfin cisco (*C. nigripinnis*) (Fuller et al., 2007). Sea lamprey is also responsible for the whitefish and chub population collapses during the 1940s and 1950s (USGS, 2008).

As a result of sea lamprey introductions, many top predator species' populations were reduced, which allowed populations of their prey, rainbow smelt and alewife, to flourish. Rainbow smelt were initially released into Crystal River, Michigan, in 1912 as food for stocked salmon and soon after spread to the Great Lakes (Crowder, 1980; UWSGI, 2002c). The alewife was first observed in Lake Michigan in 1949 and was able to outcompete and prey on the young of dwindling populations of several native fish species (Crowder, 1980). During the period of time rainbow smelt and alewife were introduced to Lake Michigan, the numbers of numerous native species declined and some became extremely rare. These species include emerald shiner (*Notropis atherinoides*), lake herring (*Coregonus artedi*), kiyi (*C. kiyi*), and five other species of cisco (Coregonus spp.) (Crowder, 1980). Numerous hypotheses may explain native fish population declines, but the effects of invasive species are the most commonly put forth. Alewives may contribute to a decline in native fish populations because alewives are able to outcompete native species for planktonic and other smaller organisms, and alewives may also prey on the eggs and larvae of native fish species (Crowder, 1980; EA Engineering, 2007). Rainbow smelt are thought to prey on eggs and larvae of native fish, including lake trout, whitefish, walleye, and cisco and have a negative impact on the native fish population (Crowder, 1980; WDNR, 2004). Native fish that consume smelt may have a decreased ability to successfully reproduce because smelt are rich in thiaminase, an enzyme that destroys thiamin, which is necessary for embryo development (WDNR, 2004). Rainbow smelt are harvested commercially and recreationally in Wisconsin, which serves as a controlling force on the population. In 2004, 155,000 pounds (70,300 kg) of smelt were harvested by commercial trawlers in Lake Michigan and Green Bay alone (WDNR, 2004).

Annual die-offs of alewives became common in the 1950s and 1960s due to overcrowding (Crawford, 2001). Alewives prey on zooplankton, which decreases the population of zooplankton available to graze on phytoplankton, thereby decreasing the clarity of water (Crawford, 2001). Evidence also suggests that selective predation on zooplankton caused a shift in the size structure of zooplankton in Lake Michigan. Larger cladocerans (including *Leptodora kindtii*, *Daphnia galeata*, and *D. retrocurva*), three species of larger calanoid copepods, and the cyclopoid copepod *Mesocyclops edax* sharply declined between the introduction of the alewife and 1966, while medium and small-sized zooplankton species increased in numbers (Wells 1970). Some populations, such as *D. retrocurva*, experienced a decrease in average size and size at onset of maturity (Wells, 1970). In 1965, WDNR initiated a stocking program that included pacific salmon and other salmonids to control alewife populations (EA Engineering, 2007). By the mid-to-late 1980s, alewife numbers were visibly reduced as a result of salmon stocking (Crawford, 2001). Stocking of salmonids continues, in reduced numbers, which has created a better balance between alewife and salmonid predator populations and provides for sport fishing (EA Engineering, 2007). Currently, the only objective for salmonid stocking is to maintain the recreational fishery base as stream temperatures are too high for natural spawning along the Wisconsin shoreline of Lake Michigan (Crawford, 2001).

Two dreissenid mussels, the zebra mussel and the quagga mussel, established populations in Lake Michigan in the 1990s as a result of ship ballast-water discharges (EA Engineering. 2007). Zebra mussels displace native clams and unionid mussels by interfering with their feeding, growth, and reproduction when they attach themselves to live clams and mussels (DEK. 2007a). The reduction of available phytoplankton mass as a result of these mussel species is attributed to the decline of Diporeia spp., which were dominant amphipods, by 90 percent between 1993 and 2002, though the exact mechanism is uncertain (Brandt. 2004). Community alterations by the dreissenid mussels are also thought to contribute to the population decline and poorer observed body condition of whitefish species and yellow perch because of the decline of Diporeia as their food source (Platt, 2009). Though the cause-and-effect relationship between the quagga mussel increase and the loss of Diporeia is not completely understood, the Great Lakes Coalition and the Natural Resources Defense Council, among others, are pushing for stronger regulations regarding ship ballast water to limit additional spread of the mussel species (Platt, 2009).

The Lake Michigan phytoplankton and zooplankton communities are highly variable and may be experiencing changes due to contaminant and nutrient levels, sedimentation, and invasive species (EPA, 2008d). Phytoplankton abundance and production in nearshore waters of Lake Michigan have been decreasing since 1970 and has been suggested to be caused by a reduction in phosphorus loadings (Madenjian et al., 2002). Makarewicz et al. (1994) examined trends in phytoplankton abundance in Lake Michigan from 1983 to 1992 and related them to “top-down mediated changes” observed in the fish and zooplankton communities. Bacillariophyta (diatoms) dominated spring samples in all but one year and accounted for 69 to 95 percent of total algal biomass. Summer phytoplankton samples were dominated by diatoms, Chlorophyta (green algae), Chrysophyta (yellow-green or yellow-brown algae), and Pyrrhophyta (dinoflagellates). The presence of large-bodied zooplankton (e.g., Daphnia spp.) resulted in increasing abundance of colonial and filamentous algae; low numbers of Daphnia spp. were associated with an increasing abundance of small, unicellular phytoplankton. Makarewicz et al. (1994) also noted that large zooplankton became more abundant from 1983 through 1985 after a sharp decline in the abundance of alewife in 1982 and 1983.

The introduction of the non-native spiny water flea (*Bythotrephes cederstroemi*), a cladoceran, caused a significant decline in three native species of Daphnia (Lehman 1991). Another non-native cladoceran, the fishhook water flea (*Cercopagis pengoi*), has also invaded the Great Lakes (WDNR, 2004a). These species compete with planktivorous larval fish for food and have been implicated as a factor in the decline of alewives in Lake Erie, Lake Huron, Lake Michigan, and Lake Ontario (Liebig and Benson, 2007).

2.2.6 Terrestrial Resources

The KPS site and its associated transmission lines are located within the Lake Michigan watershed and drainage basin. The KPS site is located in the town of Carlton, Kewaunee County, Wisconsin, and is approximately 37 miles (59.5 km) southeast of Green Bay, Wisconsin. The KPS site is 908 acres (367 ha), of which 450 acres (182 ha) are leased for farmland (DEK, 2008). These farmlands would be allowed to return to forested or wetland areas if the leases ran out or were terminated. The KPS reactor buildings, other building facilities, parking lots, and switchyard cover 60 acres (24 ha) of the overall site (DEK, 2008). The remaining 398 acres (161 ha) is mixed use and is comprised of forested plots, fields, wetlands, and water courses (DEK, 2008). Site land use consists of about 53 percent agriculture, 16 percent open fields/early successional, 18 percent forest communities, 1 percent shoreline, 7 percent plant site facilities, and 3 percent mowed fields (DEK, 2009c). Figure 2.1-3 shows the KPS site boundary. Some open fields may be due to ROW maintenance, which keeps the forested areas in stages of early succession.

Upland areas at the KPS site support a variety of trees including quaking aspen (*Populus tremuloides*), northern white cedar (*Thuja occidentalis*), eastern cottonwood (*Populus deltoides*), black willow (*Salix nigra*), green ash (*Fraxinus pennsylvanica*), American beech (*Fagus grandifolia*), and paper birch (*Betula papyrifera*) (DEK, 2008). Low-story trees and shrubs include red osier dogwood (*Cornus stolonifera*), hazelnuts (Corylus spp.), blueberry (Vaccinium spp.), and brambles (Rubus spp.) (WDNR, 2009c). Open field and grassland species include Bird's-foot violet (*Viola pedata*), rosinweed (*Silphium integrifolium*), rattlesnake master (*Eryngium yuccifolium*), and blazing star (*Liatris pycnostachya*) (WDNR, 2009d). The farmland that DEK leases out produces common Wisconsin crops including soybeans.

The Lake Michigan shoreline on the KPS site is comprised mostly of narrow (0- to 100-foot-wide (0- to 30.5-m-wide)) beaches with sparse vegetation. The beaches are bordered by bluffs or cliffs, which have been created over years of erosion induced by the fluctuating lake levels. In the late 1980s, DEK placed riprap along the edges of the bluffs of the southern end of the site shoreline to combat cliff erosion. The beach is at its narrowest at the south of KPS. North of the plant, the beaches are slightly wider, ranging from 20 to 80 feet (6 to 24 m) and also contain the most vegetation comprised of low-lying growth, shrubs, and trees. The beaches are the widest (more than 80 feet (24 m)) where the slope to the lake is more gradual (DEK, 2008).

The U.S. Fish and Wildlife Service (USFWS) National Wetlands Inventory database shows wetlands, some of which are classified as significant habitats, on the KPS site, as well as the neighboring shorelines of Lake Michigan surrounding the site (USFWS, 2009). Two wetland areas have been delineated by DEK. The first is an area referred to by DEK staff as the "Independent Spent Fuel Storage Installation wetland", which was delineated in 2005–2006 for purposes of pad construction and expansion. The second delineated wetland surrounds the KPS switchyard on three sides. Typical wetland species for the KPS site and surrounding area include tussock sedge (*Carex stricta*), northern white cedar (*Thuja occidentalis*), and wild rice (*Zizania aquatica*) (WDNR, 2009e).

Invasive plant species common to the KPS site and surrounding areas may include Amur honeysuckle (*Lonicera maackii*), European alder (*Alnus glutinosa*), bull thistle (*Cirsium vulgare*), butter and eggs (*Linarea vulgaris*), Canada bluegrass (*Poa compressa*), Canada thistle (*Cirsium* *arvense*), common buckthorn (*Rhamnus cathartica*), crown vetch (*Coronilla varia*), cottonwood (*Populus deltoides*), Kentucky bluegrass (*Poa pratensis*), kudzu (*Pueraria lobata syn Pueraria montana var lobata*), multiflora rose (*Rosa multiflora*), tree-of-heaven (*Ailanthus altissima*), big tooth (or large tooth) aspen (*Populus grandidentata*), quaking aspen (*Populus tremuloides*), black locust (*Robinia pseudoacacia*), willows (*Salix* spp.), white sweet clover (*Melilotus alba*), Queen Anne's lace (*Daucus carota*), and box elder (*Acer negundo*) (WDNR, 2009b). Invasive animal species common to the KPS site and surrounding area may include Asian longhorned beetle (*Anoplophora glabripennis*), emerald ash borer (*Agrilus planipennis*), mute swan (*Cygnus olor*), European gypsy moth (*Lymantria dispar*), and eastern tent caterpillar (*Malacosoma americanum*) (WDNR, 2009a). DEK does not manage any invasive species on the KPS site, and has not managed invasive species in the past. DEK is not required to keep records of known invasive species and does not have programs or procedures in place to control terrestrial plant or animal invasive populations on the KPS site.

A variety of wildlife exists on and in the vicinity of the KPS site. Mammals common to the KPS site include white-tailed deer (*Odocileus virginianus*), eastern cottontail (*Sylvilagus floridanus*), raccoon (*Procyon lotor*), coyote (*Canis latrans*), fox squirrel (*Sciurus niger*), eastern chipmunk (*Tamias striatus*), and short-tailed shrew (*Blarina brevicauda*) (DEK, 2008). Reptiles and amphibians common to the KPS site include spring peepers (*Pseudacris crucifer*), green frogs (*Rana clamitans*), wood frogs (*Rana sylvatica*), American toads (*Bufo americanus*), chorus frogs (*Pseudacris triserata*) as well as numerous species of snakes, turtles, lizards, and salamanders (DEK, 2008). Additionally, several common amphibian species, including spring peepers (*Pseudacris crucifer*), green frogs (*Rana clamitans*), wood frogs (*Rana sylvatica*), American toads (*Bufo americanus*), and chorus frogs (*Pseudacris triserata*) were recorded during a recent KPS terrestrial survey (DEK, 2008a).

The KPS site provides habitat to a variety of songbirds, upland game birds, waterfowl, and raptors. Birds common to the KPS site include red-winged blackbird (*Agelaius phoeniceus*), European starling (*Sturnus vulgaris*), American goldfinch (*Carduelis tristis*), clay-colored sparrow (*Spizella pallida*), American robin (*Turdus migratorius*), ring-billed gull (*Larus delawarensis*), Canada goose (*Branta canadensis*), and mallards (*Anas platyrhynchos*) (DEK, 2008). Bank swallows (*Riparia riparia*) nest in the cliffs along the Lake Michigan shore (DEK, 2008). A registered peregrine falcon (*Falco peregrinus*) breeding pair has nested on the KPS reactor building since 2001. An osprey (*Pandion haliaetus*) was seen flying over the KPS site in 2006; however, there have been no recorded sightings since.

DEK has several procedures for protecting the environment, including vegetation and wildlife, from impacts that could result from activities at KPS. Generally, procedures require KPS activity planners to complete an environmental review checklist to determine if a proposed activity requires further evaluation for environmental impacts and risk. If the environmental review checklist reveals that a planned activity could disturb vegetation or wildlife habitat, then an environmental evaluation must also be completed, and a qualified subject matter expert must evaluate the potential for adverse impacts on endangered or threatened wildlife and plant species or critical habitat. If the evaluation concludes that the proposed activity would result in an environmental impact, then the activity may not proceed until the impact has been resolved through avoidance, mitigation, or a compliance plan, when allowed by regulation.

DEK actively manages the Joe Krofta Memorial Forest, named for a previous landowner. The forest is a 15-acre (6-ha) site with various planted trees and is located within the southern half of the KPS site. It was previously used as an outdoor classroom by local schools, but since September 11, 2001, access to this site has been restricted for security reasons (DEK, 2008).

2.2.7 Threatened and Endangered Species

2.2.7.1 *Aquatic Threatened and Endangered Species*

Table 2-3 lists threatened, endangered, or candidate species known to occur in Kewaunee County, in which KPS is located, or Brown, Manitowoc, or Outagamie Counties, where transmission line ROWs associated with KPS traverse.

No Federally-listed aquatic species are known to occur on or in the vicinity of KPS or its associated transmission line ROWs. Three fish species and six mussel species are State-listed as threatened or endangered and have the potential to occur in the vicinity of KPS. None of these species were identified during the February 2006 to February 2007 impingement and entrainment study conducted by EA Engineering, Science, and Technology, Inc. (EA Engineering, 2007).

Table 2-3. Listed Aquatic Species. *The species below are Federally-listed or Wisconsin-listed as threatened, endangered, or candidate species. These species may occur on the KPS site, within Lake Michigan, or within the transmission line ROWs.*

Scientific Name	Common Name	Federal Status(a)	State Status(a)	County of Occurrence(b)
		Fish		
Acipenser fulvescens	lake sturgeon	-	SSC	Brown, Outagamie
Anguilla rostrata	American eel	-	SSC	Brown
Clinostomus elongates	redside dace	-	SSC	Brown, Manitowoc
Erimyzon sucetta	lake chubsucker	-	SSC	Manitowoc
Etheostoma clarum	western sand darter	-	SSC	Outagamie
Fundulus diaphanous	banded killifish	-	SSC	Kewaunee, Manitowoc
Lepomis megalotis	longear sunfish	-	T	Brown
Moxostoma valenciennesi	greater redhorse	-	T	Brown, Kewaunee, Manitowoc
Notropis anogenus	pugnose shiner	-	T	
Notropis texanus	weed shiner	-	SSC	Outagamie
Opsopoeodus emiliae	pugnose minnow	-	SSC	Outagamie
		Mussels		
Tritogonia verrucosa	buckhorn	-	T	Outagamie
Alasmidonta marginata	elktoe	-	SSC	Manitowoc; Outagamie
Alasmidonta viridis	slippershell mussel	-	T	Manitowoc
Epioblasma triquetra	snuffbox	-	E	Outagamie
Pleurobema sintoxia	round pigtoe	-	SSC	Outagamie
Quadrula metanevra	monkeyface	-	T	Manitowoc
Simpsonaias ambigua	salamander mussel	-	T	Outagamie
Venustaconcha ellipsiformis	ellipse	-	T	Manitowoc

[a] C = Candidate; E = Federally endangered; SSC = species of special concern; T = Federally threatened; - = No listing

[b] Species has recorded occurrence in the listed counties within the past 50 years according to the WDNR

Scientific Name	Common Name	Federal Status(a)	State Status(a)	County of Occurrence(b)

Sources: DEK 2008; FWS 2008; WDNR 2004a; WDNR 2008; WDNR 2008a; WDNR 2008b; WDNR 2008c; WNHP 2006

2.2.7.2 *Terrestrial Threatened and Endangered Species*

There are five Federally-listed threatened or endangered terrestrial species that have potential habitat on the KPS site: the piping plover (*Charadrius melodus*), the Hine's emerald dragonfly (*Somatochlora hineana*), the Karner blue butterfly (*Lycaeides melissa samuelis*), the dune or Pitcher's thistle (*Cirsium pitcheri*), and the dwarf lake iris (*Iris lacustris*). The bald eagle (*Haliaeetus leucocephalus*) and the peregrine falcon (*Falco peregrinus*) were formerly listed as Federally threatened and may also be found in the vicinity of the KPS site. A peregrine falcon (Falco peregrinus) breeding pair, mentioned in Section 2.2.6 of this draft SEIS, has nested on the KPS reactor building since 2001. Four State-listed species were identified as species for consideration of the proposed license renewal of KPS, including the Caspian tern (*Sterna caspia*), the osprey (*Pandion haliaetus*), and the formerly listed bald eagle and peregrine falcon (USFWS, 2008; DEK, 2008).

<u>Federally Protected and Formerly Protected Terrestrial Species</u>

The piping plover, a Federally- and State-listed endangered bird, is known to live on the shorelines in the vicinity of KPS. The USFWS has stated in a letter to the NRC that the habitat is not suitable for piping plovers on the KPS site (USFWS, 2008). The minimum piping plover nesting habitat requirements, as stated by the USFWS and outlined in the ER (DEK, 2008) include:

> Total shoreline length of at least 200 meters (660 feet) of gently sloping, sparsely vegetated (<50 percent herbaceous and low woody cover) sand beach with a total beach area of at least 2 hectares (5 acres); appropriately sized sites must have an area 50 meters (160 feet) in length where the beach width is at least 7 meters (23 feet).

The shoreline from the northern boundary of the KPS site to just below the reactor buildings are deemed to have "marginal" potential as plover nesting habitat while the southern end of the KPS site have no potential piping plover habitat (DEK, 2008). Recent surveys of KPS for piping plovers have not documented the species onsite (DEK, 2008). The piping plover is a small shorebird with long legs, brown feathered wings, and a white body (USFWS, 2009a). Piping plovers nest in the sand along the coastline. High human traffic to the beaches of the Atlantic coast and Great Lakes is considered to be the main reason for the decline of the species populations (USFWS, 2009a). Activity on beaches can destroy nests, eggs, and the young of the piping plover.

The Hine's emerald dragonfly, a Federally- and State-listed endangered species, has been listed by the USFWS mostly due to loss and fragmentation of habitat (DEK, 2008; USFWS, 2009). The dragonfly inhabits calcareous, spring-fed marshes and sedge meadows (DEK, 2008; USFWS, 2009). The dragonfly has bright emerald-green eyes and yellow stripes on its side, and grows to about 2.5 inches (6.4 cm) in length and has a wingspan of about 3.3 inches (8.4 cm) (USFWS, 2009). The dragonfly has been reported in Kewaunee County, and the closest location to the KPS site was a small population of the dragonflies from the Black Ash swamp in northern Kewaunee County in 2001 (DEK, 2009b). Recent wildlife surveys on KPS lands did not detect the presence of Hine's emerald dragonflies (DEK, 2008).

The Karner blue butterfly is Federally-listed by the USFWS as endangered; however, the State of Wisconsin does not list the species as either threatened or endangered (DEK, 2008; USFWS, 2009c). Of the counties that contain the KPS site and its associated transmission lines, Outagamie County is the only one with known populations of the butterfly (DEK, 2008). The butterfly has about a 1 inch (2.5 cm) wingspan and the males and females are different in appearance (USFWS, 2009c). The upper side of the male has shades of bright silver or dark blue with narrow black margins (USFWS, 2009c). Females are grayish brown, with very dark brown nodes on the outer portions of the wings, and the upper sides of the females are blue, with irregular bands of orange crescents inside the narrow black border. The underside of both the males and females are gray, and have a continuous band of orange crescents traveling the edges of both wings and the underside have scattered black spots circled with white (USFWS 2009c). For habitat, the butterfly prefers pine and oak trees, as well as savannas and barrens, which contain wild lupine (*Lupinus perennis*) and other flowering plants (DEK, 2008). After the species hatches, the caterpillars will only feed on the wild lupine species leaves and are, therefore, limited to breed in habitats containing that plant species (DEK, 2008). Habitat fragmentation, development in Wisconsin, and protection against forest fires (wild lupine requires early stages of forest succession for maximum growth), have all reduced the populations of wild lupine and its ability to reproduce (DEK, 2008). Surveys of the KPS site and its associated transmission line ROWs did not show any presence of the Karner blue butterfly (DEK, 2008).

The dune or Pitcher's thistle, a Federally- and State-listed threatened species, is known to live in Manitowoc County, a county crossed by KPS-associated transmission lines (WNDR, 2008b). The thistle is native to Wisconsin and grows on the beaches and dunes associated with the Great Lakes (WDNR, 2008b). The thistle can grow to heights of up to 3 feet (1 m) tall, and is covered with hairs along the stem (USFWS, 2009d). Leaves of the thistle can be 1 foot (0.3 m) long each, and usually have deep lobes (USFWS, 2009d). The Pitcher's thistle takes five to eight years of growing before it begins to flower (USFWS, 2009d). Its non-flowering form is a grouping or cluster of bright silvery leaves, while the flowering form of the thistle typically has a single stem with many branches that have cream or pink flowers at the ends (USFWS, 2009d). Pitcher's thistle is most often found along the shoreline of the Great Lakes or in unforested fields, and always near other plant communities. Surveys performed by DEK for Pitcher's thistle on the KPS site or in associated transmission lines have no documented occurrences (DEK, 2008).

The dwarf lake iris is Federally- and State-listed as threatened, and has been known to occur in Brown County, a county crossed by KPS-associated transmission lines (WDNR, 2008). Dwarf lake iris is a very small iris with dark, deep blue flowers, although sometimes flowers can be lilac or white (USFWS, 2009b). The flowers are about 1 to 1.5 inches (2.5 to 3.8 cm) wide and 1.5 to 2.5 inches (3.8 to 6.4 cm) tall (USFWS, 2009b). The iris's leaves can grow to 6 inches (15 cm) long and are sword-like in shape, and grow in clusters (USFWS, 2009b). The iris prefers habitats of shoreline, dunes, or cedar forest edge ecosystems, and grows in sandy soils or on beaches with little to no other vegetation present (USFWS, 2009b). Surveys for dwarf lake iris on the KPS site or its associated transmission lines did not document any occurrences of the plant species (DEK, 2008).

On July 9, 2007, the USFWS issued a *Federal Register* notice announcing the delisting of the bald eagle from the Federal List of Endangered and Threatened Wildlife (72 FR 37346). Eagles continue to be protected at the national level by the Bald and Golden Eagle Protection Act, as well as the Migratory Bird Treaty Act, and at the State level as a Wisconsin-listed threatened species. The bald eagle is a large bird, even among raptor species, and can reach a weight of more than 13 pounds (6 kg). The eagle has a white head and tail, with brown body feathers. Bald eagles eat fish, small mammals, birds, and occasionally carrion. Bald eagles are known to occur throughout Wisconsin, and in every county associated with the KPS site or its associated transmission lines. They are seen regularly along the Lake Michigan shoreline. Eagles have been seen on the KPS site by employees and during the NRC staff audit; however, the KPS site does not have any eagle nests (DEK, 2008).

The peregrine falcon was removed from the Federal listing in August 1999, but continues to be listed as endangered at the State level in Wisconsin. Adult birds have a bluish-black head and wings, are 14 to 19 inches (36 to 48 cm) tall, and have a 39- to 43-inch (99- to 109-cm) wingspan (Cornell, 2003). Peregrine falcons nest on high cliffs near river systems and in some cases, especially associated with breeding attempts, the falcon can nest on bridges and tall buildings. The KPS site has had a breeding pair nesting on its reactor building since 2001, and the pair has produced at least 14 fledglings (DEK, 2008). In an effort to protect the nesting pair and their young, DEK regularly communicates with USFWS and WDNR (DEK, 2008).

<u>State Protected Terrestrial Species</u>

The Caspian tern, a State-listed endangered species, is potentially occurring on the KPS site and its associated transmission lines (WDNR, 2004a; WNHP, 2006). The Caspian tern is the largest known tern species in the world and is easily recognized by its red bill. The tern has grey feathers on its wings, an all white underbelly, and black feathers on its head. In the spring of 2006, approximately 24 Caspian terns lived and were observed on the shoreline adjacent to the KPS site (DEK, 2008).

The Wisconsin State-listed threatened osprey may potentially occur on the KPS site or its associated transmission lines. The osprey is a fairly large bird of prey with a body length of about 21 to 24 inches (53 to 61 cm) and a wingspan of 4.5 to 5.5 feet (1.4 to 1.7 m). Osprey feed exclusively on live fish (USFWS, 2008b). Individuals are brown with a white belly and have distinctive patches on their wings. The osprey has long, sharp talons, which are used for gripping fish. Females are larger than males, which is true for most birds of prey. The osprey's habitat includes rivers, lakes, and shallow water estuaries. Nesting often occurs on artificial structures such as flat-topped wooden platforms, metrological towers, channel markers, and radio towers, where such structures are near shallow waters that support plentiful fish. Osprey pairs tend to be solitary nesters, and may colonize secure areas such as islands (USGS, undated). In May of 2006, one osprey was sighted on the KPS site; however, no other ospreys have been seen on the KPS site, or its associated transmission lines since.

2.2.8 Socioeconomic Factors

This section describes current socioeconomic factors that have the potential to be directly or indirectly affected by changes in operations at the KPS. The KPS and the people and communities surrounding it can be described as a dynamic socioeconomic system. The nuclear power plant requires people, goods, and services from local communities to operate the plant. The communities, in turn, provide the people, goods, and services to run the plant. KPS employees residing in the community receive income from the plant in the form of wages, salaries, and benefits, and spend this income on goods and services within the community thereby creating additional opportunities for employment and income. People and businesses in the community also receive income for the goods and services sold to KPS. Payments for these goods and services create additional employment and income opportunities in the community. The measure of a communities' ability to support the operational demands of KPS depends on the ability of the community to respond to changing socioeconomic conditions.

The socioeconomics region of influence (ROI) is defined by the areas where KPS employees and their families reside, spend their income, and use their benefits, thereby affecting the economic conditions of the region. The KPS ROI consists of a three-county area (Kewaunee, Manitowoc, and Brown counties in Wisconsin). The following sections describe the housing, public services, offsite land use, visual aesthetics and noise, population demography, and the economy in the ROI surrounding the KPS.

DEK employs a permanent workforce of approximately 705 workers (DEK, 2008). Approximately 95 percent live in Kewaunee County, Manitowoc County, and Brown County, Wisconsin (Table 2-4). Most of the remaining 5 percent of the workforce are divided among 9 other counties in Wisconsin and a few employees living out of state with numbers ranging from 1 to 11 employees per county. Given the residential locations of KPS employees, the most significant impacts of plant operations are likely to occur in Kewaunee, Manitowoc, and Brown counties. The focus of the socioeconomic impact analysis in this draft SEIS is based on the impacts of the KPS on these three counties.

Table 2-4. Kewaunee Power Station Employee Residence by County (Wisconsin)

County	Number of Employees	Percentage (%) of Total
Manitowoc	280	39.7
Brown	228	32.3
Kewaunee	159	22.6
Door	11	1.6
Outagamie	4	0.6
Sheboygan	4	0.6
Other	19	2.6
Total	**705**	**100**

Source: DEK 2008

Refueling outages at the KPS normally occur at 18-month intervals. During refueling outages, site employment increases by as many as 600 to 700 workers for approximately 30 days (DEK, 2008). Most of these workers are assumed to be located in the same geographic areas as KPS employees.

2.2.8.1 *Housing*

Table 2-5 lists the total number of occupied and vacant housing units, vacancy rates, and median value in the three-county ROI. According to the 2000 Census, there were approximately 133,000 housing units in the socioeconomic region, of which approximately 127,600 were occupied. The median value of owner-occupied housing units in the three Wisconsin counties ranged from $90,900 in Manitowoc County to $116,100 in Brown County. The vacancy rate was the lowest in Brown County (3.2 percent) and highest in Kewaunee County (7.3 percent). Kewaunee County has the smallest number of total and vacant housing units amongst the three counties (USCB, 2009a).

By 2007, the estimated number of housing units grew in all three counties by approximately 10 percent of their combined total inventories. In Kewaunee County, the number of housing units grew to an estimated total of 9,013 units in 2007, an increase of approximately 800 units. In Manitowoc County the number of housing units grew by more than 2,000 units to an estimated total of 36,661 units or approximately 6 percent (USCB, 2009a).

Table 2-5. Housing in Kewaunee, Manitowoc, and Brown Counties in Wisconsin

	Kewaunee	Manitowoc	Brown	ROI
2000				
Total	**8,221**	**34,651**	**90,199**	**133,071**
Occupied housing units	7,623	32,721	87,295	127,639
Vacant units	598	1,930	2,904	5,432
Vacancy rate (percent)	7.3	5.6	3.2	4.1
Median value (dollars)	92,100	90,900	116,100	99,700
2005–2007, 3-Year Estimate				
Total	**9,013**	**36,661**	**101,256**	**146,930**
Occupied housing units	8,272	33,704	95,165	137,141
Vacant units	741	2,957	6,091	9,789
Vacancy rate (percent)	8.2	8.1	6.0	6.7
Median value (dollars)	134,100	118,300	155,400	135,933

Source: USCB 2009a.

2.2.8.2 *Public Services*

This section presents a discussion of public services including water supply, education, and transportation.

Water Supply

Since 95 percent of workers at the KPS reside in Kewaunee, Manitowoc, and Brown counties, Wisconsin, the discussion of public water supply systems is limited to these counties. In Table 2-6, information about municipal water suppliers in these counties, their permitted capacities and maximum design yields, reported annual peak usage, and population served are presented.

Lake Michigan is the source of potable water for the cities of Two Rivers, Manitowoc, and Green Bay and ground water provides potable water for smaller towns and rural residences in the vicinity of the KPS site. Two ground water wells at KPS are used for cooling, stand-by cooling, the plant equipment water system, and potable water. KPS pumps ground water for use as potable water and is not connected to a municipal system. At the present time, the water supply systems in Kewaunee, Manitowoc, and Brown counties are operating below their maximum capacities. The following are brief descriptions of the water supply systems in the three counties.

Kewaunee County's major public water systems serve the majority of residential, commercial, and industrial users and are located in the cities of Kewaunee and Algoma, and the village of Luxemburg. These three municipal water systems are supplied from groundwater through community wells. County planners state that these systems are considered adequate for the cities' and village's present and future growth. The village of Casco and ten towns within the county, not serviced by public systems, have individual or shared wells that are owned and maintained by the property owner(s). The city of Green Bay obtains drinking water supplies from Lake Michigan by means of the Green Bay water pipeline. Two raw water pipelines cross through the central portion of Kewaunee County to supply potable water to the city of Green Bay and several of its suburbs. At this time, none of the communities in Kewaunee County has any plans of utilizing this utility for their water needs (Bay-Lake Regional Planning Commission, 2007).

The cities of Manitowoc and Two Rivers are the two largest municipal water suppliers in Manitowoc County (Table 2-6). Both cities obtain their municipal water from Lake Michigan. All other water systems in the County rely on ground water as their source (Bay-Lake Regional Planning Commission, 2005).

Local community infrastructures continue to be used and existing wells are used for backup purposes. Ground water is the source of all drinking water and other water uses within the remainder of Brown County (DEK, 2008).

Table 2-6. Public Water Supply Systems (thousand gallons per day)

Water Supplier	Water Source	Average Daily Demand	System Capacity	Population Served
Kewaunee County				
Algoma Waterworks	GW	261	1,584	3,357
Kewaunee Waterworks	GW	362	2,592	2,887
Luxemburg Waterworks	GW	257	590	2,292
Manitowoc County				
Cleveland Waterworks	GW	75	1,500	1,410
Kiel Waterworks	GW	500	4,532	3,630
Manitowoc Waterworks	SW	8,000	31,000	34,500
Mishicot Waterworks	GW	1,404	1,440	1,422
Reedsville Waterworks	GW	100	500	1,200
Two Rivers Waterworks	SW	1,500	4,000	13,354
Brown County				
Allouez Waterworks	SW	1,100	4,000	14,443
Ashwaubenon Waterworks	SW	3,449	6,000	17,625
Bellevue Waterworks	SW	1,000	4,000	14,500
De Pere Water Department	SW	2,600	6,000	22,310
Green Bay Waterworks	SW	20,000	42,000	103,018
Hobart Waterworks Service Area #1	GW	864	1,400	1,600
Howard Waterworks	SW	1,860	4,200	14,543
Lawrence Utility District	SW	1,050	4,320	1,200
Wrightstown Waterworks	GW	220	1,000	2,578

GW = ground water; SW = surface water
Source: DEK 2008.

Education

The KPS is located in the Kewaunee School District, Kewaunee County, which had an enrollment of approximately 1,000 students in the 2008–2009 school year (DPI, 2009). Kewaunee County has three public school districts with over 1,900 enrolled students (DPI, 2009). Manitowoc and Brown counties have six and eight public school districts, respectively (DPI, 2009). Total enrollment in Manitowoc and Brown counties' schools in the 2008–2009 school year was approximately 12,000 and 42,000 students, respectively (DPI, 2009; IES, 2009).

Transportation

Employees enter the KPS site gate after exiting State Highway 42 to the west. State Highway 42 has a north-south orientation and runs near the Lake Michigan shoreline in Kewaunee County. KPS workers from Ahnapee and Pierce would likely travel south on State Highway 42; employees from Red River, Lincoln, Luxemburg, and Casco could travel along County Highway

C to the intersection with State Highway 42 and then continue south; those in Montpelier and West Kewaunee, Franklin, and Carlton would likely choose one of the east-west roads, travel east to the State Highway 42 intersection and then continue south. KPS workers commuting from Manitowoc County would also travel north on State Highway 42. County Highway BB is just south of the station and the state-maintained Nuclear Road terminates on State Highway 42 near the plant entrance. State and county roads in this part of Wisconsin were laid out in grids on true north-south axes with accommodations for naturally occurring geographical boundaries. Thus, Nuclear Road, County Highway BB, and many other east-west roads leading to KPS are perpendicular to State Highway 42.

The annual average daily traffic volume along State Highway 42 in Kewaunee County, in 2006, ranged from 2,400 vehicles to 6,800 vehicles at the various intersections. The annual average daily traffic sampling location nearest the intersection of Nuclear Road and State Highway 42 was 2,600 vehicles. In 2005, the annual average daily traffic volume along the State Highway 42 in Manitowoc County ranged from 1,900 vehicles to 21,500 vehicles at the various intersections. The section of State Highway 42 where the 21,500 vehicles were recorded is the section where State Highway 42 and Interstate Highway 43 share the same road (just west of Manitowoc) (WDOT, 2009).

Table 2-7 lists commuting routes to KPS and average annual daily traffic (AADT) volume values. The AADT values represent traffic volumes for a 24-hour period factored by both day of week and month of year.

Table 2-7. Major Commuting Routes in the Vicinity of the Kewaunee Power Station in 2006 Average Annual Daily Traffic Counts

Roadway and Location	Average Annual Daily Traffic (AADT) [a]
State Highway 42 (between County Highway BB and Cherneyville Road)	2,600
State Highway 42 (between Cherneyville Road and Lakeshore Drive)	2,400
State Highway 42 (between State Highway 29 and Lakeshore Drive)	2,500
State Highway 42 (between Miller Street and State Highway 29)	5,400
State Highway 42 north of Miller Street	3,700–4,800
State Highway 29 west of Kewaunee	3,100–3,800
State Highway 42 (between Two Rivers and County Highway BB)	3,200

Source: WDOT 2009.

[a] All AADTs represent traffic volume during the average 24-hour day during 2005 and 2006.

2.2.8.3 *Offsite Land Use*

Offsite land use conditions in Kewaunee and Manitowoc counties are described in this section because Kewaunee and Manitowoc are the only counties in which KPS employees represent more than 0.1 percent of the county population. Kewaunee County also receives Wisconsin

Shared Revenues Utility Program payments from the State of Wisconsin because of KPS presence in the County. In addition to shared revenue, Kewaunee and other counties in the vicinity of KPS receive revenue from sales taxes and fees paid by DEK and its employees residing in the region. Changes in the number of workers at the KPS and tax payments could affect land use conditions in these counties.

The KPS is located in southeastern Kewaunee County. Manitowoc and Brown counties are located south and west of Kewaunee County respectively. Kewaunee County has experienced small increases in population and housing over the last 16 years (1990 to 2006). However, the number of housing units in Kewaunee County grew faster than the population.

Kewaunee County occupies approximately 340 square miles (217,600 acres) (USCB, 2009c). Almost 93 percent of the county's land is undeveloped. The majority (84 percent) of the undeveloped acreage consists of croplands or pastures and woodlands. Croplands or pastures comprise nearly 63 percent of the county's total land area, while woodlands cover 21 percent of the total land area. Some of the larger woodland areas in the county include the Black Ash Swamp in the town of Lincoln, Duvall Swamp in Red River, and Lipsky Swamp in West Kewaunee (Bay-Lake Regional Planning Commission, 2007).

Almost 80 percent of the county's land is agricultural (USDA, 2009). Residential uses account for the largest developed land-use, covering 2.6 percent of the County's total land area, while transportation and agricultural structures each account for approximately 1.6 percent. The largest concentrations of residential, commercial, and industrial land are found in and around the cities of Algoma and Kewaunee, the village of Casco, and the town and village of Luxemburg (Bay-Lake Regional Planning Commission, 2007).

KPS is located in the town of Carlton in Kewaunee County. The town limits of Carlton encompass an area of 35.6 square miles. Carlton has experienced relatively little land-use change since KPS began operations. Approximately 97 percent of the land is agricultural or woodland and 3 percent is developed. Dairy farming is the primary economic activity.

Manitowoc County occupies approximately 592 square miles (378,900 acres) (USCB, 2009c). Almost 66 percent of the county's land is farmed (USDA, 2009). Manitowoc County experienced small increases in population and housing over the 16 years from 1990 to 2006, with the number of housing units growing faster than the population. However, from 2000 to 2006, the population in Manitowoc County declined by a small amount while the number of housing units increased.

2.2.8.4 *Visual Aesthetics and Noise*

The KPS can be seen from the lake, but is partly shielded by vegetation along the lake. The predominant feature of the KPS site is the reactor building, which is approximately 180-feet tall (AEC, 1972). On the lake side of the reactor building is the turbine building, which is approximately 100-feet tall (AEC, 1972). Other features include the auxiliary building (adjoining the reactor building), administration building, and meteorological tower. The turbine building and reactor containment structures dominate the landscape of the site.

Noise from nuclear plant operations can be detected offsite. Sources of noise at KPS include the turbines and large pump motors. Given the industrial nature of the station, noise emissions from the station are generally nothing more than an intermittent minor nuisance. However, noise levels may sometimes exceed the 55 dBA level that the EPA uses as a threshold level to protect against excess noise during outdoor activities (EPA, 1974). However, according to the EPA this threshold does "not constitute a standard, specification, or regulation," but was intended to provide a basis for state and local governments establishing noise standards.

2.2.8.5 *Demography*

According to the 2000 Census, approximately 86,224 people lived within 20 miles of KPS, which equates to a population density of 132 persons per square mile (DEK, 2008). This density translates to GEIS Category 4, least sparse (greater than or equal to 120 persons per square mile within 20 miles). Approximately 723,900 people live within 50 miles of KPS (DEK, 2008). This equates to a population density of 202 persons per square mile. Applying the GEIS proximity measures, KPS is classified as proximity Category 4 (greater than or equal to 190 persons per square mile within 50 miles). Therefore, according to the sparseness and proximity matrix presented in the GEIS, rankings of sparseness Category 4 and proximity Category 4 result in the conclusion that KPS is located in a high population area.

Table 2-8 shows population projections and growth rates from 1970 to 2050 in Kewaunee, Manitowoc, and Brown counties, Wisconsin. The growth rate in Kewaunee County showed an increase of 6.9 percent for the period of 1990 to 2000. County populations are expected to continue to grow in Kewaunee, Manitowoc, and Brown counties through 2050.

Table 2-8. Population and Percent Growth in Kewaunee, Manitowoc, and Brown Counties, Wisconsin, from 1970 to 2000 and projected for 2008 to 2050

	Kewaunee		Manitowoc		Brown	
Year	Population	Percent Growth[(a)]	Population	Percent Growth[(a)]	Population	Percent Growth[(a)]
1970	18,961	—	82,294	—	158,244	—
1980	19,539	3.0	82,918	0.8	175,280	10.8
1990	18,878	-3.4	80,421	-3.0	194,594	11.0
2000	20,187	6.9	82,887	3.1	226,778	16.5
2008	20,388	1.0	80,641	-2.7	245,018	8.0
2010	21,841	8.2	85,834	3.6	254,040	12.0

2020	23,587	8.0	89,035	3.7	282,409	11.2
2030	25,085	6.4	91,622	2.9	306,931	8.7
2040	26,748	6.6	94,618	3.3	334,018	8.8
2050	28,370	6.1	97,512	3.1	360,463	7.9

— = No data available.

[(a)]Percent growth rate is calculated over the previous decade.

Sources: Population data for 1970 through estimated population data for 2008 (USCB, 2009b); population projections for 2010– 2030 by State of Wisconsin Demographics Services Center, Division of Intergovernmental Relations, Department of Administration (5/30/2008); population projections for 2040 and 2050 (calculated).

Demographic Profile

The 2000 and 2005–2007 American Community Survey 3-Year Estimates demographic profiles of the three-county region of influence population are presented in Table 2-9 and Table 2-10. In 2000, minority individuals (both race and ethnicity) comprised 8.5 percent of the total three-county population. The minority population was composed largely of Hispanic or Latino and Asian residents.

Table 2-9. Demographic Profile of the Population in the Kewaunee Power Station Three-County Socioeconomic Region of Influence (ROI) in 2000

	Kewaunee	Manitowoc	Brown	ROI
Total Population	20,187	82,887	226,778	329,852
Race (percent of total population, Not-Hispanic or Latino)				
White	98.2	95.0	89.6	91.5
Black or African American	0.1	0.3	1.1	0.9
American Indian and Alaska Native	0.3	0.4	2.1	1.6
Asian	0.1	2.0	2.2	2.0
Native Hawaiian and Other Pacific Islander	0.0	0.0	0.0	0.0
Some other race	0.0	0.0	0.0	0.0
Two or more races	0.5	0.7	1.0	0.9
Ethnicity				
Hispanic or Latino	153	1,343	8,698	10,194
Percent of total population	0.8	1.6	3.8	3.1
Minority Population (including Hispanic or Latino ethnicity)				
Total minority population	365	4,131	23,535	28,031
Percent minority	1.8	5.0	10.4	8.5

Source: USCB, 2009b

According to the U.S. Census Bureau's (USCB's) 2005–2007 American Community Survey 3-Year Estimates, minority populations in the three-county region were estimated to have increased by over 8,300 persons and comprised 10.6 percent of the total three county population (see Table 2-10). Most of this increase was due to an estimated increase in the Hispanic or Latino population (over 5,000 persons) of over 52 percent from 2000. This was the largest percentage increase of any minority population and a 1.4 percent increase in the

Hispanic or Latino population when compared to the total increase in the three-county population. The next largest increase in minority population was in the Black or African American population, an increase of over 1,600 persons from 2000. However, this resulted in a 0.5 increase in population as a percentage of the total increase in the three-county population.

Table 2-10. Demographic Profile of the Population in the Kewaunee Power Station Three-County Socioeconomic Region of Influence in 2005-2007, 3-Year Estimate

	Kewaunee	Manitowoc	Brown	ROI
Total Population	20,532	81,009	240,801	342,342
Race (percent of total population, Not-Hispanic or Latino)				
White	97.0	94.0	87.2	89.4
Black or African American	0.0	0.6	1.7	1.3
American Indian and Alaska Native	0.2	0.3	1.9	1.4
Asian	0.2	1.9	2.3	2.1
Native Hawaiian and Other Pacific Islander	0.2	0.0	0.1	0.1
Other	0.0	0.0	0.1	0.1
Two or more races	0.8	0.9	1.2	1.1
Ethnicity				
Hispanic or Latino	314	1,880	13,347	15,541
Percent of total population	1.5	2.3	5.5	4.5
Minority Population (including Hispanic or Latino ethnicity)				
Total minority population	624	4,895	30,826	36,345
Percent minority	3.0	6.0	12.8	10.6

Source: USCB, 2009b

Transient Population

Within 50 miles (80 km) of the KPS, colleges and recreational opportunities attract daily and seasonal visitors who create demand for temporary housing and services. In 2009, there were approximately 11,794 students attending colleges and universities within 50 miles (80 km) of the KPS (IES, 2009).

In 2000 in Kewaunee County, 45.2 percent of all housing units were considered temporary housing for seasonal, recreational, or occasional use. By comparison, seasonal housing accounted for 26.8 percent, 14.3 percent, and 60.1 percent of total housing units in Manitowoc and Brown counties and Wisconsin, respectively (USCB, 2009a). Table 2-11 provides information on seasonal housing for the 12 counties located all or partly within 50 miles of the KPS.

Table 2-11. Seasonal Housing in Counties Located within 50 Miles of the Kewaunee Power Station

County[a]	Housing units	Vacant housing units: For seasonal, recreational, or occasional use	Percent
Wisconsin	**236,600**	**142,313**	**60.1**
Brown	2,904	414	14.3
Calumet	848	287	33.8
Door	7,759	6,970	89.8
Fond du Lac	2,340	573	24.5
Kewaunee	598	270	45.2
Manitowoc	1,930	518	26.8
Marinette	8,675	7,586	87.4
Oconto	5,833	4,837	82.9
Outagamie	2,084	237	11.4
Shawano	2,502	1,793	71.7
Sheboygan	2,402	804	33.5
Winnebago	3,564	1,032	29.0
County Total	**41,439**	**25,321**	**45.9 (avg.)**

Source: USCB 2009a

[a] Counties within 50 miles of the KPS that are totally or partially located within the 50-mile radius.

avg. = percent average for counties within the KPS 50-mile radius and excludes state percentage.

Migrant Farm Workers

Migrant farm workers are individuals whose employment requires travel to harvest agricultural crops. These workers may or may not have a permanent residence. Some migrant workers follow the harvesting of crops, particularly fruit, throughout rural areas of the United States. Others may be permanent residents near the KPS who travel from farm to farm harvesting crops.

Migrant workers may be members of minority or low-income populations. Because they travel and can spend a significant amount of time in an area without being actual residents, migrant workers may be unavailable for counting by census takers. If uncounted, these workers would be “underrepresented” in USCB minority and low-income population counts.

Information on migrant farm and temporary labor was collected in the 2007 Census of Agriculture. Table 2-12 provides information on migrant farm workers and temporary farm labor (less than 150 days) within 50 miles of the KPS. According to the 2007 Census of Agriculture, approximately 8,000 farm workers were hired to work for less than 150 days and were employed on 2,300 farms within 50 miles of the KPS. The county with the largest number of temporary farm workers (1,108 workers on 298 farms) was Fond du Lac County, Wisconsin (USDA, 2009).

In the 2002 Census of Agriculture, farm operators were asked for the first time whether or not any of them hired migrant workers, defined as a farm worker whose employment required travel that prevented the migrant worker from returning to their permanent place of residence the same day. A total of 131 farms in the 50-mile radius of the KPS reported hiring migrant workers in the 2007 Census of Agriculture. Brown County, reported the most farms (20 farms) with hired migrant workers, followed by Fond du Lac County and Outagamie County with 16 farms (USDA, 2009).

According to the 2007 Census of Agriculture estimates, 675 temporary farm laborers (those working fewer than 150 days per year) were employed on 148 farms in Kewaunee County, and 976 and 823 temporary farm workers were employed on 256 and 213 farms in Manitowoc and Brown counties, respectively (USDA, 2009).

Table 2-12. Migrant Farm Workers and Temporary Farm Labor in Counties Located within 50 Miles of the Kewaunee Power Station

County [a]	Number of farms with hired farm labor [b]	Number of farms hiring workers for less than 150 days [b]	Number of farm workers working for less than 150 days [b]	Number of farms reporting migrant farm labor [b]
Wisconsin	**17,889**	**13,169**	**45,921**	**636**
Brown	318	213	823	20
Calumet	244	163	471	12
Door	201	167	564	6
Fond du Lac	451	298	1,108	16
Kewaunee	250	148	675	11
Manitowoc	353	256	976	12
Marinette	143	107	476	9
Oconto	251	171	606	7
Outagamie	350	230	755	16
Shawano	417	246	872	8
Sheboygan	290	201	664	5
Winnebago	214	144	404	9
County Total	**3,482**	**2,344**	**8,394**	**131**

Source: 2007 Census of Agriculture–County Data (USDA, 2009)

[a] Counties within 50 miles of the KPS that are totally or partially located within the 50-mile radius

[b] Table 7. Hired Farm Labor - Workers and Payroll: 2007

2.2.8.6 *Economy*

This section contains a discussion of the economy, including employment and income, unemployment, and taxes.

Employment and Income

Between 2000 and the U.S. Census Bureau's 2005–2007 American Community Survey 3-Year Estimates, the civilian labor force in Kewaunee County increased 5.7 percent from 10,984 to 11,609. During the same time period, the civilian labor force in Manitowoc County grew by 1.6 percent. By 2007, the civilian labor force in Brown County increased by 6.1 percent (USCB, 2009).

According to the U.S. Census Bureau's 2005–2007 American Community Survey 3-Year Estimates, manufacturing represented the largest industrial sector of employment in the three-county region followed by educational services, health care and social assistance, and retail trade industry. A list of some of the major employers in Kewaunee County is provided in Table 2-13.

Table 2-13. Major Employers in Kewaunee County in 2005

Employer	Service or Product	Number of Employees
Aurora Medical Center of Oshkosh	General medical & surgical hospitals	500–999
Wisconsin Label Corp.	Commercial flexographic printing	500–999
Algoma Hardwoods Inc.	Wood window & door manufacturing	250–499
Kewaunee Nuclear Power Plant	Nuclear electric power generation	250–499
Luxemburg-Casco Public Schools	Elementary & secondary schools	250–499
Kewaunee Fabrications LLC	Miscellaneous gen. purpose machinery mfg.	250–499
Kewaunee School District	Elementary & secondary schools	100–249
County of Kewaunee	Highway, street, & bridge construction	100–249
N E W Plastics Corp.	Plastics bottle manufacturing	100–249
The Vollrath Co. LLC	Kitchen utensil, pot, & pan manufacturing	100–249

Source: DWD, 2006

Estimated income information for the KPS ROI is presented in Table 2-14. According to the USCB's 2005–2007 American Community Survey 3-Year Estimates, Kewaunee and Brown counties each had median household incomes above the State average. Brown County had the highest median household income among the three counties. Per capita incomes in Kewaunee County and Manitowoc County were both below per capita income estimates for Brown County and the State. In Kewaunee and Manitowoc counties an estimated 5.8 and 8.6 percent of the population were living below the official poverty level, respectively, while the percentage for Brown County and the State of Wisconsin as a whole was over 10 percent. The percentage of families living below the poverty level in Kewaunee County and Manitowoc County (4.6 and 5.5 percent, respectively) was lower than the percentage of families in Brown County and the State of Wisconsin as a whole (both over 7 percent) (USCB, 2009).

Table 2-14. Estimated Income Information for the Kewaunee Power Station Region of Influence, 2005–2007 3-Year Estimates

	Kewaunee	Manitowoc	Brown	Wisconsin
Median household income (dollars)	51,734	47,075	51,624	50,309
Per capita income (dollars)	23,771	23,592	25,741	25,742
Percent of families living below the poverty level	4.6	5.5	7.6	7.1
Percent of individuals living below the poverty level	5.8	8.6	10.4	10.8

Source: USCB, 2009

<u>Unemployment</u>

According to the U.S. Census Bureau's 2005–2007 American Community Survey 3-Year Estimates, the unemployment rate in Kewaunee and Manitowoc counties was 4.5 and 5.5 percent, respectively, which was lower than the unemployment rate of 5.8 percent for the State of Wisconsin (USCB, 2009). The unemployment rate in Brown County was 6.2 percent, which was higher than the state average (USCB, 2009).

<u>Taxes</u>

Utilities and large electricity generators in Wisconsin are generally exempt from paying local property taxes. Instead, "gross revenue" taxes are collected from the utilities, which are then combined with other revenue collected statewide to become part of the state's general purpose revenue fund. The general purpose revenue fund is disbursed in the form of aid payments to local governments. In general, utility aid payments are distributed to the county and municipality based on utility valuation or location.

Utility aid payments consist of six components: the ad valorem payment, spent nuclear fuel storage payment, the minimum payment, the per capita limit, megawatt-based payment and incentive payments. Descriptions of the components applicable to KPS are provided below.

<u>Ad Valorem Payment</u>

This component is based on the "net book value" of "qualifying property" for "eligible utilities". The total value of "qualifying property" in a municipality may not exceed $125 million per utility company or, if the property is owned by two or more utilities, $125 million for that specific property.

- "Net book value" is the original cost of the property minus depreciation. For deregulated companies, depreciation is generally reported on a straight-line basis.

- "Qualifying property" includes (a) production plants that were in operation on January 1, 2004, and not subsequently rebuilt or "repowered," (b) substations, and (c) general structures. The land on which such property is located is excluded. Electric utility production plant consists of generating station structures and improvements and associated boilers, reactors, reservoirs, dams, waterways, fuel holders; engines, prime movers, and generators. Electric utility substations are facilities that connect the local distribution lines to the interstate electric transmission system. Gas utility substations are facilities that connect the local distribution lines to interstate gas transmission pipelines. For any utility, general structures included office buildings, garages, maintenance facilities, and related structures.

- "Eligible utilities" include: (1) private companies that produce, transmit, or distribute electricity or gas in more than one municipality; (2) electric cooperatives; (3) municipal utilities (for the portion of their property located outside the municipality that owns the utility) (4) municipal electric association projects (multi-municipal entities that own electric plants and/or purchase and transmit electricity to their members); and (5) qualified wholesale electric companies (entities that sell 95 percent or more of their power at wholesale and have a total generating capacity of 50 megawatts (MW) or more).

When calculating payments, the net book value in a municipality may not be less than the net book value as of December 31, 1989, minus the value of property removed since that date. This is called the "value guarantee."

Spent nuclear fuel storage

A payment of $50,000 is made to any municipality and county in which spent nuclear fuel is stored on December 31 of the prior year. If the nuclear fuel storage facility is located within one mile of another municipality or county, the municipality or county where the fuel is stored is paid $40,000 and the nearby municipality or county is paid $10,000.

Minimum payment

This component applies only to electric generating plants with a rated capacity of 200 MW or more that were in operation on January 1, 2004, and not subsequently rebuilt or "repowered". The minimum payment to a municipality or county with such a plant may not be less than $75,000.

Per capita limit

The total payment from the ad valorem and minimum payments may not exceed $300 per capita for municipalities and $100 per capita for counties. Payments under the spent nuclear fuel storage component are exempt from this limit.

Megawatt-based payment

Through 2008, this component only applies to electric generating plants that began operation or were "repowered" after December 31, 2003. Beginning in 2009, this component may apply to KPS in lieu of the ad valorem payment. The payment is $2,000 per MW of name-plate generating capacity. For a plant in a town, one-third ($666.67) is paid to the town and two-thirds ($1,333.33) is paid to the county. For a plant in a village or city, two-thirds ($1,333.33) is paid to the village or city and one-third ($666.67) is paid to the county.

Pending Utility Tax Changes

Beginning in 2009, the Wisconsin Department of Revenue changed the methodology for computing the utility aid payment. For production plants that were in operation on January 1, 2004, and not subsequently rebuilt or "repowered," the payment is the greater of (a) the amount calculated under the current net book value based payment, or (b) the amount that would be paid under the $2,000 per MW payment plus incentive payments for plants that use a renewable energy source. Once a payment is made under alternative (b), all future payments will be calculated under alternative (b) (WDOR, 2007).

In addition, the provision under which the net book value in a municipality may not be less than the net book value as of December 31, 1989, minus the value of property removed since that date, the "value guarantee," was repealed effective with payments in 2009. Also, in 2009, the per capita limitation on payments increased over previous years for municipalities and counties (WDOR, 2007).

Taxes Paid by DEK

In lieu of property tax on its electrical generating plant and other facilities, DEK pays the State of Wisconsin a lump sum gross revenue tax. There is no direct correlation between the amount of taxes paid to the State of Wisconsin and the distribution of funds to local taxing jurisdictions. The allocation of tax revenue attributable to KPS to local taxing jurisdictions is not recorded.

Wisconsin state law requires that utility aid funds be paid to the municipalities and counties where utility property is located. The utility aid payments to the town of Carlton and Kewaunee County from the state could be attributed to the presence of KPS in these jurisdictions. Tables 2-15 through 2-19 present information about the town of Carlton's and Kewaunee County's total tax revenues and the utility aid payments to the town of Carlton and Kewaunee County from the State of Wisconsin (for all utility property located in the town of Carlton).

As presented in Table 2-16, the utility aid payments represent approximately 58.0 to 69.2 percent of the town of Carlton's total tax revenues. The vast majority of the payments are attributed to KPS. In 2004 and 2005, the town of Carlton collected no general property tax from its residents (DEK, 2008). Additionally, as shown in Table 2-17, the utility aid payments to Kewaunee County represent approximately 2.3 to 3.8 percent of Kewaunee County's total tax revenue.

1 **Table 2-15. Wisconsin Shared Revenue Utility Payments to the Town of Carlton for Utility**
2 **Property in the Town of Carlton, 2004 to 2008**

Item	2004	2005	2006	2007	2008
Utility Property: Net Book Value:					
Wisconsin Power & Light	48,276,451	44,689,234	6	6	6
Wisconsin Public Service	70,717,380	73,240,209	0	240,250	154,309
Dominion Energy Kewaunee	0	0	75,773,083	36,556,659	37,503,448
American Transmission	1,310,499	1,281,173	1,872,469	2,209,085	2,043,656
Total	120,304,330	119,210,616	77,643,558	39,006,000	39,701,413
Value Guarantee	1,093,714	0	17,062,594	55,702,152	55,006,739
Total Value	**121,398,044**	**119,210,616**	**94,708,152**	**94,708,152**	**94,708,152**
Payment:					
Payment Rate	0.003	0.003	0.003	0.003	0.003
Payment – Rate X Total Value	364,194.13	357,631.85	284,124.46	284,124.46	284,124.46
Population	1,032	1,037	1,031	1,034	1,061
Payment Limit – Per Capita	300.00	300.00	300.00	300.00	300.00
Maximum Payment	309,600.00	311,100.00	309,300.00	310,200.00	318,300.00
Value-Based payment	309,600.00	311,100.00	284,124.46	284,124.46	284,124.46
Spent Nuclear Fuel payment	50,000.00	50,000.00	50,000.00	50,000.00	50,000.00
Total Utility Payment	**359,600.00**	**361,100.00**	**334,124.46**	**334,124.46**	**334,124.46**

Source: DEK, 2008

Note: The shared revenue payment is funded from general state revenues; it is not paid by the utilities in the town. It is a payment for the presence of the utilities in the town and county.

Table 2-16. Wisconsin Shared Revenue Utility Payments to Kewaunee County for Utility Property in the Town of Carlton, 2004 to 2008

Item	2004	2005	2006	2007 (estimated)	2008 (estimated)
Utility Property: Net Book Value:					
Wisconsin Power & Light	48,276,451	44,689,234	6	6	6
Wisconsin Public Service	70,717,380	73,240,209	0	240,250	154,309
Dominion Energy Kewaunee	0	0	75,773,083	36,556,659	37,503,448
American Transmission	1,310,499	1,281,173	1,872,469	2,209,085	2,043,656
Total	120,304,330	119,210,616	77,643,558	39,006,000	39,701,413
Value Guarantee	1,093,714	0	17,062,594	55,702,152	55,006,739
Total Value	**121,398,044**	**119,210,616**	**94,708,152**	**94,708,152**	**94,708,152**
Payment:					
Payment Rate	0.006	0.006	0.006	0.006	0.006
Payment – Rate X Total Value	728,388.26	715,263.70	568,248.91	568,248.91	568,248.91
Population	20,648	21,082	12,157	21,198	21,358
Payment Limit – Per Capita	100.00	100.00	100.00	100.00	100.00
Maximum Payment	2,064,800.00	2,108,200.00	2,115,700.00	2,119,800.00	2,135,800.00
Value-Based payment	728,388.26	715,263.70	568,248.91	568,248.91	568,248.91
Spent Nuclear Fuel payment	50,000.00	50,000.00	50,000.00	50,000.00	50,000.00
Total Utility Payment	**778,388.26**	**765,263.70**	**618,248.91**	**618,248.91**	**618,248.91**

Source: DEK, 2008

Note: The shared revenue payment is funded from general state revenues; it is not paid by the utilities in the town. It is a payment for the presence of the utilities in the town and county.

Table 2-17. Wisconsin Shared Revenue Utility Payments to the Town of Carlton and Kewaunee County for Utility Property in the Town of Carlton, Projected for 2009

Item	Town of Carlton	Kewaunee County	Combined Total
Utility Property: Net Book Value:			
Wisconsin Public Service	148,137	148,137	148,137
American Transmission	1,961,910	1,961,910	1,961,910
Total	**2,110,047**	**2,110,047**	**2,110,047**
Payment Rate	0.003	0.006	
Value-Based Payment	6,330.14	12,660.28	18,990.42
Megawatt-Based Payment:			
$ per MW of Capacity	666.67	1,333.33	2,000.00
MW Capacity	535	535	535
Megawatt – Based Payment	356,666.67	713,333.32	1,070,000.00
Maximum Payment:			
Population	1,061	21,494	
Payment Limit – Per capita	425.00	125.00	
Maximum Payment	450,925.00	2,686,750.00	3,137,675.00
Utility Property – Value-Based Payment	6,330.14	12,660.28	18,990.42
Utility Property – Megawatt-Based Payment	356,666.67	713,333.32	1,070,000.00
Spent Nuclear Fuel Payment	50,000.00	50,000.00	50,000.00
Total Utility Aid Payment	**412,996.81**	**775,993.60**	**1,138,990.42**

Source: DEK, 2008

Note: The shared revenue payment is funded from general state revenues; it is not paid by the utilities in the town. It is a payment for the presence of the utilities in the town and county.

Table 2-18. Town of Carlton – Wisconsin Shared Revenue Utility Payments and Total Town Revenues, 2004 to 2008

Year	2004	2005	2006	2007	2008
Total Revenues	522,200	522,100	515,200	576,400	NA
Wisconsin Shared Revenue Utility Payments	359,600	361,100	334,124	334,124	334,124
Percent of Total Revenues	68.9	69.2	64.9	58.0	NA

Source: DEK, 2008; WDOR, 2009.

Table 2-19. Kewaunee County – Wisconsin Shared Revenue Utility Payments and Total Town Revenues, 2004 to 2008

Year	2004	2005	2006	2007	2008
Total Revenues	20,376,900	22,597,300	21,683,600	26,351,500	NA
Wisconsin Shared Revenue Utility Payments	778,388	765,264	618,249	618,249	618,249
Percent of Total Revenues	3.8	3.4	2.9	2.3	NA

Source: DEK, 2008; WDOR, 2009.

2.2.9 Historic and Archaeological Resources

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

2.2.9.1 *Cultural Background*

KPS is located on the west central shore of Lake Michigan in Kewaunee County, Wisconsin. The landscape of Wisconsin is dominated by glacial and postglacial geological deposits. The Pleistocene Age glaciers reached their greatest extent 14,000 to 16,000 years ago, and the last glacial advance (the Two Rivers, or Valderan) dates to about 12,400 years ago. Approximately 12,000 years ago the glaciers retreated and exposed most of the current area of Wisconsin.

The region around the KPS site contains prehistoric and historic Native American and Euro-American cultural resources. Twenty properties in Manitowoc County and eleven properties in Kewaunee County are listed in the National Register of Historic Places (NRHP). None of these properties fall within a 6-mile radius of KPS (NPS 2009a, 2009b).

<u>Prehistoric Periods</u>

The climate during the Paleo-Indian period was much cooler and wetter than today. The distribution of Paleo-Indian artifacts in Wisconsin correlates with the last stages of glacial activity and fluctuating lake levels. Paleo-Indians exploited postglacial environments and organized in small mobile hunting groups and appear to have been more numerous in southern Wisconsin than in the north where glacial conditions persisted longer (R. Mason, 1997). Paleo-Indian populations were highly mobile. Most sites would have been short-term occupations (campsites). Paleo-Indian peoples hunted large, now extinct game, such as mastodon, mammoth, and caribou that lived on the lush vegetation that colonized postglacial soils (R. Mason, 1997). By the late Paleo-Indian period, the levels of the Great Lakes may have been significantly lower than present. Paleo-Indian sites of this period could be submerged several hundred feet below the current surface (R. Mason, 1997). Later Paleo-Indian sites show evidence of woodworking tools reflecting the increasing forestation of the previously glaciated land. Late Paleo-Indian sites are widespread and continue to reflect small mobile populations. Instead of large game, species hunted during the later period included deer, caribou, bison, turtle, beaver, and other small mammals (R. Mason, 1997).

During the Archaic Period, subsistence hunting and gathering underwent changes to adapt to resource availability. As glaciers retreated northward and larger animals disappeared from the region, humans adapted to modern plants and smaller game animals. Between 10,000 and 7,500 years ago, Archaic populations consisting of small groups of hunters and gatherers living in caves and rock shelters along rivers, around lakes and wetlands, replaced the older Paleo-Indian culture.

Archaic peoples may have been direct descendants of Paleo-Indians or may represent a migration of people from the south. These hunter-gatherers subsisted on fish, wild plants, nuts, acorns, and modern game animals such as elk and deer. Archaeological evidence indicates that settlement was sparse with small, mobile groups relying on diverse hunting and gathering strategies. At least one extensive Archaic local Wisconsin quarry site is known; however, stone tool materials from neighboring Illinois are also found at Archaic sites (Stoltman, 1997). By about 4,000 to 6,000 B.C., Archaic sites were more widely distributed throughout Wisconsin. Drier, warmer conditions with a rise in herbaceous species characterized this period. Archaic tool assemblages expanded to include fishing gear, ground stone plant processing tools, axes, and copper tools (Stoltman, 1997). Copper artifacts (such as harpoons, axes, adzes, chisels, knives, and drills) are widely found in eastern Wisconsin and in Manitowoc County (Stoltman, 1997).

The Red Ochre Complex, an elaborate ceremonial burial complex distributed widely across the Midwest and the Great Lakes areas, serves to mark the transition between the Archaic and the Woodland periods. Information about the complex is largely limited to burial sites, therefore the connections to the Archaic and Woodland period remains uncertain (Stevenson et al., 1997). Use of copper for ornaments increased; evidence of fishing and wild rice harvesting exists. Toward the end of this period, mounds and Woodland pottery are found at these sites.

Approximately 2,500 years ago, the presence of pottery marks the beginning of the Woodland period in Wisconsin. In Wisconsin, the Archaic culture persists throughout the early Woodland period. The Woodland period is also defined by the introduction of horticulture to augment subsistence hunting and gathering. In the Great Lakes region, evidence of domestication of local plants appears, as well as the introduction of exotic species. Squash is the earliest known agricultural crop (R. Mason, 1981). A reliance on agriculture led to the establishment of more permanent settlements during this period. Use of bows and arrows and pottery and construction of effigy mounds all began during of the Woodland period.

The middle Woodland occupation (roughly 1,500 to 2,200 years ago) has distinctive characteristics that include construction of conical burial mounds and evidence of widespread interaction throughout central and eastern North America. The characteristics of this network, called the Hopewell Interaction Sphere, include elaborate ceremonialism, extensive trade of exotic manufactured items and raw materials, and large mound construction.

Late Woodland sites (occupied 700 to 1,600 years ago) show a decline in Hopewellian ceremonialism but continue the tradition of mound construction, primarily in the form of animal and human shapes, in the southern half of Wisconsin. Burials are associated with some, but not all, mounds (Stevenson et al., 1997). Cultivation of corn became increasingly prominent, and villages became more permanent (Stevenson et al., 1997). Late Woodland populations continued to increase and archaeological evidence from settlements shows a greater dependence on agriculture (R. Mason, 1981).

An exception to the typical Woodland occupation is the intrusion of a few Middle Mississippian sites in Wisconsin about 1,000 years ago. These sites consist of permanent towns and ceremonial sites in Iowa, Minnesota, Missouri, and Illinois, particularly the site of Cahokia. Hierarchical structure, extensive trade networks, a focus on larger centralized villages, and intensive agriculture characterized these societies. Several sites in south-central Wisconsin represent a northern extension of Mississippian culture. Aztalan, a palisade village containing four platform mounds and a series of dwellings, is the best known of these sites in Wisconsin (Goldstein and Freeman, 1997). The relationship of such sites with the surrounding Woodland sites is unclear, and the influence of the Mississippian culture on Woodland culture in Wisconsin appears to have been transitory (Green, 1997).

The transition from Woodland to later cultures is poorly understood. About 1,000 years ago, overlapping the late Woodland and Mississippian period, sites referred to as the Oneota culture, recognized by distinctive pottery styles, appear in the archaeological record. Permanent villages, some fortified, were established; subsistence was based on corn, beans, squash, aquatic resources, and a variety of wild plants and game. Hunting and gathering, probably on a seasonal basis, supplemented the basic agricultural economy (Overstreet, 1997). Following the collapse of Mississippian influence, Oneota communities returned to the abandoned areas, and by about 700 years ago, they were the predominant culture in most of southern Wisconsin (Overstreet, 1997).

During the late Oneota culture, villages were concentrated in several areas, such as the Fox River valley in eastern Wisconsin. Subsistence patterns remained relatively constant throughout Oneota history until the arrival of Europeans (circa 1600 to 1650). Oneota settlements in eastern Wisconsin were abandoned by the time of French contact. Causes for this rapid depopulation could include disease, warfare, or out-migration (Overstreet, 1997). The Ho-Chunk (formerly Winnebago) Indians are commonly believed to be descendants of Oneota populations, but the archaeological evidence is inconclusive.

Historic Period

At the time of the first European contact (1600 to 1650), eastern Wisconsin was occupied by several American Indian groups (Ho-Chunk (Winnebago), Potawatomi, Menominee, and Chippewa). American Indian communities in the east were forced west due to ecological shifts (Cronon, 1983), societal collapse, and disease. Encroaching European settlement created waves of population shifts as these tribal groups pushed north and westward (Bragdon, 2001). Wisconsin tribal groups, responding to these pressures, shifted their areas of use to around Wisconsin, Michigan, and other areas of the Midwest.

The first European known to have visited the area was Jean Nicolet, a French explorer, who reached the Green Bay region in 1634 (AEC, 1972). Green Bay was subsequently established as the first French fur trading settlement, and a number of other trading posts were established throughout the late 1600s and 1700s. Father Marquette said his First Mass on All Saints Day, November 1, 1674, in Kewaunee County (Kewaunee County, 2009). French influence continued until the end of the French and Indian War. As the French withdrew from the western Great Lakes, items of British manufacture replaced French trade goods in Native American communities (C. Mason, 1997). Throughout the historic period, American Indian economies were supplanted or supplemented by an emphasis on hunting for the fur trade. European trade goods increasingly replaced traditional tools and utensils.

The United States acquired ownership of the northern Midwest at the close of the American Revolution, but de facto control remained with the British until the War of 1812 (AEC, 1972). Wisconsin was sparsely settled by Europeans prior to becoming a U.S. territory. Lead mining drew the first wave of Euro-American immigrants to southwestern Wisconsin in the 1820s. In 1834, Wisconsin was surveyed and opened to Euro-American settlers. The fur trade, which had been a lucrative enterprise for the French, declined rapidly in the 1830s. During this time, the region was heavily forested. Settlement began in earnest when the lumber industry was started and the streams were dammed for water power. The vast forests of pine and larchwood led to shipbuilding. In 1848, Wisconsin became a State. Toward the end of the 19th century, farm settlement in the region followed the lumber industry (AEC, 1972).

The Potawatomi tribe lived in the area that is presently Door, Kewaunee, and Manitowoc counties for hundreds of years before Europeans began settling in Wisconsin. The Potawatomi are Algonquin speakers and are Neshnabek, a Potawatomi word that refers to “original people” (Forest County Potawatomi, 2009). A major village, Ma-kah-da-we-kah-mich-(cock), also known as Black Earth, was located 3.5 miles west of the plant site, on what is now the East Twin River (DEK, 2008). It was there that members of the tribe would plant crops of corn, beans, pumpkins, and squash. Each spring, the Potawatomi would establish a camp in Sandy Bay Creek, located on the northern edge of the KPS property (DEK, 2008). It was at this camp where the Potawatomi would fish during the annual spawning runs, primarily for suckers (Bach, 1933). This area was used for hunting and gathering purposes until 1862, when the tribe was forced from their land by the U.S. government for non-payment of taxes (AVD, 2007). The burial ground for the tribe was also located here. (KCHS, 2002)

Kewaunee County was created in 1850s from Manitowoc County, and was divided into three towns, Sandy Bay, Wolf River, and Kewaunee (Kewaunee County undated). The southernmost town, Sandy Bay, was named for the little indenture in the shore of Lake Michigan. The town originally consisted of the present-day limits of Carlton and Franklin (Kewaunee County undated). During the mid to late 1800s, Sandy Bay was a thriving village, with a productive sawmill (using a dam erected on Fischer Creek), a general store, cheese factory, post office, and hotel (KCHS, 2002). The large pier at Sandy Bay served as the center for shipping in the area, where lumber, bark (for tanning), and farmers' crops were shipped to Milwaukee and Chicago. St. John's Lutheran Church and cemetery and the Sandy Bay School were also part of the Sandy Bay Community. St. John's was founded in 1869 and disbanded in 1947. The church was located on Route 42, but no longer exists. The cemetery is a Wisconsin Historical Resource and is currently owned and maintained by the Town of Carlton. Sandy Bay School was located across Route 42 from the church, and was in use until the 1960s. The schoolhouse was torn down in the 1960s to make way for the construction of KPS. By 1891, the settlement had all but disappeared. The only remnants from the community are the cemetery and a number of rotting pilings from the pier, which are visible from the shore by the mouth of Sandy Bay Creek (DEK 2008).

2.2.9.2 *Historic and Archaeological Resources at the Kewaunee Power Station Site*

Most of the land at KPS was used for agricultural purposes. During the 1960s, land was acquired from 12 families to build KPS. The only remnants onsite from the farms are stretches of old barbed wire scattered around the site, part of the back end of an old threshing machine, a farm bridge north of the plant, and a bridge of unknown origin southwest of the plant (DEK, 2008). As noted earlier, the Sandy Bay school house was also located onsite, but was torn down due to the construction of KPS.

During the early to mid-1900s, Joe Krofta owned land approximately one-quarter mile south of the KPS plant. He planted a grove of trees in the area, and in 1931, built a small cabin. When KPS went into operation, the previous owners established the Kewaunee School Forest, which was used as an outdoor classroom for the county's schools (DEK, 2008). During the 1980s, the lake level rose to historic high levels resulting in severe erosion. The cabin was about to collapse into Lake Michigan, and the plant's owner at the time salvaged the front facade of the cabin and moved it to its current location. In 1987, the forest was renamed Joe Krofta Memorial Forest (DEK, 2008).

In 2007, DEK contracted with AVD Archaeological Services, Inc. (AVD) to conduct a Phase 1 Archaeological Survey and literature review for the KPS site. Land disturbed during construction of KPS was not surveyed. A majority of the remaining land is leased agricultural cropland. A search of the Wisconsin records found only 141 historic and archaeological sites in Kewaunee County compared with more than 500 sites each for bordering Manitowoc, Brown, and Door counties (AVD, 2007). In addition, there are no eligible or listed NRHP properties located on the KPS site.

2.3 RELATED FEDERAL AND STATE ACTIVITIES

The NRC staff reviewed the possibility that activities of other Federal agencies might impact the renewal of the operating license for the KPS. Any such activity could result in cumulative environmental impacts and the possible need for a Federal agency to become a cooperating agency in the preparation of the KPS SEIS.

The NRC has determined that there are no Federal projects that would make it desirable for another Federal agency to become a cooperating agency in the preparation of the SEIS. There are no federal lands, facilities, national wildlife refuges, forests, and parks within 50 miles of the KPS. However, Two Creeks Buried Forest State Natural Area, a unit of the Ice Age National Scientific Reserve, is located approximately one mile south of the KPS property. The Reserve is a separate affiliated area of the National Park Service.

NRC is required under Section 102(2)(c) of the National Environmental Policy Act of 1969 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 has consulted with the USFWS, Advisory Council on Historic Preservation, Wisconsin Historical Society, Wisconsin Coastal Management Program, WDNR, Menominee Indian Tribe of Wisconsin, and 23 other Native American Tribes listed in Section 1.8 and Appendix E. Federal Agency consultation correspondence and comments on the SEIS are presented in Appendix D.

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3.0 ENVIRONMENTAL IMPACTS OF REFURBISHMENT

Facility owners or operators may need to undertake or, for economic or safety reasons, may choose to perform refurbishment activities in anticipation of license renewal or during the license renewal term. The major refurbishment class of activities characterized in the Generic Environmental Impact Statement (GEIS) (NRC 1996, 1999) is intended to encompass actions which typically take place only once in the life of a nuclear plant, if at all. Examples of these activities include, but are not limited to, replacement of boiling water reactor recirculation piping and pressurized water reactor steam generators. As noted in the GEIS, refurbishment activities could result in environmental impacts beyond those that occur during normal plant operations. Refurbishment activities may affect a variety of environmental issues as listed in Table 3-1.

Table 3-1. Issues Related to Refurbishment. *Kewaunee Power Station (KPS) does not have any plans for refurbishment activities.*

Issues	Category
Surface Water Quality, Hydrology, and Use	
Impacts of refurbishment on surface water quality	1
Impacts of refurbishment on surface water use	1
Aquatic Ecology	
Refurbishment	1
Terrestrial Resources	
Refurbishment impacts	2
Threatened or Endangered Species	
Threatened or endangered species	2
Ground Water Use and Quality	
Impacts of refurbishment on ground water use and quality	1
Air Quality	
Air quality during refurbishment (nonattainment and maintenance areas)	2
Land Use	
Onsite land use	1
Human Health	
Radiation exposures to the public during refurbishment	1
Occupational radiation exposures during refurbishment	1
Socioeconomics	
Public services: public safety, social services, and tourism and recreation	1
Aesthetic impacts (refurbishment)	1
Housing impacts	2
Public services: education (refurbishment)	2
Public services: public utilities	2
Public services: transportation	2
Offsite land use (refurbishment)	2
Historic and Archaeological resources	2
Environmental Justice	
Environmental justice	Uncategorized

Dominium Energy Kewaunee, Inc. (DEK) submitted to the U.S. Nuclear Regulatory Commission (NRC) an environmental report (ER) as part of its license renewal application for the Kewaunee Power Station (KPS) in August 2008. DEK addressed refurbishment activities in the ER (DEK, 2008a), which is Attachment E of the license renewal application (DEK, 2008b). DEK states in the ER that the refurbishing assessment for KPS was done according to the regulations in

10 CFR Parts 51 and 54 and complementary information in the GEIS, NUREG-1437 (NRC 1996, 1999).

The requirements for the assessment of refurbishing in a license renewal of operating nuclear power plants include the preparation of an integrated plant assessment (IPA) under 10 CFR 54.21. The IPA must identify and list systems, structures, and components subject to an aging management review. Items that are subject to aging and might require refurbishment include, for example, the reactor vessel, piping, supports, and pump casings, as well as those that are not subject to periodic replacement.

In the case of KPS, the IPA did not identify the need for major refurbishment or replacement actions to maintain the functionality of important systems, structures, and components during the KPS license renewal period. Also, the IPA did not identify the need for modifications to any of the KPS facilities associated with the license renewal.

The NRC staff reviewed the information presented in the KPS ER, support documentation, and gathered during the site audits and interviews. During the review, the NRC staff did not identify any new and significant information that would affect the conclusion presented in the ER. Therefore, based on the review, the NRC staff concluded that no refurbishing activities are necessary in anticipation of the license renewal or during the license renewal term. The NRC staff does not expect that the environmental impacts caused by KPS during the renewal term will be beyond those that occur during the normal plant operations.

3.1 REFERENCES

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

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Dominion Energy Kewaunee, Inc. (DEK). 2008a: "Applicant's Environmental Report – Operating License Renewal Stage. Appendix E of Application for Renewed Operating License, Kewaunee Power Station." Docket No. 50-305. August 2008. Agencywide Documents Access and Management System (ADAMS) Accession No. ML082341039.

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4.0 ENVIRONMENTAL IMPACTS OF OPERATION

This chapter addresses potential environmental impacts related to the period of extended operation of Kewaunee Power Station (KPS). These impacts are grouped and presented according to resource. Generic issues (Category 1) rely on the analysis provided in the generic environmental impact statement (GEIS), prepared by the U.S Nuclear Regulatory Commission (NRC 1996, 1999) and are discussed briefly. Site-specific issues (Category 2) have been analyzed for KPS and assigned a significance level of SMALL, MODERATE, or LARGE, accordingly. Some remaining issues are not applicable to KPS because of site characteristics or plant features. Section 1.4 of this report explains the criteria for Category 1 and Category 2 issues, and defines the impact designations of SMALL, MODERATE, and LARGE.

4.1 LAND USE

Table 4.1 lists the Category 1 issues (from 10 CFR Part 51, Subpart A, Appendix B, Table B–1) which are applicable to onsite land use and power line right of way (ROW) impacts during the renewal term. As stated in the GEIS, the impacts associated with these Category 1 issues were determined to be SMALL, and plant-specific mitigation measures would not be sufficiently beneficial to be warranted.

NRC reviewed and evaluated the applicant’s environmental report (ER), Dominion Energy Kewaunee, Inc. (DEK, 2008), scoping comments, other available information, and visited the KPS in search of new and significant information that would change the conclusions presented in the GEIS. No new and significant information was identified during this review and evaluation. Therefore, it is expected that there would be no impacts related to these Category 1 issues during the renewal term beyond those discussed in the GEIS.

Table 4-1. Land Use Issues. *Section 2.2.1 of this draft supplemental environmental impact statement (SEIS) describes the land use around KPS.*

Issues	GEIS Section	Category
Onsite land use	4.5.3	1
Power line ROW	4.5.3	1

4.2 AIR QUALITY

The air quality issue applicable to KPS is listed in Table 4-2. No Category 2 issues have been identified for air quality. The NRC staff did not identify any new and significant information during the review of the applicant’s ER (DEK, 2008), the site audit, or during the scoping process. No major facility construction or refurbishments are planned to occur during the license renewal period. Therefore, there are no impacts related to this issue beyond those discussed in the GEIS. For these issues, the GEIS concluded that the impacts are SMALL.

Table 4-2. Air Quality Issue. *Section 2.2.2 of this document provides a description of air quality at Kewaunee Power Station.*

Issue	GEIS Section	Category
Air quality effects of transmission lines	4.5.2	1

4.3 GENERIC GROUNDWATER ISSUES

There were no Category 1 groundwater impacts identified for the KPS license renewal term and no Category 2 issues were found applicable to the continued operation of the facility. KPS withdraws less than 100 gallons per minute of groundwater, and its once-through cooling system does not utilize cooling towers or cooling ponds, therefore, none of the NRC specified Category 2 issues for groundwater issues are applicable to KPS.

4.4 GENERIC SURFACE WATER ISSUES

The following sections discuss the surface water quality issues applicable to KPS. The issues are also listed in Table 4-3. NRC did not identify any new and significant information during the environmental review for the KPS license renewal, the site visit, or the scoping process. Therefore, no impacts are related to these issues beyond those discussed in the GEIS. For these issues, the GEIS concludes that the impacts are SMALL and additional site-specific mitigation measures are not likely to be warranted.

Table 4-3. Category 1 Surface Water Issues. *Applicable to the operation of the KPS cooling system during the renewal term.*

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections
Surface Water Quality, Hydrology, and Use	
Altered current patterns at intake and discharge structures	4.2.1.2.1
Temperature effects on sediment transport capacity	4.2.1.2.3
Scouring caused by discharged cooling water	4.2.1.2.3
Discharge of chlorine or other biocides	4.2.1.2.4
Discharge of sanitary wastes and minor chemical spills	4.2.1.2.4
Discharge of other metals in wastewater	4.2.1.2.4
Water use conflicts – plants with once-through cooling systems	4.2.1.3

4.4.1 Water Use Conflicts

There were no Category 2 surface water issues identified for the KPS license renewal term.

4.5 AQUATIC RESOURCES

The Category 1 and Category 2 issues related to aquatic resources applicable to KPS are discussed below and listed in Table 4-4.

Table 4-4. Aquatic Resources Issues. *Section 2.1.6 of this document describes KPS's cooling water system and Section 2.2.5 of this document describes the aquatic resources.*

Issues	GEIS Sections	Category
For All Plants		
Accumulation of contaminants in sediments or biota	4.2.1.2.4	1
Entrainment of phytoplankton and zooplankton	4.2.2.1.1	1
Cold shock	4.2.2.1.5	1
Thermal plume barrier to migrating fish	4.2.2.1.6	1
Distribution of aquatic organisms	4.2.2.1.6	1
Premature emergence of aquatic insects	4.2.2.1.7	1
Gas supersaturation (gas bubble disease)	4.2.2.1.8	1
Low dissolved oxygen in the discharge	4.2.2.1.9	1
Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses	4.2.2.1.10	1
Stimulation of nuisance organisms	4.2.2.1.11	1
For Plants with Once-Through Cooling Pond Heat Dissipation Systems		
Entrainment of fish and shellfish in early life stages	4.1.2	2
Impingement of fish and shellfish	4.1.3	2
Heat shock	4.1.4	2

4.5.1 Generic Aquatic Ecology Issues

The NRC staff did not identify any new or significant information during the review of the applicant's ER (DEK, 2008), the staff's site audit, the scoping process, or the evaluation of other available information. Therefore, the NRC staff found no impacts related to the generic, Category 1 issues beyond those discussed in the GEIS. For these issues, the GEIS concluded that the impacts are SMALL, and additional site-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

4.5.2 Entrainment of Fish and Shellfish in Early Life Stages

Entrainment occurs when aquatic organisms (usually eggs, larvae, and other small organisms) are drawn into the cooling water system and are subjected to thermal, physical, and chemical stress. For nuclear power plants with once-through cooling systems, the NRC considers the entrainment of fish and shellfish in early life stages into cooling water systems to be a Category 2 issue, which requires a site-specific assessment during the license renewal application review process. KPS operates a once-through heat dissipation system that withdraws water from and discharges it back to Lake Michigan. A detailed description of the KPS cooling system is presented in Section 2.1.6 of this draft SEIS. Flow rates and discharge volumes are given in Section 4.2.5 of this draft SEIS.

For the site-specific assessment of the KPS cooling system, the NRC staff reviewed the applicant's ER (DEK, 2008) and related documents, including the Clean Water Act (CWA) Section 316(a) Demonstration (NES, 1976), CWA Section 316(b) Demonstration (NES, 1976), the KPS Impingement Mortality and Entrainment Characterization Report and the Kewaunee

Power Station WPDES WI-0001571-07, “Cooling Water Intake Structure Information Submittal” (Dominion, 2008), and visited the KPS site. The NRC staff also reviewed the applicant’s State of Wisconsin WPDES Permit No. WI-0001571-07-0, issued on July 18, 2005, and in force until June 30, 2010 (WDNR 2005; 2005a).

Section 316(b) of the CWA requires that the location, design, construction, and capacity of the cooling water intake structures reflect the best technology available (BTA) in order to minimize adverse environmental impacts, specifically impingement and entrainment, to protect fish, shellfish, and other forms of aquatic life (33 USC 1326). Phase II of Section 316(b)’s implementing regulations applies to large existing electric generating plants, such as KPS, that withdraw more than 50 million gallons of water per day (gpd; 6.7 million cubic feet per day (cfd)). The Environmental Protection Agency (EPA) implemented Phase II on July 9, 2004 (69 FR 41575). The new Phase II performance standards were designed to significantly reduce impingement mortality due to water withdrawals associated with cooling water intake structures used for power production and were to be implemented through the NPDES permitting process. The rule would require licensees to demonstrate compliance with Phase II performance standards upon renewal of their NPDES permit.

However, the EPA suspended the Phase II rule on July 9, 2007 (72 FR 37107), in response to the Second Circuit Court of Appeals decision in Riverkeeper, Inc. v. EPA, 475 F.3d 83 (2d Cir. 2009). As a result, the EPA directed NPDES permit writers for Phase II facilities to develop technology-based permit conditions on a case-by-case basis using all reasonably available and relevant data and best professional judgment (BPJ) regarding the BTA. Some of the changes that the licensees may be required to implement by the EPA could include altering their intake structure, redesigning the cooling system, modifying station operation, or taking other mitigative measures.

Before suspension of the Phase II rule, DEK submitted a Proposal for Information Collection (PIC) to the Wisconsin Department of Natural Resources (WDNR) in October 2005 to demonstrate KPS’s compliance with the Phase II requirements. The PIC included options for achieving compliance with the rule and proposals for biological studies. The WDNR provided comments modifying the PIC, and DEK began collecting data in accordance with the modified PIC in March 2006. As a result of the July 9, 2007, suspension of the Phase II rule, KPS was no longer required to comply with the modified PIC; however, the WDNR modified the requirements contained in the KPS WPDES permit so that the one-year impingement and entrainment field study detailed in the modified PIC remained a requirement (WDNR, 2007). On January 4, 2008, DEK submitted a letter to the WDNR (Dominion, 2008) containing the one-year impingement and entrainment field study from March 2006 through February 2007 prepared by EA Engineering Science and Technology, Inc. (EAE, 2007).

Prior to this study, as a condition of the original WPDES permit for KPS, Nalco Environmental Sciences (NES) performed a one-year entrainment and impingement study (NES 1976) for Wisconsin Public Service Corporation (WPSC) from April 1, 1975, through March 31, 1976. The results of this study were summarized in a 316(b) Demonstration. At that time, WDNR did not require any additional modifications of the cooling system or mitigation for compliance with the KPS WPDES permit as a result of the study.

4.5.2.1 *Nalco Environmental Sciences, 1975-1976*

The original KPS WPDES Permit required a one-year study on the environmental impacts of the cooling water intake structure, which NES (1976) conducted from April 1, 1975 through March 31, 1976; the results were summarized in a 316(b) Demonstration. NES gathered entrainment samples from the forebay once per week from April through August 1975 and twice per month from September 1975 through March 1976. Two zero-mesh (335 μm) plankton nets with digital flow monitors were used to gather entrainment samples three times (12:00 a.m., 8 a.m., and 4 p.m.) during each 24-hour period of sampling. Two replicates were collected for each net at each time period. Collected fish eggs, larvae, and debris were then sorted, counted, and recorded. Larvae were measured to the nearest 0.1 mm (0.004 in.) and identified by species, as possible. Some juveniles were collected, though NES combined juveniles and larvae for purposes of analysis. Intake and discharge temperatures, water flow, and turbidity were also collected at the time of each sample. Impingement sampling methods for this study are discussed in Section 4.5.3 (NES, 1976).

Alewife was the most prevalent species of eggs collected from entrainment sampling, followed by rainbow smelt and white or longnose sucker (the study groups these together by family, Catostomidae) (See Table 4-5). Alewife eggs were collected in June, July, and August, while catostomid and rainbow smelt eggs were only collected in April and May. A total of 3,224 fish eggs were collected during the study with a peak collection of 1777 eggs in July. NES (1976) estimated that a total of 52.6 million eggs were entrained through the KPS cooling system during the study year with peak numbers in July and August and a combined estimated total of 43.9 million eggs (NES, 1976).

Table 4-5. Entrainment by Species, April 1975 through March 1976

Common Name	Taxa	Total Number Collected	Percentage of Total
Eggs			
Alewife	*Alosa pseudoharengus*	2208	68.5
Rainbow smelt	*Osmerus mordax*	976	30.3
White or longnose sucker	Catostomidae spp.	26	0.8
Unidentified taxa		14	0.4
Total		**3224**	**100**
Larvae and Juveniles			
Rainbow smelt	*Osmerus mordax*	411	89.7
Alewife	*Alosa pseudoharengus*	20	4.4
Carp	*Cyprinus carpio*	12	2.6
Burbot	*Lota lota*	6	1.3
Whitefish	*Coregonidae* spp.	5	1.1
Slimy sculpin	*Cottus cognatus*	3	0.7
White or longnose sucker	Catostomidae spp.	1	0.2
Total		**458**	**100**

Source: adapted from NES 1976

Rainbow smelt was the most prevalent species of larvae and juveniles collected from entrainment sampling, and accounted for almost 90 percent of the total collected. Alewife and catostomid larvae and juveniles were also identified in the samples. Additionally, carp (*Cyprinus carpio*), burbot (*Lota lota*), whitefish (*Coregonidae* spp.), and slimy sculpin (*Cottus cognatus*) were present, none of which were identified in egg samples. NES (1976) estimated that KPS entrained a total of 13.6 million larvae and juveniles through the KPS cooling system during the study year with the majority entrained during summer months (6.4 million), followed by autumn (5.2 million), and then spring (2.0 million).

When all life stages are considered (eggs, larvae, and juveniles), alewife accounted for 61 percent and rainbow smelt accounted for 38 percent of the total entrained. The study estimates that the number of alewife and rainbow smelt eggs lost to entrainment over the study year would be comparable to the potential production of 4,286 alewife females and 200 smelt females (NES 1976). The estimated loss of larval and juvenile individuals for each species would be equivalent to the larval production of 105,400 alewife, 4,630 smelt, 323 slimy sculpin, 1 burbot, 10 whitefish, and 1 Catostomid female (NES, 1976). The loss of carp juveniles was noted to be small compared to the large number of larvae produced by an average carp female, though no equivalent was provided. Froese and Pauly (2009) estimate that a 19-inch (47-cm) carp female can produce 300,000 eggs; therefore the loss of carp larvae and juveniles due to entrainment is equivalent to the egg production of less than one adult female. NES (1976) considered these losses to be small for all species.

The NES (1976) study shows that the alewife population is adversely affected the most from entrainment. As discussed in Section 2.2.5 of this draft SEIS, the alewife is invasive to the Great Lakes and was first introduced to Lake Michigan in 1949. From the mid-1950s through 1960s, the rapid decrease in abundance of certain native fish that the alewife preyed on led to large-scale die-offs of alewives in the 1950s and 1960s (Crawford, 2001). In response, Wisconsin Department of Natural Resources (WDNR) began a salmonid stocking program in 1965 to control the overabundant alewife population (Madenjian et al., 2005). Though the number of entrained alewife seems high, this study took place within the time period that the previously overabundant population of alewife was showing decline due to salmonid predation. Therefore, the effect of entrainment on the total population of alewife may not have been significant. The National Marine Fisheries Service does not have annual commercial landing statistics available for 1976, the year that the impingement and entrainment study took place (NOAA, 2007). The closest years available for the state of Wisconsin are 1961 (2,113,200 lbs or 958,531 kg) and 1985 (23,366,000 lbs or 10,598,639 kg) (NOAA, 2007). Because the decline of alewife in Lake Michigan occurred between the 1960s and 1980s, NRC will assume the average between 1961 and 1985 as an estimate for 1976, which is 12,739,600 lbs (5,778,585 kg). Adult alewives might typically weigh 8 to 9 ounces (227 to 255 g) on average (Bigelow and Schroeder, 1953). Therefore, the 1976 estimated landings would account for an estimated 23,980,423 adult alewives. In comparison, the equivalent loss of production of 109,686 females from entrainment of eggs, larvae, and juveniles is small.

4.5.2.2 *EA Engineering, Science, and Technology, Inc., 2006–2007*

After the EPA suspended the CWA 316(b) Phase II rule (discussed above), the WDNR modified the requirements of the KPS WPDES permit to include a one-year impingement and entrainment study. EAE performed this study from March 2006 through February 2007. EAE gathered entrainment samples from the discharge canal once per week from March through August 2006, once in September 2006 due to a planned plant outage, and twice per month from October 2006 through February 2007. One zero-mesh (335 μm) plankton net equipped with a mechanical flow meter was used to gather entrainment samples four times (generally at 4:00 a.m., 10 a.m., 4 p.m., and 10 p.m.) during each 24-hour period of sampling. Two replicates were collected for each sampling time. Collected fish eggs, larvae, and debris were then sorted, counted, and recorded. Unlike the NES (1976) study, EAE (2007) based their findings on density of entrainment rather than total number of organisms of each taxon collected. Additionally, eggs were only counted and identified as fertilized or unfertilized, but were not identified by species. Up to 20 larvae of each taxon and life-stage were measured to the nearest 0.004 inches (0.1mm). Impingement sampling methods for this study are discussed in Section 4.5.3 (EAE, 2007).

The amphipod crustacean genus *Gammarus* accounted for the vast majority (93 percent) of entrained organisms based on annual density. Burbot, alewife, and common carp were the most abundant fish species; however, these three species collectively accounted for only 1.08 percent of the estimated total number of organisms entrained. A total of 15 fish species were identified in the entrainment samples. Density data as well as station cooling water flow data were used to estimate the total number of organisms entrained during the study year for each species (see Table 4-6) (EAE, 2007).

Table 4-6. Estimated Entrainment by Species, March 2006 through February 2007

Common Name	Taxa	Total Estimated Number (x 10^6)	Percentage of Total
Eggs			
Unidentified taxa		25.28	1.63
Total		**25.28**	**1.63**
Larvae			
Burbot	*Lota lota*	7.82	0.50
Carp	*Cyprinus carpio*	5.40	0.35
Alewife	*Alosa pseudoharengus*	3.52	0.23
Carp and minnow family	Cyprinidae spp.	2.80	0.18
Clupeid family	Clupeidae spp.	1.96	0.13
Rainbow smelt	*Osmerus mordax*	1.25	0.08
Whitefish family	Coregoninae spp.	0.80	0.05
Sickleback family	Gasterosteidae spp.	0.66	0.04
Perch family	Percidae spp.	0.55	0.03
Unidentified taxa		0.39	0.02
Round goby	*Neogobius melanostomus*	0.14	0.01
Sucker spp.	Catostomus spp.	0.12	<0.01
Ninespine Stickleback	*Pungitius pungitius*	0.07	<0.01
White sucker	*Catostomus commersoni*	0.05	<0.01
Deepwater sculpin	*Myoxocephalus thompsoni*	0.04	<0.01
Juveniles			

Rainbow smelt	*Osmerus mordax*	3.22	0.21
Alewife	*Alosa pseudoharengus*	0.29	0.02
Ninespine Stickleback	*Pungitius pungitius*	0.20	0.01
Deepwater sculpin	*Myoxocephalus thompsoni*	0.07	<0.01
Total		**29.35**	**1.88**
Invertebrates			
Scud spp.	Gammarus spp.	1494.22	96.23
Opossum shrimp	*Mysis relicta*	3.22	0.21
Bloody-red mysid	*Hemimysis anomala*	0.74	0.05
Total		**1498.18**	**96.49**

Source: adapted from EAE, 2007

Total estimated numbers entrained for each species of fish were generally small when compared to the potential production of reproducing females. Female burbot can produce between 500,000 and 1,500,000 eggs (USFWS, 2003). Using the average egg production of 1,000,000 eggs per female, the total estimated number of entrained burbot larvae is equivalent to the egg production of about eight females. Female carp can produce up to 300,000 eggs (Froese and Pauly, 2009). Therefore, the total estimated number of entrained carp larvae is equivalent to the egg production of 18 females. Female alewife can produce 60,000 to 100,000 eggs (Fay et al., 1983). Using the average egg production of 80,000 eggs per female, the total estimated number of entrained alewife larvae is equivalent to the production of 44 females.

Because not all eggs are spawned, not all spawned eggs are fertilized, few fertilized eggs survive to become larvae in the wild, and mortality rates can be high within the larval stages, the estimated equivalent number of reproducing females for each species will likely be greater than the numbers calculated above. Though the specific mortality rate of alewives from egg to larval stage is unavailable, Edsall in 1970, (Fay et al., 1983) reported an alewife egg hatching rate of 38 percent at an optimal incubation temperature of 64 °F (18 °C) in Lake Michigan. Using this hatching rate and the average production of 80,000 eggs per female (Fay et al., 1983), the total estimated number of entrained alewife larvae is equivalent to the production of 116 females. The NRC staff calculated the percent of the Lake Michigan alewife population that 116 females represents by using a 2007 estimate (Madenjian et al., 2008) of a lake-wide biomass of alewives (11,674 metric tons; 25,736,764.5 lbs) and the average weight of an adult alewife, which might typically be 8 to 9 ounces (227 to 255 g) (Bigelow and Schroeder, 1953). The staff found that alewife larval entrainment, calculated to be equivalent to the egg production of 116 females, would represent only 0.0002 percent of the Lake Michigan population. Specific mortality rates for burbot and carp were unavailable; however, the equivalent loss of reproducing females from larval entrainment would likely remain small in comparison to the lake-wide population of each species.

When results of the 1975–1976 NES (1976) study are compared to the 2006–2007 EAE (2007) study, some notable differences appear. Rainbow smelt were more abundant in 1975–1976 samples than in 2006–2007 samples. Table 4-7 contains the total estimated numbers of entrained individuals for those species that appear in both studies. The total estimated number of eggs entrained was also much higher in the 1975–1976 study. Alewife, carp, burbot, and whitefish were more abundant in the 2006–2007 samples. EAE (2007) notes that these differences primarily reflect the changing population dynamics and species' abundances in Lake Michigan during the 30-year interval between studies. Section 2.2.5 of this draft SEIS describes the changing aquatic communities within Lake Michigan as a result of numerous invasive species introductions, which supports this conclusion.

Sampling differences may have occurred due to location of sampling; NES (1976) sampled in the forebay at the intake, while EAE (2007) sampled in the discharge canal. However, the total absence of certain species from the 1975–1976 study is unlikely if these species were within the vicinity of KPS at the time of the study. Burbot, ninespine stickleback, round goby, and white sucker, all of which appeared in the 2006–2007 study but not in the 1975–1976 study, spawn in relatively shallow water, which means that their larvae would have a greater likelihood of being entrained if these species were in the vicinity of KPS. Bunnell et al., 2007 reports a recovery of burbot numbers beginning in the 1980s, after the species had suffered a decline in the 1970s following the introduction of alewife, which may account for the appearance of this species in the 2006–2007 study, but not the 1975–1976 study. The ninespine stickleback population density in Lake Michigan was low from 1973–1995, increased dramatically in 1996–1997, and has remained variable since this time, which may account for the increased number of individuals recorded in the 2006–2007 study (Bunnel et al., 2007; EAE, 2007). Though species composition differs between the studies, both studies collected species representing the major trophic levels of fish: predator species, forage species, and bottom-dwellers; therefore the results of these studies do not indicate that the aquatic community within the vicinity of KPS has become destabilized. Additionally, neither study indicates that any one species is being affected enough to cause decline or destabilization of the species population in Lake Michigan.

Table 4-7. Estimated Total Numbers of Entrained Fish. *Total estimated numbers are compared between the 1975–1976 study (NES, 1976) and 2006–2007 (EAE, 2007) study for those species that appeared in both studies.*

Species and/or Life Stage	Total Estimated Number ($x 10^6$) 1975–1976	Total Estimated Number ($x 10^6$) 2006–2007
Fish eggs	52.672	25.28
Rainbow smelt juveniles	9.715	3.22
Rainbow smelt larvae	2.764	1.32
Alewife juveniles	0.393	0.29
Alewife larvae	0.271	3.52
Carp larvae	0.237	5.40
Burbot larvae	0.076	7.82
Slimy sculpin larvae	0.085	0.00
Whitefish larvae	0.076	0.80

Source: adapted from EAE, 2007

Based on the information presented in this section, the NRC staff determined that the potential impacts of entrainment of fish and shellfish by the KPS cooling system during the 20-year renewal period would be SMALL. The staff identified potential mitigation measures, including use of finer mesh screens, operating under reduced intake flow, and scheduling outages during historic periods of high fish density. However, the staff concludes that none of the mitigation measures considered would eliminate adverse entrainment impacts and would not reduce the significance level below SMALL. The NRC does not have the authority to mandate these measures; it is the responsibility of the WDNR to impose any restrictions or modifications to the cooling system to reduce the impact of entrainment under the WPDES permitting process. The staff did not identify any cost benefit studies applicable to these mitigation measures.

4.5.3 Impingement

Impingement occurs when aquatic organisms are pinned against intake screens or other parts of the cooling water system intake structure. For plants with once-through cooling systems, the impingement of fish and shellfish on screens associated with plant cooling systems is considered a Category 2 issue, which requires a site-specific assessment during the license renewal application review process. The NRC staff considered the information and documents described previously in Section 4.5.2 to perform a site-specific assessment of impingement resulting from the KPS cooling system. Impacts of existing cooling water systems, including impacts of impingement, are regulated under the provisions of the CWA as described in Section 4.5.2. Section 4.5.2 also includes a discussion of Section 316(b) requirements, which are also relevant to impingement. A detailed description of the KPS cooling system is presented in Section 2.1.6. Flow rates and discharge volumes are given in Section 4.2.5.

4.5.3.1 *Nalco Environmental Sciences, 1975–1976*

As previously described in Section 4.5.2, NES (1976) conducted a one-year impingement and entrainment study from April 1, 1975 through March 31, 1976. NES sampled adult and juvenile fish impinged on the traveling screens from two to seven days per week during the study period. Impinged fish were washed into a discharge sluice and collected in a basket to be identified, measured, and weighed. Once the total number of alewives or smelt exceeded 50, only 10 percent of the remaining alewives or smelt were removed to be weighed and measured, and these individuals served as a subsample from which to estimate the total number of alewives or rainbow smelt impinged (NES, 1976).

A total of 31 species of fish were collected in entrainment samples during the study year (See Table 4-8). No Federally- or State-listed species were collected. Alewife accounted for the vast majority (83.2 percent) of the total individual fish impinged. Rainbow smelt, slimy sculpin, and longnose dace were also prevalent. A total of 215,108 fish were impinged with June having the highest number of fish (57,871) and March having the lowest number of fish (931). Alewives were collected in greatest numbers in the spring and summer, and few alewives were collected in winter, which corresponds to their seasonal patterns of migrating into shallower waters in the spring and inhabiting deeper portions of the lake in winter. NES (1976) estimated that only 0.0003 percent of the total estimated biomass of alewife in Lake Michigan was impinged at KPS during the study year, which represents 0.02 percent of the total commercial catch in Wisconsin. Also, alewife die-offs were common during the late-1970s, which may account for the large number of alewives collected in impingement samples. The final SEIS for Point Beach Nuclear Station (NRC, 2005), which is located about 5 mi (8km) south of KPS, notes that a majority of "impinged alewives were assumed to be dead or dying individuals associated with the annual spring die-off." Rainbow smelt was the second most abundant species collected in impingement samples and was most common in October and November. Impinged smelt only accounted for 0.003 percent of the total estimated biomass of smelt in Lake Michigan and 0.3 percent of the total commercial catch in Wisconsin. Similarly, impinged slimy sculpin accounted for only 0.002 percent of the total estimated biomass of the species in Lake Michigan. All other species of fish impinged during the study year accounted for less than 0.002 percent of the total estimated biomass of that species. (NES, 1976).

Table 4-8. Impinged Fish by Species, April 1975 through March 1976

Common Name	Taxa	Total Number	Percentage of Total
Alewife	*Alosa pseudoharengus*	178,883	83.2
Rainbow smelt	*Osmerus mordax*	19,206	8.9
Slimy sculpin	*Cottus cognatus*	8,640	4.0
Longnose dace	*Rhinichthys cataractae*	4,389	2.0
Lake chub	*Couesius plumbeus*	1,584	0.7
Sucker group[a]	*Catostomus catostomus, C. commersonii, and Moxostoma macrolepidotum*	1,000	0.5
Trout group[b]	*Oncorhynchus mykiss, Salmo trutta, Salvelinus fontinalis, and Salvelinus namaycush*	344	0.2
Gizzard shad	*Dorosoma cepedianum*	311	0.1
Carp	*Cyprinus carpio*	259	0.1
Yellow perch	*Perca flavescens*	245	0.1
Bullhead group[c]	*Ameiurus natalis and A. nebulosus*	111	<0.1
Ninespine stickleback	*Pungitius pungitius*	55	<0.1
Troutperch	*Percopsis omiscomaycus*	39	<0.1
Whitefish group[d]	*Coregonus clupeaformis and Prosopium cylindraceum*	13	<0.1
Pumpkinseed	*Lepomis gibbosus*	9	<0.1
Burbot	*Lota lota*	7	<0.1
Common shiner	*Notropis cornutus*	4	<0.1
Salmon group[e]	*Oncorhynchus tshawytscha and O. kisutch*	3	<0.1
Lamprey	*Petromyzontidae spp.*	2	<0.1
Northern pike	*Esox lucius*	2	<0.1
Bloater	*Coregonus hoyi*	1	<0.1
Blacknose dace	*Rhinichthys atratulus*	1	<0.1
Total		**215108**	**100**

[a]Sucker group consists of white sucker, longnose sucker, and shorthead redhorse.
[b]Trout group consists of rainbow trout, brown trout, brook trout, and lake trout.
[c]Bullhead group consists of yellow bullhead and brown bullhead.
[d]Whitefish group consists of lake whitefish and round whitefish.
[e]Salmon group consists of Chinook salmon and coho salmon.
Source: adapted from NES, 1976

4.5.3.2 *EA Engineering, Science and Technology, Inc., 2006–2007*

As previously described in Section 4.5.2, EAE (2007), conducted a one-year impingement and entrainment study from March 2006 through February 2007. Impingement samples were collected once per week from March through August 2006 and twice per month October 2006 through February 2007. No samples were collected in September 2006 due to a planned plant outage. Impingement samples were gathered in a collection basket downstream of the traveling screens over 24-hour periods from 9 a.m. to 9 a.m. As in the 1975–1976 NES (1976) study, fish were then removed, identified, weighed, and counted. Up to 50 individual fish per species per 24-hour period were individually measured and weighed, and the excess individuals were counted and collectively weighed. (EAE, 2007)

A total of 34 species of fish were collected in entrainment samples during the study year. Over 90 percent of all impinged fish were collected in June and July. No Federally- or State-listed species were collected. Alewife accounted for the vast majority (99.7 percent) of the total individuals impinged (EAE, 2007). Alewife collection peaked in June and July 2006 and again, to a lesser extent, in October and November 2006 (EAE, 2007). The NRC staff estimated the percent of Lake Michigan alewives that were impinged in the KPS cooling system during the study year. EAE, 2007 recorded 690,402 individual alewives with a combined biomass of 2,666,686.5 grams (5879 lbs) in impingement samples over the study year. Using the total number of collected alewife, the biomass of collected alewife, and the total estimated number of alewife impinged over the study year (5,592,692 individuals), the NRC staff extrapolated the total estimated biomass of alewife impinged over the study year to be 21,601,844 grams (47,624 lbs). Madenjian et al., (2008) estimates the 2007 lake-wide biomass of alewife was 11,674 metric tons (25,736,764.5 lbs). Therefore, impinged alewife represented 0.002 percent of the total estimated alewife biomass in Lake Michigan in 2007.

Ninespine stickleback, rainbow smelt, yellow perch, mottled sculpin, and spottail shiner were collected in excess of 100 individual fish over the study year, and less than 100 individual fish of all other species were collected (See Table 4-9) (EAE, 2007). Similar to the estimates above, the NRC staff used Madenjian et al.'s (2008) lake-wide biomass estimates, EAE 2007 total estimated number of individual fish impinged over the study year, and an extrapolated total estimated biomass based on the combined collected biomass during the study. The NRC staff found that ninespine stickleback, rainbow smelt, yellow perch, mottled sculpin, and spottail shiner each accounted for less than 0.001 percent of the total estimated biomass of their species in Lake Michigan.

1 **Table 4-9. Impinged Fish by Species, February 2006 through January 2007**

Common Name	Taxa	Total Collected	% of Total Collected	Total Estimated	% of Total Estimated
Alewife	*Alosa pseudoharengus*	690,402	99.741	5,592,692	99.624
Ninespine stickleback	*Pungitius pungitius*	572	0.083	4473	0.080
Rainbow smelt	*Osmerus mordax*	300	0.043	3279	0.058
Yellow perch	*Perca flavescens*	164	0.024	3080	0.055
Mottled sculpin	*Cottus bairdii*	145	0.021	2148	0.038
Spottail shiner	*Notropis hudsonius*	125	0.018	1615	0.029
Northern clearwater crayfish	*Orconectes propinquus*	123	0.018	1104	0.020
Longnose sucker	*Catostomus catostomus*	62	0.009	590	0.011
Threespine stickleback	*Gasterosteus aculeatus*	55	0.008	525	0.009
White sucker	*Catostomus commersonii*	52	0.008	597	0.011
Longnose dace	*Rhinichthys cataractae*	50	0.007	714	0.013
Gizzard shad	*Dorosoma cepedianum*	41	0.006	1216	0.022
Burbot	*Lota lota*	27	0.004	384	0.007
Slimy sculpin	*Cottus cognatus*	18	0.003	277	0.005
Round goby	*Neogobius melanostomus*	12	0.002	117	0.002
Channel catfish	*Ictalurus punctatus*	8	0.001	219	0.004
Lake trout	*Salvelinus namaycush*	7	0.001	49	<0.001
Round whitefish	*Prosopium cylindraceum*	7	0.001	169	0.003
Black bullhead	*Ameiurus melas*	3	<0.001	90	0.002
Carp	*Cyprinus carpio*	3	<0.001	70	0.001
Smallmouth bass	*Micropterus dolomieui*	3	<0.001	43	<0.001
Brown trout	*Salmo trutta*	2	<0.001	35	<0.001
Chinook salmon	*Oncorhynchus tshawytscha*	2	<0.001	36	<0.001
Lake whitefish	*Coregonus clupeaformis*	2	<0.001	38	<0.001
Bloater	*Coregonus hoyi*	1	<0.001	28	<0.001
Bluegill	*Lepomis macrochirus*	1	<0.001	28	<0.001

Common Name	Taxa	Total Collected	% of Total Collected	Total Estimated	% of Total Estimated
Sucker group	Catostominae spp.	1	<0.001	22	<0.001
Sculpin group	Cottidae spp.	1	<0.001	38	<0.001
Creek chub	*Semotilus atromaculatus*	1	<0.001	29	<0.001
Pumpkinseed	*Lepomis gibbosus*	1	<0.001	29	<0.001
Rock bass	*Ambloplites rupestris*	1	<0.001	26	<0.001
Shorthead redhorse	*Moxostoma macrolepidotum*	1	<0.001	7	<0.001
Silver lamprey	*Ichthyomyzon unicuspis*	1	<0.001	10	<0.001
White perch	*Morone americana*	1	<0.001	22	<0.001
Total		**692,195**	**100**	**5,613,799**	**100**

Source: adapted from EAE, 2007

When results of the 1975–1976 NES (1976) study are compared to the 2006–2007 EAE (2007) study, some notable differences appear. Alewife and rainbow smelt were among the most prevalent species impinged during both study years though the total number of alewife collected in the 2006–2007 study (690,402 individuals) was significantly higher than the total number collected in the 1975–1976 study (178,883 individuals). Impinged alewives in 2006–2007 accounted for a slightly higher percentage of the total estimated biomass in Lake Michigan. However, both study years collected only a very small percentage of the total estimated biomass of alewives.

Generally, the same family groups were present in both studies, though species composition and abundance vary. Lake chub, rainbow trout, brook trout, yellow bullhead, brown bullhead, troutperch, common shiner, coho salmon, lamprey, northern pike, and blacknose dace were present in the NES (1976) study, but did not appear in EAE 2007 impingement samples. Conversely, mottled sculpin, spottail shiner, northern Clearwater crayfish, threespine stickleback, round goby, channel catfish, black bullhead, smallmouth bass, bluegill, Catostominae spp., Cottidae spp., creek chub, rock bass, silver lamprey, and white perch were present in the EAE 2007 study, but did not appear in NES (1976) impingement samples. Slimy sculpin and longnose dace were the third (4.0 percent) and fourth (2.0 percent) most prevalent species, respectively, in the NES (1976) study, while the two species only accounted for 0.003 and 0.007 percent, respectively, of total collected individuals in EAE 2007 impingement samples. EAE (2007) attributes the majority of these differences to the changes in the Lake Michigan aquatic community between study years.

Bunnell et al. (2007) report a record class of yellow perch in 2005, which may explain the increase in this species numbers between the 1975–1976 study and the 2006–2007 study. As discussed in Section 4.5.2, Bunnell et al. (2007) also reports a recovery of burbot numbers beginning in the 1980s, after the species had suffered a decline in the 1970s following the introduction of alewife. Though ninespine stickleback accounted for less than 0.01 percent in both studies, about ten times as many individuals were collected in the 2006–2007 study. Threespine stickleback was not present in the 1975–1976 study, but appeared in the 2006–

2007 study. These two species' densities were low from 1973–1995, increased dramatically in 1996–1997, and have remained variable since that time, which may account for the increased number of individuals recorded in the 2006–2007 study (Bunnell et al., 2007; EAE, 2007). Rainbow smelt, which represented 8.9 percent of impinged individuals in the 1975–1976 study, has shown decline since 1994, though the cause for this decline is unclear (Bunnell et al. 2007; EAE 2007). Rainbow smelt were present, but in much reduced numbers in the 2006–2007 study.

Section 2.2.5 of this draft SEIS describes the changing aquatic communities within Lake Michigan as a result of numerous invasive species introductions, which supports these conclusions. Because impinged fish represented such a small percentage of total estimated numbers in Lake Michigan, results of neither the NES (1976) study nor the EAE, 2007) study suggest that the impacts of the KPS cooling system on the aquatic community in the vicinity of KPS is negatively affecting any fish species or destabilizing the aquatic community as a whole.

Based on the information presented in this section, the NRC staff determined that the potential impacts of impingement of fish and shellfish by the KPS cooling system during the 20-year renewal period would be SMALL. The NRC staff identified potential mitigation measures, including closed cycle cooling, and derating the facility and scheduling plant outages during historic peak impingement periods. However, the staff concludes that none of the mitigation measures considered would eliminate adverse entrainment impacts and would not reduce the significance level below SMALL. The NRC does not have the authority to mandate these measures. It is the WDNR's jurisdiction to impose any restrictions or modifications to the cooling system to reduce the impact of impingement under the WPDES permitting process. The staff did not identify any cost benefit studies applicable to these mitigation measures.

4.5.4 Heat Shock

The NRC defines heat shock as acute thermal stress caused by exposure to a sudden elevation of water temperature that adversely affects the metabolism and behavior of fish and can lead to death. Heat shock is most likely to occur when an offline unit returns to service or when a station has a discharge canal effectively trapping fish in the flow of heated discharge from the plant. For plants with once-through cooling systems, the effects of heat shock are listed as a Category 2 issue and require a plant-specific assessment before license renewal. The NRC staff considered the information and documents described previously in Section 4.5.2 to perform a site-specific assessment of heat shock resulting from the KPS cooling system. The KPS cooling system is described in Section 2.1.6. Flow rates and discharge volumes are given in Section 4.2.5.

Section 316(a) of the CWA establishes a process by which a discharger can demonstrate that the established thermal discharge limitations are more stringent than necessary to protect balanced, indigenous populations of fish and wildlife and obtain facility-specific thermal discharge limits (33 USC 1326). In May 1976, NES (1976) provided WDNR with a Section 316(a) demonstration that addressed compliance with the thermal effluent limitations in the WPDES permit and environmental impacts of KPS's thermal discharge. This demonstration supported a petition for relief from Wisconsin Administrative Code thermal standards and a

State statute that required all plants on Lake Michigan with cooling water-related thermal discharges to transition to a recirculating system by 1981 (DEK, 2008).

For the demonstration, NES reviewed monthly reports of temperature, flow, chemical and biological data for the KPS thermal plume under average, ideal, and worst case conditions. NES (1976a) used thermal plume surveys conducted by Industrial BIO-TEST Laboratories, Inc. between June 1974 and July 1975 to assess thermal plume characteristics at KPS. NES determined that the data was highly variable and could not be used to adequately characterize ambient conditions to yield a reliable plume model. However, NES used the thermal plume data to determine a discharge zone for KPS. The discharge zone was based on the EPA's September 1974 Draft Guidelines for a 316(a) Demonstration and included the maximum surface area and maximum bottom area of the 2 °C (34 °F) isotherm. The discharge zone was determined to have an area of 985.3 acres (398.7 hectare (ha)) at the surface and 94.5 acres (38.2 ha) at the bottom. NES (1976a) estimated the extent of the thermally-affected zones for extreme conditions in summer and winter. In the summer, an ambient lake temperature of 21.1 °C (70 °F) and a plant discharge temperature of 30 °C (86 °F) were used to predict the area of the thermal plume with zero lake current and with a lake current of 0.8 feet per second (fps); 0.2 meters per second (m/s)). In the winter, an ambient lake temperature of 0 °C (32 °F) and a plant discharge temperature of 15.5 °C (59.9 °F) were used to predict the area of the thermal plume with zero lake current and a lake current of 1.2 fps (0.37 m/s). Table 4-10 and 4-11 summarize these thermal plume estimates.

Lake Michigan has a surface area of 22,300 mi^2 (14.27 million ac; 5.78 million ha) (WDNR, 2009a), and so, based on these thermal plume estimates, any thermal effects on aquatic species originating from the KPS cooling system would be very localized for those species with a lake-wide distribution. Additionally, KPS's discharge is located on the shoreline, just south of the forebay. Because water is discharged directly to Lake Michigan rather than returning to the lake via a discharge canal, fish are less likely to become entrapped in areas of elevated temperatures. The final SEIS for Point Beach Nuclear Station (NRC, 2005), which is located about 5 miles (8 km) south of KPS, also concluded that thermal effects on aquatic species would be localized because the plant is located on a relatively featureless portion of Lake Michigan with sandy substrate and rapid plume dissipation, no bays or points nearby to act as fish nurseries or other attracting features, and no substantial unique spawning grounds in the vicinity of the plant.

Table 4-10. KPS Thermal Plume Characteristics in Summer Under Extreme Conditions

Isotherm Temperature(a)	Distance in ft (m)	Width in ft (m)	Area in ac (ha)
No current			
29.0 °C (84.2 °F)	111.4 (34.0)	79.5 (24.2)	0.17 (0.07)
28.0 °C (82.4 °F)	147.7 (45.0)	92.4 (28.2)	0.27 (0.11)
27.0 °C (80.6 °F)	204.9 (62.5)	112.7 (34.4)	0.46 (0.19)
26.0 °C (78.8 °F)	302.1 (92.1)	147.2 (44.9)	0.88 (0.36)
25.0 °C (77.0 °F)	486.9 (148.4)	212.7 (64.8)	2.04 (0.83)
24.0 °C (75.2 °F)	904.9 (275.8)	361.0 (110.0)	6.45 (2.61)
23.0 °C (73.4 °F)	2194.1 (668.8)	818.3 (249.4)	35.45 (14.35)
22.0 °C (71.6 °F)	4939.5 (1505.6)	1792.2 (546.3)	174.80 (70.74)
0.8 fps (0.2 m/s) current			
29.0 °C (84.2 °F)	101.4 (30.9)	66.0 (20.1)	0.13 (0.05)
28.0 °C (82.4 °F)	174.3 (53.1)	84.8 (25.8)	0.29 (0.12)
27.0 °C (80.6 °F)	279.3 (85.1)	111.8 (34.1)	0.62 (0.25)
26.0 °C (78.8 °F)	411.7 (125.5)	145.8 (44.4)	1.19 (0.48)
25.0 °C (77.0 °F)	663.5 (202.2)	210.5 (64.2)	2.76 (1.12)
24.0 °C (75.2 °F)	1233.2 (375.9)	356.8 (108.8)	8.69 (3.52)
23.0 °C (73.4 °F)	2989.6 (911.2)	808.1 (246.3)	47.70 (19.30)
22.0 °C (71.6 °F)	6727.2 (2050.5)	1768.4 (539.0)	234.90 (95.06)

[a] The discharge temperature is 30 °C (86 °F), and the ambient summer temperature is assumed to be 21.1 °C (70 °F).

Source: Adapted from NES 1976

Table 4-11. KPS Thermal Plume Characteristics in Winter under Extreme Conditions.

Isotherm Temperature(a)	Distance in ft (m)	Width in ft (m)	Area in ac (ha)
No current			
15.0 °C (59.0 °F)	101.5 (30.9)	77.1 (23.5)	0.15 (0.06)
10.0 °C (50.0 °F)	331.2 (100.9)	119.7 (36.5)	0.78 (0.32)
5.0 °C (41.0 °F)	1411.0 (430.1)	486.4 (148.3)	13.55 (5.48)
4.0 °C (39.2 °F)	2101.9 (366.3)	751.2 (229.0)	31.18 (12.62)
3.0 °C (37.4 °F)	3337.1 (1017.1)	1224.7 (373.3)	80.70 (32.66)
2.0 °C (35.6 °F)	4994.8 (1522.4)	1860.2 (567.0)	183.46 (74.24)
1.0 °C (33.8 °F)	9920.4 (3023.7)	3748.4 (1142.5)	734.26 (297.14)
1.2 fps (0.37 m/s) current			
15.0 °C (59.0 °F)	132.7 (40.4)	51.7 (15.8)	0.14 (0.06)
10.0 °C (50.0 °F)	671.8 (204.8)	99.3 (30.3)	1.32 (0.53)
5.0 °C (41.0 °F)	2274.3 (693.2)	462.3 (140.9)	20.76 (8.40)
4.0 °C (39.2 °F)	3176.2 (968.1)	629.7 (191.9)	39.49 (15.98)
3.0 °C (37.4 °F)	4800.2 (1463.1)	1147.3 (349.7)	108.74 (44.01)
2.0 °C (35.6 °F)	7183.0 (2189.4)	1589.2 (484.4)	225.39 (91.21)
1.0 °C (33.8 °F)	14257.0 (4345.5)	2900.9 (884.2)	816.63 (330.48)

[a] The discharge temperature is 15.5 °C (59.9 °F), and the ambient winter temperature is assumed to be 0 °C (32 °F).

Source: Adapted from NES 1976

NES (1976a) also considered biological studies conducted by Industrial BIO-TEST Laboratories, Inc., from 1971 through 1975, to determine any impacts that the KPS thermal discharge may have on the fish community. A comparison of pre-operational and operational data showed no noticeable changes in the aquatic community as a result of thermal changes near the KPS discharge. No major changes in species composition, seasonal abundance, spatial distribution, or use of affected area were observed. Densities of major macroinvertebrate taxa remained similar between preoperational and operational studies, and no changes to the benthic community were detected as a result of KPS thermal discharge. The demonstration concluded that “the thermal component of the [KPS] discharge has not disturbed the balanced indigenous communities of fish, shellfish, and wildlife in Lake Michigan” (NES, 1976).

On September 13, 1976, the WDNR granted alternative effluent limitations for KPS and exempted the thermal component of the Wisconsin Administration Code (DEK, 2008). As a result of this exemption, the current WPDES permit for KPS does not contain thermal effluent limitations. Under Dominion’s license, Appendix B of the Environmental Protection Plan, Dominion is required to report fish kills as an “unusual or important event.” To date, Dominion has not reported any fish kills related to thermal effluent discharge from the KPS cooling system.

The WDNR is currently in the process of revising Chapter NR 102 of the Wisconsin Administrative Code to include water quality standards for thermal discharges. The new

Subchapter II would be entitled “Water Quality Standards for Temperature” and would include water quality criteria as well as ambient temperatures for certain fish and aquatic species. As part of this rule proposal, the WDNR would also establish procedures for calculating thermal limitations for WPDES-permitted discharges. The rule package was most recently revised in May 2009 (WDNR, 2009b). If this rule package is passed, KPS may be subject to thermal discharge limitations in the future, such as an upper limit on the temperatures of discharged waters. In this case, KPS would have to monitor intake and discharge temperatures and report them to WDNR on an annual or semi-annual basis. These limitations would most likely be addressed at the time of the WPDES permit renewal, or a timeline specified in the final rule. The current WPDES permit expires June 30, 2010. The NRC does not have authority to regulate thermal conditions, and therefore, relies on the State to set appropriate guidelines for thermal discharge through the WPDES permitting process.

The NRC staff has reviewed available information, including the applicant’s ER (DEK, 2008), the current WPDES permit (WDNR, 2005a), the CWA Section 316(a) Demonstration (NES, 1976), and other applicable sources of information on heat shock. Plant operating conditions have not changed significantly since the original 316(a) Demonstration. Therefore, it can be reasonably concluded that the extent and distribution of KPS’s thermal plume has remained relatively unchanged. The NRC staff evaluated the potential impacts to aquatic resources due to heat shock during continued operation and determined that thermal impacts are likely to be limited because of the design and location of the KPS discharge structure. Furthermore, the NRC staff concludes that the potential impacts to fish and shellfish due to heat shock during the renewal term are SMALL. The NRC staff identified potential mitigation measures, including closed cycle cooling, helper cooling towers, derating the plant, and operating under reduced intake flows. The staff did not identify any cost benefit studies applicable to these mitigation measures. However, the NRC does not have the authority to mandate these measures; it is the WDNR’s jurisdiction to impose any restrictions or modifications to the cooling system to reduce the impact of heat shock under the WPDES permitting process.

4.5.5 Total Impacts on Aquatic Resources

Impingement, entrainment and heat shock all act on the same populations of aquatic resources. The purpose of this section is to provide perspective on the total impact of cooling system operation on fish and other aquatic resources. The WDNR, not the NRC, is responsible for issuing and enforcing WPDES permits. Because the NRC level of impact associated with impingement and entrainment is SMALL and the level of impact associated with thermal impacts is SMALL, the NRC staff believes that the total impact from all of these sources together on aquatic resources would also be SMALL through the period of license renewal.

4.6 TERRESTRIAL RESOURCES

The issues related to terrestrial resources applicable to KPS site are discussed below and listed in Table 4-12. There are no Category 2 issues related to terrestrial resources for license renewal. The NRC staff did not identify any new and significant information during the review of the DEK ER (DEK, 2008), the site audit, the scoping process, or the evaluation of other available information. Therefore, the NRC staff concludes that there would be no impacts related to these issues beyond those discussed in the GEIS (NRC, 1996). The GEIS concludes that the impacts are SMALL, and additional site-specific mitigation measures are not likely to be sufficiently beneficial to implement.

Table 4-12. Terrestrial Resources Issues. *Section 2.2.6 of this draft SEIS provides a description of the terrestrial resources at KPS and in the surrounding area.*

Issues	GEIS Section	Category
Power line ROW management (cutting herbicide application)	4.5.6.1	1
Bird collisions with power lines	4.5.6.1	1
Impacts of electromagnetic fields on flora and fauna (plants, agricultural crops, honeybees, wildlife, livestock)	4.5.6.3	1
Floodplains and wetland on power line right of way	4.5.7	1

4.7 THREATENED AND ENDANGERED SPECIES

Table 4-13. Threatened or Endangered Species. *Section 2.2.7 of this document describes the threatened or endangered species on or near KPS.*

Issue	GEIS Section	Category
Threatened or endangered species	4.1	2

This site-specific, or Category 2 issue, requires consultation with the appropriate agencies to determine whether or not threatened or endangered species are present and whether or not they would be adversely affected by continued operation of KPS during the license renewal term. The characteristics and habitats of threatened and endangered species in the vicinity of the KPS site are discussed in Sections 2.2.6 and 2.2.7 of this draft SEIS.

The NRC contacted the USFWS on September 20, 2008, regarding threatened and endangered species at the KPS site (NRC, 2008). A description of the site and the in-scope transmission lines and a preliminary assessment of the Federally-listed threatened and endangered species potentially occurring on or near the KPS site were provided in this letter. The USFWS provided its response on October 28, 2008, indicating that the Hine's emerald dragonfly (*Somatochlora hineana*) and the piping plover (*Charadrius melodus*) have the potential to occur in the vicinity of KPS (USFWS, 2008a).

4.7.1 Aquatic Species

The NRC staff has reviewed information provided by the applicant and information publicly available and has contacted the Greenbay Field Office of USFWS (NRC, 2008). Currently, no threatened or endangered aquatic species are known to occur within Lake Michigan on or in the vicinity of the KPS site or within any streams crossed by in-scope transmission line ROWs. Therefore, license renewal of KPS would have no effect on any Federally- or State-listed aquatic species, and mitigation measures need not be considered.

4.7.2 Terrestrial Species

Sections 2.2.6 and 2.2.7 of this draft SEIS discuss the characteristics and habitat of threatened and endangered species in the vicinity of the KPS site.

The NRC staff contacted the USFWS and the WDNR to request information that could assist in assessing the environmental impacts associated with license renewal. On October 28, 2008, the FWS indicated that no known Federally-listed threatened or endangered species occur within the project area; therefore, the proposed project would not likely adversely affect any Federally-listed species (USFWS, 2008).

There are five Federally-listed threatened or endangered terrestrial species that potentially occur on the KPS site, although these species have not been documented on the site: the piping plover (Charadrius melodus), the Hine's emerald dragonfly (*Somatochlora hineana*), the Karner blue butterfly (*Lycaeides melissa samuelis*), the dune or Pitcher's thistle (*Cirsium pitcheri*), and the dwarf lake iris (*Iris lacustris*). The bald eagle (*Haliaeetus leucocephalus*) and the peregrine falcon (*Falco peregrinus*) were formerly Federally-listed as threatened and may also be found in the vicinity of the KPS site. Four State-listed species were identified as species for consideration of the proposed license renewal of KPS, including the Caspian tern (*Sterna caspia*), the osprey (*Pandion haliaetus*), and the formerly listed bald eagle and peregrine falcon. Section 2.2.7 of this report describes these species in greater detail (USFWS, 2008a; DEK, 2008).

The NRC staff encourages DEK, as well as American Transmission Company (ATC), who own the transmission lines, to report the existence of any Federally- or State-listed endangered or threatened species within or near the transmission line ROWs to the WDNR and USFWS, or both, if any such species are identified during the license renewal term. In particular, if any evidence of injury to, or mortality of, migratory birds, piping plovers, or any other threatened or endangered species is observed within the corridor during the license renewal period, the NRC staff encourages DEK and ATC to promptly report this to the appropriate wildlife management agencies. Also, if a Caspian tern (or common tern, also State-listed) population revisits the shore of either the KPS site or the surrounding areas, the NRC staff encourages DEK to monitor the situation and the species. Finally, the NRC staff encourages DEK and ATC to continue providing information concerning the peregrine falcon nesting pair and any fledglings that nest on the reactor building or occur in the transmission line ROW's to the FWS and the State of Wisconsin.

Because no threatened or endangered species are known to occur on or in the vicinity of the KPS site, operation of the site and its associated transmission lines are not expected to adversely affect any threatened or endangered species during the license renewal term. Therefore, the NRC staff concludes that adverse impacts to threatened or endangered species during the period of extend operation would be SMALL. The NRC staff finds several mitigation measures currently in place at the KPS site, and with its associated transmission lines, the NRC staff finds them to be adequate. They include: nest construction and placement for the peregrine falcon, environmental review checklists, environmental evaluation forms, and best management practices.

4.8 HUMAN HEALTH

The human health issues applicable to KPS are discussed below and listed in Table 4-14 for Category 1, Category 2, and uncategorized issues.

Table 4-14. Human Health Issues. *Table B-1 of Appendix B to Subpart A of 10 CFR Part 51 contains more information on these issues.*

Issues	GEIS Section	Category
Microbiological organisms (occupational health)	4.3.6	1
Noise	4.3.7	1
Radiation exposures to public (license renewal term)	4.6.1, 4.6.2	1
Occupational radiation exposures (license renewal term)	4.6.3	1
Electromagnetic fields – acute effects (electric shock)	4.5.4.1	2
Electromagnetic fields – chronic effects	4.5.4.2	Uncategorized

4.8.1 Generic Human Health Issues

The NRC staff did not identify any new and significant information regarding generic human health issues during its review of the Environmental Report, the site audit, or the scoping process. Therefore, there are no impacts related to these issues beyond those discussed in the GEIS. For these issues, the GEIS concluded that the impacts are SMALL, and additional site-specific mitigation measures are not likely to be sufficiently beneficial to be warranted. The information presented below is a discussion of selected radiological programs conducted at KPS which monitor the impacts of radioactive effluents on the environment and members of the public.

4.8.1.1 *Radiological Environmental Monitoring*

KPS conducts a Radiological Environmental Monitoring Program (REMP) in the environs around their site to assess the radiological impact, if any, to its employees, the public, and the environment. KPS issues an annual environmental monitoring report which contains a discussion of the environmental data, and includes graphs which trend the data from prior years. The objectives of the REMP are to include the following:

- Measure and evaluate the levels of radiation and radioactive material in the environs around the KPS site to assess the radiological impacts, if any, of plant operation on the environment.
- Supplement the results of the radiological effluent monitoring program by verifying that the measurable concentrations of radioactive material and levels of radiation are not higher than expected based on the measurement of radioactive effluents and modeling for the applicable exposure pathways.
- Provide data on the radiation dose to the public by direct or indirect pathways of exposure.

- Demonstrate compliance with applicable Federal regulatory requirements.

The KPS REMP collects samples of environmental media in the environs around the site for analysis to measure the amount of radioactivity, if any, in the samples. The media samples are representative of the radiation exposure pathways to the public from all plant radioactive effluents. The REMP measures the aquatic, terrestrial, and atmospheric environment for radioactivity, as well as ambient gamma radiation. Ambient gamma radiation pathways include radiation from buildings, plant structures, and airborne material that may be released from the plant. In addition, the REMP also measures background radiation (i.e., cosmic sources, global fallout, and naturally occurring radioactive material, including radon). Thermoluminescent dosimeters are used to measure direct radiation. The atmospheric environmental monitoring consists of sampling the air for particulates and radioiodine. Terrestrial environmental monitoring consists of analyzing samples of milk and food products. The aquatic environmental monitoring consists of analyzing samples of surface water, drinking water ground water, fish, and sediment from Lake Michigan. There is also an onsite ground water protection program designed to monitor the onsite plant environment for indication of leaks from plant systems and pipes carrying radioactive liquid.

The NRC staff reviewed the KPS radioactive environmental monitoring reports from 2004 through 2008 to look for any significant impacts to the environment or any unusual trends in the data (DEK 2005, 2006, 2007, 2008a, 2009). The NRC staff's review of the KPS REMP reports showed no unusual trends in the data and showed no measurable impact from the operations at KPS on the environment.

The Wisconsin Department of Health Services (WDHS) conducts a yearly independent comprehensive environmental radioactivity survey program around the two nuclear power plant sites, KPS and Point Beach Nuclear Plant (PBNP), in Wisconsin. The program collects various types of samples of environmental media, similar to that obtained by KPS, from the environs around the KPS site. The sampling program includes samples of air, precipitation, ambient gamma radiation, surface water, fish, shoreline sediment, soil, milk, well water, and vegetation.

The NRC staff reviewed the WDHS 2007 environmental survey program report for the KPS and PBNP sites. The state reported that it observed radioactivity levels associated with natural background and fallout from atmospheric weapons testing. No radioactivity attributable to the operation of the KPS and PBNP was observed (WDHS, 2008).

Based on the review of the radiological environmental monitoring data from KPS and the WDHS, the NRC staff concludes that there are no measurable radiological impacts from the operations at KPS on the environment.

4.8.1.2 *Radioactive Effluent and Dose Information*

The NRC staff reviewed KPS historical data on radioactive releases and the calculated dose to a hypothetical maximally exposed individual to verify that the doses are within the dose limits specified in 10 CFR Part 20 and are as low as reasonably achievable (ALARA) per the dose design objectives in Appendix I to 10 CFR Part 50.

Dose estimates for members of the public are calculated based on liquid and gaseous effluent release data and atmospheric and aquatic transport models. The KPS 2008 annual radioactive effluent release report (DEK, 2009) contains a detailed presentation of radioactive discharges and the resultant calculated doses. The following summarizes the calculated hypothetical maximum dose to an individual located at the KPS site boundary from radioactive liquid and gaseous effluents released during 2008:

- The maximum whole-body dose to an offsite member of the public from liquid effluents was 1.04 E-03 milliroentgen equivalent man (mrem) (1.04 E-05 millisievert (mSv), which is below the 3 mrem (0.03 mSv) dose criterion in Appendix I to 10 CFR Part 50.
- The maximum organ (gastro-intestinal tract) dose to an offsite member of the public from liquid effluents was 4.19 E-03 mrem (4.19 E-05 mSv), which is below the 10 mrem (0.1 mSv) dose criterion in Appendix I to 10 CFR Part 50.
- The maximum air dose at the site boundary from gamma radiation in gaseous effluents was 4.21 E-06 mrad (4.21 E-08 mGy which is below the 10 mrad (0.1 mGy) dose criterion in Appendix I to 10 CFR Part 50.
- The maximum air dose at the site boundary from beta radiation in gaseous effluents was 1.07 E-05 mrad (1.07 E-07 mGy), which is below the 20 mrad (0.2 mGy) dose criterion in Appendix I to 10 CFR Part 50.
- The maximum organ (liver) dose to an offsite member of the public from radioactive iodine and radioactive particulate material in gaseous effluents was 5.55 E-04 mrem (5.55 E-06 mSv), which is below the 15 mrem (0.15 mSv) dose criterion in Appendix I to 10 CFR Part 50.

Based on the NRC staff review and assessment of the KPS radioactive waste system performance in controlling radioactive effluents and the resultant doses to members of the public in conformance with the ALARA criteria, the NRC staff found that the 2008 radiological effluent data for KPS are consistent, with reasonable variation attributable to operating conditions and outages and with the 5-year historical radiological effluent releases and resultant doses. These results demonstrate that KPS is operating in compliance with Federal radiation protection standards contained in 10 CFR Part 20 and Appendix I to 10 CFR Part 50.

The applicant has no plans to conduct refurbishment activities during the license renewal term, thus, no change to radiological conditions is expected. Continued compliance with regulatory requirements is expected during the license renewal term. Thus, the radiological impacts are not expected to change during the license renewal term and there are no impacts beyond those discussed in the GEIS. Therefore, the NRC staff concludes that the radiological impacts to human health from the continued operation of KPS during the license renewal term would be SMALL.

4.8.2 Electromagnetic Fields – Acute Shock

Based on the GEIS, the NRC found that electric shock resulting from direct access to energized conductors or from induced charges in metallic structures has not been a problem at most operating plants and generally is not expected to be a problem during the period of extended operation. However, a site-specific review is required to determine the significance of the electric shock potential along the portions of the transmission lines within the scope of the SEIS.

The GEIS states that it is not possible to determine the significance of the electric shock potential without a review of the conformance of each nuclear plant transmission line with National Electrical Safety Code (NESC) and Institute of Electrical and Electronics Engineers (IEEE) 2007 criteria. 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, Part 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.

As a result of the Wisconsin Legislature Act 9 of 1999, Wisconsin Public Service Corporation and Wisconsin Power and Light Company (owners of KPS at the time) transferred ownership of their transmission lines to ATC. The transmission Interconnection Agreement for KPS between ATC, DEK, and Midwest Independent Transmission System Operator (MISO) constitutes that ATC is the transmission system operator and MISO is the independent system operator.

All transmission lines associated with KPS were constructed in accordance with National Electric Safety Code (NESC) and industry guidance in effect at that time (AEC, 1972). Since the lines were constructed, a new criterion has been added to the NESC for power lines with voltages exceeding 98 Kilovolt (kV). This criterion states that the minimum clearance for a line must limit induced currents due to static effects to 5 milliamperes (mA). ATC has reviewed the transmission lines for compliance with this criterion (DEK, 2008) and indicated that all transmission lines within the scope of this review have been restudied. The results show there are no locations under the transmission lines that have the capacity to induce more than 5 mA in a vehicle parked beneath them. No induced shock hazard to the public should occur, since the lines are operating within original design specifications and meet current NESC clearance standards.

The NRC staff has reviewed the available information, including the applicant’s evaluation and computational results. Based on this information, the NRC staff evaluated the potential impacts for electric shock resulting from operation of KPS and its associated transmission lines. The NRC staff concludes that the potential impacts from electric shock during the renewal period would be SMALL.

The NRC staff identified a variety of measures that could mitigate potential acute electromagnetic fields (EMF) impacts resulting from continued operation of the KPS transmission lines. These mitigation measures would include erecting barriers along the length of the transmission line to prevent unauthorized access to the ground beneath the conductors and installing road signs at road crossings. These mitigation measures could reduce human health impacts by minimizing public exposures to electric shock hazards. The NRC staff did not identify any cost benefit studies applicable to the mitigation measures mentioned above.

4.8.3 Electromagnetic Fields – Chronic Effects

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

The potential for chronic effects from these fields continues to be studied and is not known at this time. The National Institute of Environmental Health Sciences (NIEHS) directs related research through the U.S. Department of Energy (DOE). The report by NIEHS (1999) contains the following conclusion which is supported by recently published Environmental Health Criteria Monograph No. 238:

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

This statement was not sufficient to cause the NRC staff to change its position with respect to the chronic effects of electromagnetic fields. This position is expressed in footnote 5 of Table B-1 of Appendix B to Subpart A of 10 CFR Part 51:

> If, in the future, the Commission finds that, contrary to current indications, a consensus has been reached by appropriate Federal health agencies that there are adverse health effects from electromagnetic fields, the Commission will require applicants to submit plant-specific reviews of these health effects as part of their license renewal applications. Until such time, applicants for license renewal are not required to submit information on this issue.

The NRC staff considers the GEIS finding of “uncertain” still appropriate and will continue to follow developments on this issue.

4.9 SOCIOECONOMICS

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B–1, which are applicable to socioeconomic impacts during the renewal term are listed in Table 4-15. As stated in the GEIS, the impacts associated with these Category 1 issues were determined to be SMALL, and plant-specific mitigation measures would not be sufficiently beneficial to be warranted.

The NRC staff reviewed and evaluated the KPS Environmental Report, scoping comments, other available information, and visited KPS in search of new and significant information that would change the conclusions presented in the GEIS. No new and significant information was identified during this review and evaluation. Therefore, it is expected that there would be no impacts related to these Category 1 issues during the renewal term beyond those discussed in the GEIS.

Table 4-15. 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

4.9.1 Generic Socioeconomic Issues

The results of the review and brief statement of GEIS conclusions, as codified in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, for each of the socioeconomic Category 1 issues are provided below.

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

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

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

> Only impacts of small significance are expected.

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

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

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

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

No new and significant information was identified for these issues during the review. Therefore, it is expected that there would be no impacts during the renewal term beyond those discussed in the GEIS.

Table 4.16 lists the Category 2 socioeconomic issues, which require plant-specific analysis, and an environmental justice impact analysis that was not addressed in the GEIS.

Table 4-16. Category 2 Issues Applicable to Socioeconomics and Environmental Justice 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 plant-specific reviews.

4.9.2 Housing Impacts

Appendix C of the GEIS presents a population characterization method based on two factors, sparseness and proximity (GEIS, Section C.1.4). Sparseness measures population density within 20 miles (32 km) of the site, and proximity measures population density and city size within 50 miles (80 km). Each factor has categories of density and size (GEIS, Table C.1). A matrix is used to rank the population category as low, medium, or high (GEIS, Figure C.1).

According to the 2000 Census, approximately 86,224 people lived within 20 miles of KPS, which equates to a population density of 132 persons per square mile (DEK, 2008). This density translates to GEIS Category 4, least sparse (greater than, or equal to, 120 persons per square mile within 20 miles). Approximately 723,900 people live within 50 miles of KPS (DEK, 2008). This equates to a population density of 202 persons per square mile. Applying the GEIS proximity measures, KPS is classified as proximity Category 4 (greater than, or equal to, 190 persons per square mile within 50 miles). Therefore, according to the sparseness and proximity matrix presented in the GEIS, rankings of sparseness Category 4 and proximity Category 4 result in the conclusion that KPS is located in a high population area.

Since Kewaunee, Manitowoc, and Brown counties are not subject to growth control measures that would limit housing development, any changes in employment at KPS would have little noticeable effect on housing availability in these counties. Considering that DEK has no plans to add non-outage employees during the license renewal period, employment levels at KPS would remain relatively constant with no additional demand for permanent housing during the license renewal term. Based on this information, there would be no impact on housing during the license renewal term beyond what has already been experienced.

4.9.3 Public Services: Public Utilities

Impacts on public utility services are considered SMALL if the existing infrastructure could accommodate any plant-related demand without a noticeable effect on the level of service. Impacts are considered MODERATE if the demand for service or use of the infrastructure is sizeable and would noticeably decrease the level of service or require additional resources to maintain the level of service. Impacts are considered LARGE when new programs, upgraded or new facilities, or substantial additional staff is needed because of plant-related demand. In the absence of new and relevant information to the contrary, the only significant impacts on public utilities would be on public water supplies.

Analysis of impacts on the public water systems considered both plant demand and plant-related population growth. Section 2.1.3 of this draft SEIS describes the permitted withdrawal rate and actual use of water for reactor cooling at KPS.

Because DEK has no plans to add non-outage employees during the license renewal period, employment levels at KPS would remain relatively unchanged with no additional demand for public water services. Public water systems in the region would be adequate to meet the demands of residential and industrial customers in the area. Therefore, there would be no additional impact to public water services during the license renewal term beyond what is currently being experienced.

4.9.4 Offsite Land Use

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

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

- **SMALL** - Little new development and minimal changes to an area's land-use pattern.
- **MODERATE** - Considerable new development and some changes to the land-use pattern.
- **LARGE** - Large-scale new development and major changes in the land-use pattern.

Tax revenue can affect land use because it enables local jurisdictions to provide the public services (e.g., transportation and utilities) necessary to support development. Section 4.7.4.1 of the GEIS states that the assessment of tax-driven land-use impacts during the license renewal term should consider: (1) the size of the plant's tax payments relative to the community's total revenues, (2) the nature of the community's existing land-use pattern, and (3) the extent to which the community already has public services in place to support and guide development.

If the plant's tax payments are projected to be small relative to the community's total revenue, tax-driven land-use changes during the plant's license renewal term would be SMALL, especially where the community has pre-established patterns of development and has provided public services to support and guide development. Section 4.7.2.1 of the GEIS states that if new tax payments are less than 10 percent of the taxing jurisdiction's revenue, the significance level would be SMALL. If tax payments are 10 to 20 percent of the community's total revenue, new tax driven land-use changes would be MODERATE. If tax payments are greater than 20 percent of the community's total revenue, new tax-driven land-use changes would be LARGE. This would be especially true where the community has no pre-established pattern of development or has limited public services available to support and guide development.

4.9.4.1 *Population-Related Impacts*

DEK has no plans to add non-outage employees during the license renewal period. Therefore, there would be no plant operations-driven population increase in the vicinity of KPS. Additionally, there would be no population-related offsite land use impacts during the license renewal term beyond what has already been experienced.

4.9.4.2 *Tax-Revenue-Related Impacts*

As previously discussed in Chapter 2, by state law, DEK makes annual gross revenue tax Payments In Lieu Of Taxes (PILOT) to the State of Wisconsin. Since DEK started making payments, population levels and land use conditions have not changed significantly, which might indicate that these tax revenues have had little or no effect on land use activities within the county.

Beginning in 2009, the Wisconsin Department of Revenue changed the methodology for computing the utility aid payment. Because of pending changes to the Wisconsin Shared Revenue Program (WSRP) methodology for taxing public utilities in the State of Wisconsin, it is anticipated that KPS will be taxed differently beginning in tax-year 2009. The estimated WSRP Utility payment from the State of Wisconsin to the town of Carlton and Kewaunee County will increase over previous years. Although these changes will increase the size of the payment, the overall tax-revenue-related impact from KPS in Kewaunee County and the town of Carlton will not change because KPS does not directly pay taxes to these jurisdictions and there is no direct correlation between the amount of taxes KPS pays to the State of Wisconsin and the distribution of funds to local jurisdictions.

DEK has no plans to add non-outage employees during the license renewal period. Therefore, employment levels would remain relatively unchanged. After the 2009 tax payment increase, annual PILOT payments would likely remain unchanged throughout the license renewal period. Based on this information, there would be no tax-revenue-related offsite land use impacts during the license renewal term beyond what has already been experienced.

4.9.5 Public Services: Transportation Impacts During Operations

Table B-1, 10 CFR Part 51 states: "Transportation impacts (level of service) of highway traffic generated... during the term of the renewed license are generally expected to be of small significance. However, the increase in traffic associated with additional workers and the local road and traffic control conditions may lead to impacts of moderate or large significance at some sites." All applicants are required by 10 CFR, Part 51.53(c)(3)(ii)(J) to assess the impacts of highway traffic generated by the proposed project on the level of service of local highways during the term of the renewed license.

Since DEK has no plans to add non-outage employees during the license renewal period, there would be no noticeable change in traffic volume and levels of service on roadways in the vicinity of KPS. Therefore, there would be no transportation impacts during the license renewal term beyond what is currently being experienced.

4.9.6 Historic and Archaeological Resources

The National Historic Preservation Act (NHPA) requires Federal agencies to consider the effects of their undertakings on historic properties. Historic properties are defined as resources that are eligible for listing on the National Register of Historic Places (NRHP). The criteria for eligibility are listed in Title 36, "Parks, Forests, and Public Property," Part 60, Section 4, "Criteria for Evaluation," of the *Code of Federal Regulations* (36 CFR Part 60.4) and include: (1) association with significant events in history; (2) association with the lives of persons significant in the past; (3) distinctive characteristics of type and period of construction, and (4) sites or places that have yielded or are likely to yield important information (Advisory Council on Historic Preservation (ACHP) 2009). The historic preservation review process (Section 106 of the NHPA) is outlined in regulations issued by the ACHP in Title 36, "Parks, Forests, and Public Property," Part 800, "Protection of Historic Properties," of the *Code of Federal Regulations* (36 CFR Part 800).

The issuance of a renewed operating license for a nuclear power plant is a Federal action that could affect historic properties on or near the nuclear plant site and transmission lines. In accordance with the provisions of the NHPA, the NRC is required to make a reasonable effort to identify historic properties included in, or eligible for inclusion in, the NRHP in the area of potential effect (APE). The APEs for license renewal are the nuclear power plant site, transmission lines, and immediate environs. If historic properties are present, the NRC is required to contact the State Historic Preservation Office (SHPO), assess the potential impact, and resolve any possible adverse effects of the undertaking (license renewal) on historic properties. The NRC is also required to notify the SHPO if historic properties would not be affected by license renewal or if no historic properties are present.

Dominion contacted the Wisconsin Historical Society (WHS) in February requesting information on historic and archaeological resources in the vicinity of KPS and describing the proposed action (license renewal) (DEK, 2008). In October 2007, Dominion forwarded its Phase 1 Archaeological Survey (AVD Archaeological Services, Inc. (AVD)) to the WHS for review and comment (DEK, 2008). In December 2007, the WHS concurred with the archaeological assessment (WHS, 2007).

In accordance with 36 CFR 800.8(c), the NRC contacted the WHS (NRC 2008a), the Advisory Council on Historic Preservation (NRC, 2008b), and Federally-recognized American Indian Tribes to initiate Section 106 consultation. These letters are presented in Appendix D.

As discussed in Section 2.2.9, a search of the WHS site files identified no previously recorded historic properties at KPS; however, the AVD report indicates that portions of site 47KE72 could extend onto KPS property. In addition, there are no eligible or listed NRHP properties located on the KPS site.

A review of WHS records found only 141 historic and archaeological sites within Kewaunee County compared with more than 500 each for bordering Manitowoc, Brown, and Door counties

(AVD, 2007). Only fourteen archaeological sites have been recorded in Carlton Township. Five of these sites are cemeteries and the remaining are pre-contact sites (AVD, 2007). Three archaeological sites are located within one mile of the KPS site.

In 2007, DEK contracted with AVD to conduct a Phase 1 survey of the KPS site. Approximately 80 acres of the site were heavily disturbed from construction of KPS. A majority of the remaining land is open grassland and approximately 407 acres are leased agricultural cropland (AVD, 2007). The survey identified three known archaeological sites (47KE10, 47KE72, and 47KE44 [BKE-0044]) within one mile of KPS and nine new isolated artifact finds on the KPS site. However, there remains a potential for additional prehistoric sites and historic (camp) sites to be in the area. This area was part of the Potawatomi hunting, farming, and gathering lands. In addition, historical records indicate that American Indians utilized the Sandy Bay area for fishing and hunting.

The area in the vicinity of KPS was also settled by Euro-Americans who farmed the area prior to the construction of KPS. While there are no visible remnants of the former farmhouses and outbuildings at KPS, subsurface portions of these buildings could remain. During NRC's walkover survey, the staff noted the presence of barbed wire fencing, farm equipment, rudimentary farm bridges, and historic artifact scatters on KPS property.

Site 47KE10 is a campsite/village of unknown prehistoric affiliation. Very little information about this site exists within the WHS database. The site is located offsite and would not be affected by plant operation.

In 1996, site 47KE72 was recorded and listed as a Late Archaic site of unknown purpose. The extent of this site remains undetermined. Portions of this archaeological site could extend onto the KPS site. According to the site file, previous land owners recovered a few artifacts which remain in a private collection. Any land disturbing activities near 47KE72 should be surveyed prior to any disturbance.

Site 47KE44 is the Sandy Bay Cemetery (St. John's Cemetery) and was associated with St. John's Church. The church was founded in 1869 and the congregation disbanded in 1947. The church no longer exists; however, subsurface portions of the church could remain. Burials associated with fifteen families are located in this cemetery with the last burial dating to 1943. In 1969, the cemetery was turned over to Carlton Township (AVD, 2007). The township maintains the cemetery.

Nine locations on the KPS site yielded artifacts. Location #71 was a scatter of nineteenth to twentieth century (domestic) artifacts found in the vicinity of a former farm. A single diagnostic point was recovered at location #72, which could date to either the Late Archaic or Woodland time periods (AVD, 2007). No other lithics materials were recovered in this area. One thermally altered piece of chert was recovered from Location #73. AVD noted that this piece of chert was probably pushed to this location during construction of KPS. One chert diagnostic fragment (Location #74) was recovered in a cultivated field. The fragment appears to date to the Middle Woodland Period. A uniface of off-white chert was found at Location #75. There is no sign of utilization on the edge of the piece (AVD, 2007). No other lithics materials were recovered from this location.

A projectile point chert tip was recovered from Location #76. No temporal affiliation can be assigned to this point. An oolitic chert projectile point fragment that potentially dates to either the Late Archaic or Woodland time periods was recovered from Location #77 (AVD, 2007). A side notched chert projectile point (tip missing) was found at Location 78. This point bears resemblance to the Madison side-notched type (AVD, 2007). A possible chert tool which had indications of pressure flaking on one edge was recovered at Location #79 (AVD, 2007). In total, one historic scatter, five projectile point fragments, one possible chert scraping or cutting tool, and two possible tools. These finds indicate that pre-contact American Indians hunted in this area and provides evidence of Euro-American occupation. According to AVD, all farmstead-related artifacts are out of context due to the demolition of the buildings prior to the construction of KPS. The fixed projectile point fragments and three pieces of chert were single items found without context or association with other artifacts. AVD stated that either the projectile points were merely discarded or lost in use, or later dispersed/damaged by farm equipment (AVD, 2007).

DEK is in the process of revising its procedures and establishing a Cultural Resources Protection Plan for the protection of historic and archaeological resources at KPS. In its plan, KPS has an inadvertent discovery (stop work) provision. Should historic and archaeological resources be encountered during land disturbing activities, work will be halted and the WHS will be consulted for guidance.

DEK currently has no planned changes or ground disturbing activities associated with license renewal at KPS. However, given the potential for the discovery of additional historic and archaeological resources at the KPS site, DEK needs to ensure that these resources are considered prior to any ground disturbance during future plant operations and maintenance activities. DEK currently has a stop work order within its Cultural Resource Protection Plan and procedures to ensure that proper notification is taken to protect these resources should they be discovered.

Based on review of WHS archaeological file surveys, assessments, and other information, the potential impacts of continued operations and maintenance on historic and archaeological resources at KPS would be SMALL. DEK could reduce any potential impacts to historic and archaeological resources located at the KPS by training staff in the Section 106 consultation process and cultural awareness training to ensure that informed decisions are made prior to any ground disturbing activities. In addition, KPS may also forward its Cultural Resources Protection Plan to the WHS for review and comment. This will ensure that historic and archaeological resources are protected at the KPS site. Any revisions to the Cultural Resources Protection Plan should be developed in consultation with the NRC and the WHS. In addition, lands not surveyed should be investigated by a qualified archaeologist prior to any ground disturbing activity.

4.9.7 Environmental Justice

Under Executive Order (E.O.) 12898 (59 FR Federal Register 7629), Federal agencies are responsible for identifying and addressing potential disproportionately high and adverse human health and environmental impacts on minority and low-income populations. In 2004, the Commission issued a Policy Statement on the Treatment of Environmental Justice Matters in

NRC Regulatory and Licensing Actions (69 FR 52040). That policy states: "The NRC is committed to the general goals of E.O. 12898, [and] will strive to meet those goals through its normal and traditional NEPA review process."

The Council of Environmental Quality (CEQ) provides the following information in Environmental Justice: Guidance Under the National Environmental Policy Act (NEPA) 1997:

> **Disproportionately High and Adverse Human Health Effects.** Adverse health effects are measured in risks and rates that could result in latent cancer fatalities, as well as other fatal or nonfatal adverse impacts on human health. Adverse health effects may include bodily impairment, infirmity, illness, or death. Disproportionately high and adverse human health effects occur when the risk or rate of exposure to an environmental hazard for a minority or low-income population is significant (as defined by NEPA) and appreciably exceeds the risk or exposure rate for the general population or for another appropriate comparison group (CEQ, 1997).

> **Disproportionately High and Adverse Environmental Effects.** A disproportionately high environmental impact that is significant (as defined by NEPA) refers to an impact or risk of an impact on the natural or physical environment in a low-income or minority community that appreciably exceeds the environmental impact on the larger community. Such effects may include ecological, cultural, human health, economic, or social impacts. An adverse environmental impact is an impact that is determined to be both harmful and significant (as defined by NEPA). In assessing cultural and aesthetic environmental impacts, impacts that uniquely affect geographically dislocated or dispersed minority or low-income populations or American Indian tribes are considered (CEQ, 1997).

The environmental justice analysis assesses the potential for disproportionately high and adverse human health or environmental effects on minority and low-income populations that could result from the operation of KPS during the renewal term. In assessing the impacts, the following CEQ (1997) definitions of minority individuals and populations and low-income population were used:

> **Minority individuals.** Individuals who identify themselves as members of the following population groups: Hispanic or Latino, American Indian or Alaska Native, Asian, Black or African American, Native Hawaiian or Other Pacific Islander, or two or more races meaning individuals who identified themselves on a Census form as being a member of two or more races, for example, Hispanic and Asian.

> **Minority populations.** Minority populations are identified when (1) the minority population of an affected area exceeds 50 percent, or (2) the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis.

Low-income population. Low-income populations in an affected area are identified with the annual statistical poverty thresholds from the Census Bureau's Current Population Reports, Series PB60, on Income and Poverty.

4.9.7.1 *Minority Population in 2000*

The 50-mile radius around KPS includes 12 counties in Wisconsin. The geographic area includes any census block with all or part of its area within the 50-mile radius. According to 2000 census data, 7.6 percent of the population (approximately 724,241 individuals) residing within a 50-mile (80-km) radius of KPS identified themselves as minority individuals. The largest minority group was Hispanic or Latino (19,195 persons or 2.7 percent), followed by Asian (17,200 or about 2.4 percent) (USCB, 2003 – Land View 6). About 1.8 percent of the Kewaunee County population identified themselves as minorities, with Hispanic or Latino as the largest minority group (0.8 percent) followed by American Indian and Alaska Native (0.6 percent) (USCB, 2009) (see Table 2.2.8.5–2).

Approximately 15 census block groups within 50 miles of KPS were determined to have high density minority population percentages that exceeded the state average by 20 percentage points or more. The largest number of high density minority block groups was Hispanic or Latino, with six census block groups that exceed the state average 20 percent or more. The greatest concentrations of high density minority population block groups are located near Green Bay, Wisconsin, or the Oneida Indian Reservation just west of Green Bay. No high density minority census block groups were found within 20 miles of KPS (DEK, 2008). The Oneida Nation Indian Reservation is located west of Green Bay, Wisconsin (Brown and Outagamie counties).

Based on 2000 census data, Figure 4-1 shows the location of high density minority blocks within a 50-mile radius of KPS.

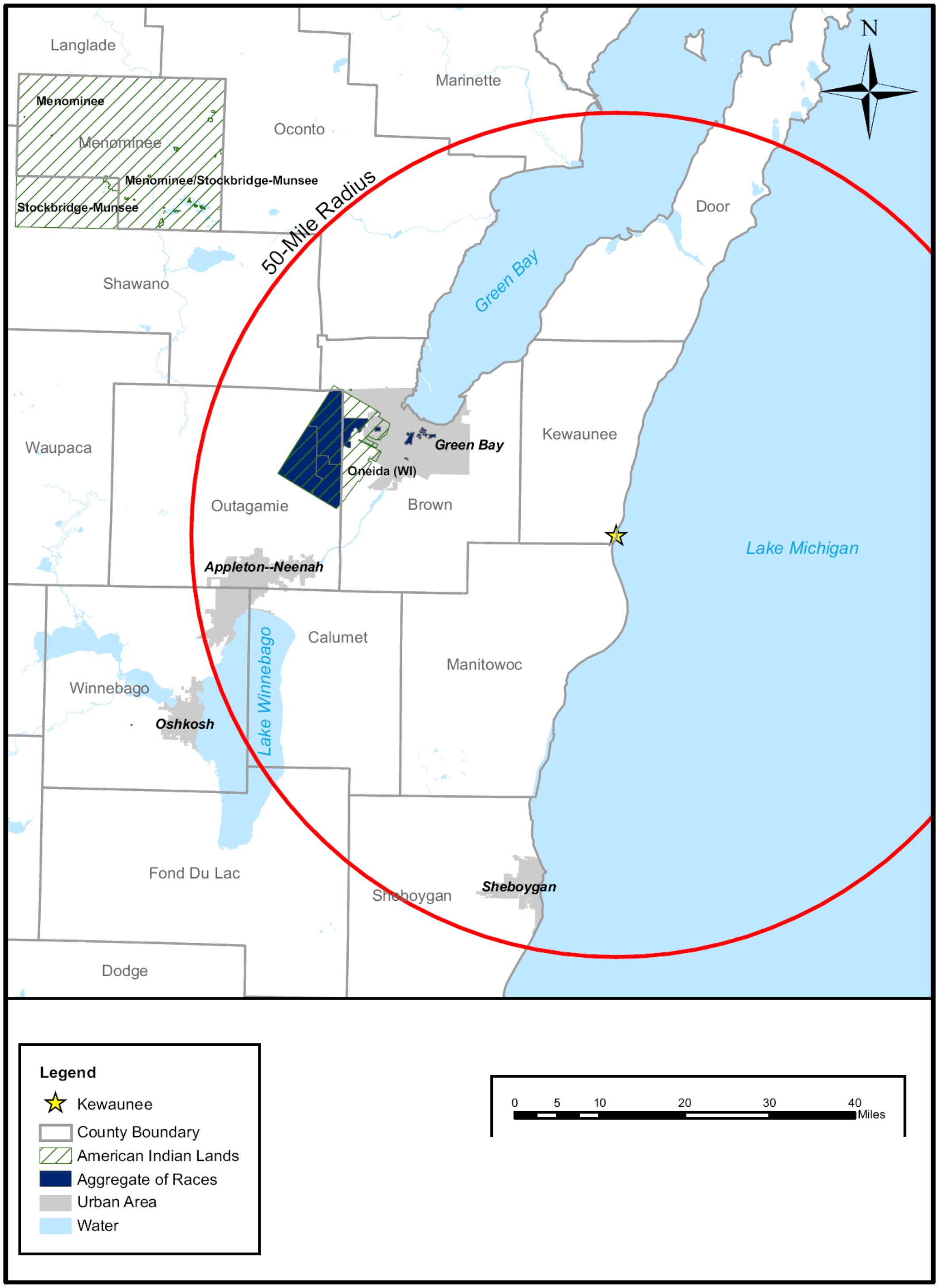

Figure 4-1. Minority Blocks in 2000 within a 50-Mile Radius of Kewaunee Power Station (DEK, 2008; USCB, 2003)

4.9.7.2 *Low-Income Population in 2000*

According to 2000 census data, approximately 7,418 families and 41,197 individuals (approximately 3.9 and 5.7 percent, respectively) residing within a 50-mile radius of KPS were identified as living below the Federal poverty threshold in 1999 (USCB, 2003 LandView 6). The 1999 Federal poverty threshold was $17,029 for a family of four.

According to census data estimates, the median household income for Wisconsin in 2007 was $50,567, with 10.8 percent of the State population living below the Federal poverty threshold. Kewaunee County had the highest median household income average ($53,356) and the lowest percentage (7.3 percent) of individuals living below the poverty level when compared to the State average and the other three counties. Manitowoc County had the lowest median household income of the four counties ($48,175) and a lower percentage (8.6 percent) of individuals living below the poverty level when compared to the State. Brown County had a median household income of $52,452 and the highest percentage (10.3 percent) of individuals living below the poverty level among the three counties (USCB, 2009).

Census block groups were considered high density low-income block groups if the percentage of households below the Federal poverty threshold exceeded the State average by 20 percent or more. Based on 2000 Census data, there were 2 block groups within the 50-mile radius of KPS that exceeded the State average for low income households by 20 percent or more. The census block groups with low-income populations were located in Brown County and in Green Bay, Wisconsin (DEK, 2008). Figure 4-2 shows the location of the high density low-income census block groups within a 50-mile radius of KPS.

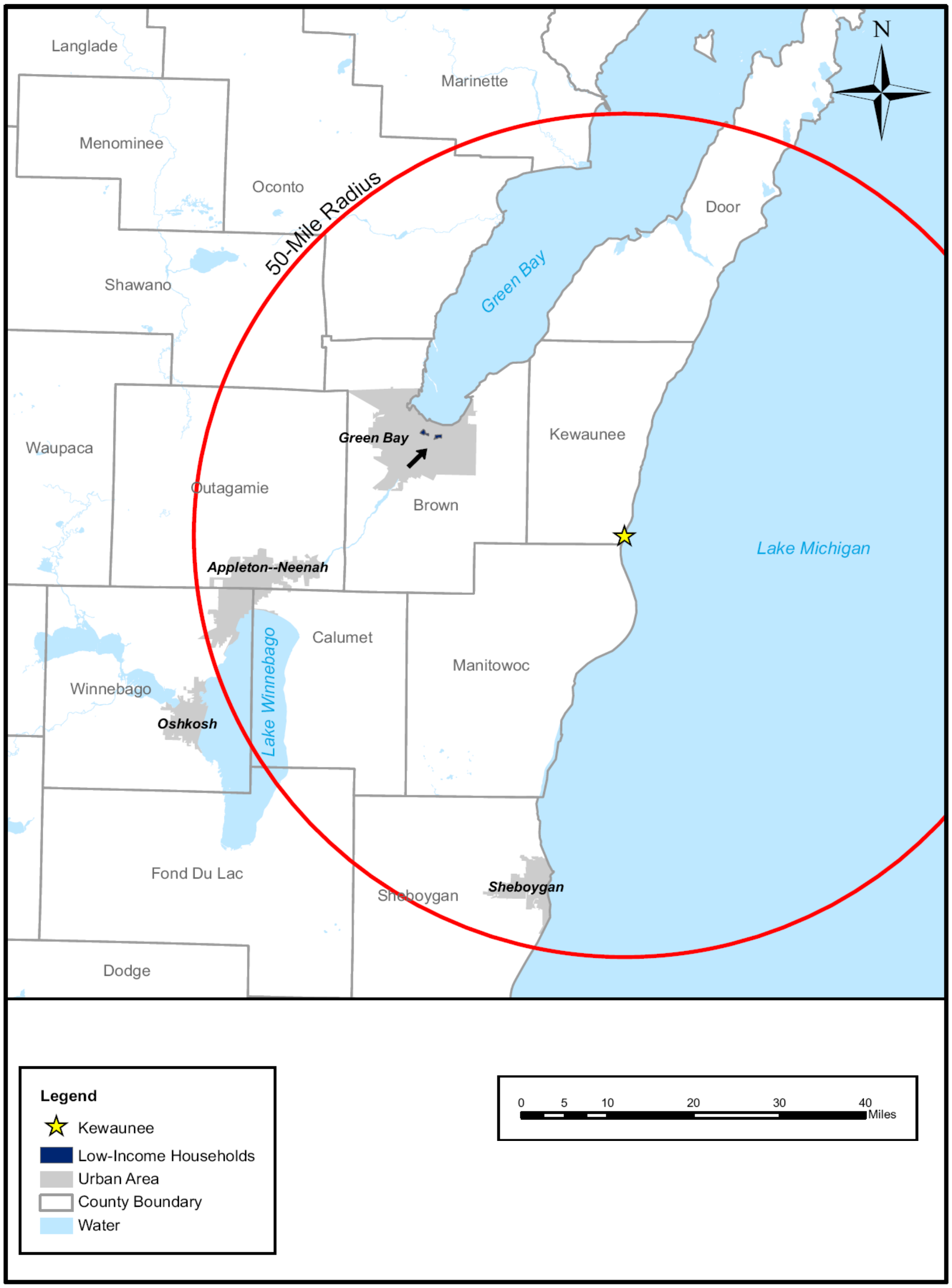

Figure 4-2. Low-Income Block Groups within a 50-Mile Radius of Kewaunee Power Station (DEK, 2008; USCB, 2003)

4.9.7.3 *Analysis of Impacts*

Consistent with the impact analysis for the public and occupational health and safety, the affected populations are defined as minority and low-income populations who reside within a 50-mile radius of the KPS. Based on the analysis of environmental health and safety impacts presented in Chapter 4 of this draft SEIS for other resource areas, there would be no disproportionately high and adverse impacts to minority and low-income populations from the continued operation of the KPS during the license renewal period.

The NRC analyzed the risk of radiological exposure through the consumption patterns of special pathway receptors, including subsistence consumption of fish, native vegetation, surface waters, sediments, and local produce. The NRC also analyzed the absorption of contaminants in sediments through the skin and inhalation of plant materials. The special pathway receptors analysis is important to the environmental justice analysis because consumption patterns may reflect the traditional or cultural practices of minority and low-income populations in the area. This analysis is presented below.

4.9.7.4 *Subsistence Consumption of Fish and Wildlife*

Section 4-4 of E.O. 12898 (1994) directs Federal agencies, whenever practical and appropriate, to collect and analyze information on the consumption patterns of populations that rely principally on fish and/or wildlife for subsistence and to communicate the risks of these consumption patterns to the public. The NRC staff considered whether or not there were any means for minority or low-income populations to be disproportionately affected by examining impacts to American Indian, Hispanic, and other traditional lifestyle special pathway receptors. In addition, the NRC staff considered special pathways that took into account the levels of contaminants in native vegetation, crops, soils and sediments, surface water, fish, and game animals in the vicinity of KPS.

DEK has an ongoing comprehensive Radiological Environmental Monitoring Program (REMP) at KPS that assesses the radiological impact of site operations on the environment. The REMP program monitors radiation levels in atmospheric, terrestrial, and aquatic environments. All samples are collected by DEK personnel and are shipped to a laboratory for analysis.

To assess the radiological impact of the plant on the environment, the monitoring program at KPS uses indicator-control sampling. Samples are collected at nearby indicator locations downwind and downstream from the plant and at distant control locations upwind and upstream from the plant. A plant effect would be indicated if the radiation level at an indicator location was significantly larger than at the control location. The difference would also have to be greater than could be accounted for by typical fluctuations in radiation levels arising from other naturally-occurring sources.

Samples are collected from the aquatic and terrestrial pathways in the vicinity of KPS. The aquatic pathways include fish, surface water, slime, bottom sediment, and ground water. The terrestrial pathways include airborne particulates, milk, domestic meat, eggs, garden vegetables, grass and cattle feed, soil, and direct radiation. During 2007, analyses performed on collected samples of environmental media showed no significant or measurable radiological impact from KPS operations (DEK, 2008b).

Surface water sampling at KPS consists of monthly samples from three locations on Lake Michigan and three creeks (North, Middle, and South creeks) that pass through the site. All samples are analyzed for gamma-emitting isotopes. Tritium activity is measured through one composite sample from South Creek. All results from the 2007 REMP were below the required lower limit of detection (DEK, 2008b).

In bottom sediment samples, the mean gross beta concentrations measured lower at the indicator locations than the control locations. Cesium-134 measured below detection levels in all samples. A low level of cesium-137 was observed in one of the two control samples tested. On average, cesium-137 measurements are lower than, or similar to, levels observed from 1979 through 2006. Levels of strontium-89 and strontium-90 measured below respective detection limits in all samples (DEK, 2008b).

In fish, gross beta concentration was primarily due to potassium-40 activity. A concentration of Cesium-137 was detected in one of three tested samples in levels lower than those observed between 1979 and 1991, but at similar levels to those seen from 1992 through 2006. The strontium-89 and strontium-90 concentrations were below detection levels in all samples (DEK, 2008b).

According to the 2007 KPS REMP, 126 milk samples were collected and analyzed for low-level iodine-131 by radiochemical separation. All samples were below detection levels. Naturally occurring potassium-40 results were almost identical in all samples. Strontium-89 concentrations measured below detection levels in all samples. Low levels of strontium-90 were found in 62 of the 84 samples tested. Mean values were almost identical for indicator and control sample locations and are similar to or less than averages seen from 1990 through 2006 (DEK, 2008b).

Ground water was collected from two onsite wells and analyzed for tritium and gamma emitting radionuclides. All samples were tested for tritium and gamma emitting isotopes. Tritium concentrations measured below detection levels. Gamma-emitting isotopes measured below respective detection levels (DEK, 2008b).

In domestic meat and egg samples, gross alpha concentration measured below detection levels for both indicator and control locations. Gamma-spectroscopic analyses showed that almost all beta activity was due to naturally occurring potassium-40. All other gamma-emitting isotopes were below their respective detection levels (DEK, 2008b).

In vegetables, gamma-spectroscopic analyses showed that almost all beta activity was due to naturally occurring potassium-40 and was below respective levels of detection. Levels of strontium-89 and strontium-90 measured below their respective levels of detection (DEK, 2008b).

In two samples (clover and oats) gamma-spectroscopic analyses showed that almost all beta activity was due to naturally occurring potassium-40 and beryllium-7 observed in the samples. Beryllium-7 is produced continuously in the upper atmosphere by cosmic radiation. Other gamma-emitting isotopes were below their respective levels of detection. Levels of strontium-89 and strontium-90 measured below their respective levels of detection (DEK, 2008b).

In grass and cattlefeed samples, gamma-spectroscopic analyses showed that almost all beta activity was due to naturally occurring potassium-40 and beryllium-7. Other gamma-emitting isotopes were below their respective levels of detection. Levels of strontium-89 measured below the levels of detection in grass and cattlefeed samples. Strontium-90 activity was found in one of twelve cattlefeed samples tested, and was similar or lower than levels observed from 1996 through 2006 (DEK, 2008b).

Gross alpha concentrations in soil samples at the indicator locations were similar to concentrations at the control locations. Levels of strontium-89 measured below the levels of detection. Low levels of strontium-90 activity were detected in nine of fourteen samples tested (DEK, 2008b).

Low levels of cesium-137 were detected in 12 of 14 soil samples, similar at both indicator and control locations. Potassium-40 was detected in all samples and averaged the same at indicator and control locations. All other gamma-emitting isotopes were below their respective detection levels. These levels of detected activities are similar to those observed from 1990 through 2006. The data suggests no evidence of a plant effect on soil measurements (DEK, 2008b).

The results of the KPS 2007 REMP sampling demonstrate that the routine operation at KPS has had no significant or measurable radiological impact on the environment. No elevated radiation levels were detected in the offsite environment as a result of plant operations and the storage of radioactive waste. The results of the REMP continue to demonstrate that the operation of the KPS did not result in a significant measurable dose to a member of the general population or adversely impact the environment as a result of radiological effluents. The REMP continues to demonstrate that the dose to a member of the public from the operation of KPS remains significantly below the Federally required dose limits specified in 10 CFR Part 20, 10 CFR Part 72, and 40 CFR Part 190.

Based on recent monitoring results, concentrations of contaminants in native leafy vegetation, soils and sediments, surface water, and fish in areas surrounding KPS have been quite low (at or near the threshold of detection) and seldom above background levels. Consequently, no disproportionately high and adverse human health impacts would be expected in special pathway receptor populations in the region as a result of subsistence consumption of fish and wildlife.

4.10 EVALUATION OF NEW AND POTENTIALLY SIGNIFICANT INFORMATION

The new and significant assessment process that DEK used during preparation of the KPS ER (DEK, 2008) license renewal application included:

(1) Interviews with DEK, Dominion Resources Services, Inc., WPSC, and ATC subject experts on information related to the conclusions in the GEIS as they relate to KPS;

(2) Review of DEK and KPS environmental management systems for how current programs manage potential impacts and/or provide mechanisms for KPS staff to become aware of new and significant information;

(3) Correspondence with State and Federal regulatory agencies to determine if the agencies had concerns;

(4) Review of documents related to environmental issues at KPS and regional environs;

(5) Credit for oversight provided by inspections of plant facilities and environmental monitoring operations by State and Federal regulatory agencies; and

(6) Independent review of plant-related information contracted by DEK with industry experts on license renewal and environmental impacts.

DEK stated in the KPS ER (DEK, 2008) that it is aware of no new and significant information regarding the environmental impacts of KPS license renewal.

The NRC staff evaluated this information during its independent review of the KPS ER, the scoping process, the site audit, and interviews with knowledgeable DEK personnel. The NRC staff concluded that there is no new and significant information related to the environmental impacts of the KPS license renewal.

4.11 CUMULATIVE IMPACTS

The NRC staff considered potential cumulative impacts in its environmental analysis of continued operation of KPS. For the purposes of this analysis, past actions are those related to the resources at the time of the power 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 including the period of extended operation. Therefore, the analysis considers potential impacts through the end of the current license terms as well as the 20-year renewal license term. The geographic area over which past, present, and future actions would occur 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 Sections 4.1 through 4.9, are combined with other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions.

4.11.1 Cumulative Impacts on Water and Aquatic Resources

This section addresses the impacts of the proposed action that relate to the withdrawal and discharge of lake water by the KPS once-through cooling system, combined with other past, present, and future actions that occur within the defined geographic area of Lake Michigan. The geographic area considered for the analysis of cumulative impacts on aquatic resources focuses on the western portion of Lake Michigan.

The water quality of Lake Michigan directly affects the aquatic resources in the vicinity of KPS. Lake Michigan's water quality in turn is affected, and will continue to be affected, by boating and fishing, agricultural runoff, and development along and near the waterfront. Water quality has been a recognized issue within the Great Lakes for over a century. The Great Lakes Water Quality Agreement, which was first signed in 1972, was formed to address the deteriorating water quality within the Great Lakes. Numerous fish species in Lake Michigan have consumption advisories as a result of elevated levels of mercury. Atrazine and other compounds found in herbicides and pesticides also contribute to the lake's water quality problems. These compounds affect water quality most in the spring and summer months, corresponding to agricultural production. Atrazine concentrations, specifically, may be increasing under present loads to Lake Michigan (Brent et al., 2001). However, with continued bi-national management efforts, including the Great Lakes Fishery Commission, Great Lakes Water Quality Agreements, and the International Joint Commission, which are discussed in Section 2.2.5, Aquatic Resources, water quality is expected to improve in the future.

Lake Michigan has undergone drastic changes in its fish communities due to exotic species introductions. As discussed in Section 2.2.5, Aquatic Resources, the sea lamprey (*Petromyzon marinus*) and alewife (*Alosa pseudoharengus*) have had the most pronounced impact on native aquatic populations. Overfishing and predation by sea lamprey is thought to be responsible for the extirpation of lake trout (*Salvelinus namaycush*) in Lake Michigan (USGS, 2008). Sea lamprey have also led to the extinction of three deepwater cisco species: the long jaw cisco (*Coregonus alpenae*), the deepwater cisco (*C. johannae*), and the blackfin cicso (*C. nigripinnis*) (Fuller et al. 2007). Alewives negatively impact water clarity by consuming zooplankton, outcompeting native species for food, and also preying on other species' eggs (Crowder 1980). Future management challenges will include keeping the salmonid community stable given the available forage base, and suppressing the alewife population growth to a level that does not threaten the continued existence of native species (Eshenroder et al. 1995).

Point Beach Nuclear Plant (PBNP) is located about 5 miles (8 km) south of KPS along Lake Michigan. PBNP is a two-unit pressurized-water reactor plant with a once-through cooling system. PBNP received a renewed license through 2030 and 2033 for Units 1 and 2, respectively, and therefore, will continue to operate during the term of KPS's continued operation. The PBNP SEIS (NRC, 2005) concluded that the impacts of continued operation of PBNP on the impingement and entrainment of aquatic organisms and heat shock to aquatic organisms are all SMALL. Studies at PBNP indicated that alewives and rainbow smelt (*Osmerus mordax*) were the primary species in both impingement and entrainment samples. Though both cooling systems alone have been determined to have a SMALL effect on aquatic organisms, the combined impact of KPS and PBNP on the alewife and rainbow smelt populations, specifically, may be noticeable, though these combined impacts have not been specifically studied and both the alewife and rainbow smelt are considered invasive, nuisance species. The PBNP SEIS concluded that cumulative impacts from heat shock are not expected to be any greater when both plants are considered because the KPS and PBNP heated discharge mixing zones do not overlap (NRC, 2005).

The NRC staff has determined that the cumulative impacts on aquatic resources resulting from all past, present, and reasonably foreseeable future actions, including non-KPS actions, would be MODERATE. This designation is largely the result of past actions including water quality issues and native aquatic community destabilization due to invasive species introductions.

4.11.2 Cumulative Impacts on Terrestrial Resources

This section addresses past, present, and future actions that could result in adverse cumulative impacts to terrestrial resources, including wildlife populations, upland habitats, wetlands, Lake Michigan shoreline, riparian zones, invasive species, protected species, and land use. For purposes of this analysis, the geographic area considered in the evaluation includes the KPS site, the adjacent shoreline both to the north and south, any wetlands on the KPS site or adjacent to the KPS site, and the in-scope transmission line ROWs identified in section 2.1.5 of this draft SEIS.

Before construction of KPS, terrestrial communities on the surrounding area supported forested habitat, wetland habitat, Lake Michigan coastline, and agricultural lands. With the construction of KPS, 60 acres (24 ha) were converted to developed areas for the reactor building and other plant structures.

Construction of the transmission line ROWs maintained by ATC for the KPS site resulted in changes to the plant species, and possibly wildlife within the ROWs. Habitat fragmentation resulting from the transmission line ROWs likely caused effects such as change in light, wind, and temperature; an increased susceptibility to invasive species; and a possible reduction in habitat ranges for certain species. ROW maintenance has likely had past impacts and is likely to have present and future impacts on the terrestrial habitat, which may include the buildup of herbicides, prevention of natural selection stages, an increase in edge species, a decrease in interior species, and an increase in invasive species. Continuing to lease agricultural land to farmers for areas within the transmission line ROWs will help reduce some of these potential impacts.

Neither DEK nor ATC manage invasive species on their land holdings. Therefore, a potential exists for invasive species to be introduced on or in the vicinity of the KPS site or its associated transmission line ROWs from present and future actions. Introduction of these species may contribute to the establishment of an invasive species population, which could compete with native populations for resources and degrade areas of terrestrial habitat.

Erosion to the Lake Michigan shoreline on the KPS site and its associated transmission lines from activities such as boating and fishing have the potential for adverse cumulative impacts. Continued maintenance for erosion on the shoreline by KPS should minimize impacts.

Prior and continued residential, commercial, agricultural, and industrial development of the areas surrounding the KPS site and its associated transmission line ROWs may impact terrestrial habitat in the area. Increases in both commercial and residential development have occurred in these areas over the past 40 years. As this area continues to grow, additional runoff from roads and impervious surfaces, development adjacent to wetlands and riparian zones, and an increase in waste releases could have future impacts on the terrestrial habitat. Section 2.2.8.3 of this draft SEIS discusses offsite land use in the vicinity of KPS.

The potential cumulative effects of climate change could result in a variety of changes to terrestrial resources on and around the KPS site. Increases in average annual temperature and increased frequency of heat waves, droughts, and heavy rainfall events all have the potential to impact wildlife populations, protected species, upland habitats, wetlands, riparian zones, and invasive species. Increased precipitation could change vegetation composition on the KPS site, potentially increasing wetlands, and decreasing riparian communities due to coastal erosion. Long-term effects of climate change on terrestrial resources could include a shift in forest composition or even an overall loss of forests, loss of bird diversity, a change in local mammal populations, and an increase in the range of invasive species and other pests (CEQ, 1997).

The NRC staff believes that the cumulative impacts during the term of license renewal on terrestrial habitat and associated species, when added to past, present, and reasonably foreseeable future actions, would be SMALL.

4.11.3 Cumulative Impacts on Human Health

The NRC and the EPA established radiological dose limits for protection of the public and workers from both acute and long-term exposure to radiation and radioactive materials. These dose limits are codified in 10 CFR Part 20 and 40 CFR Part 190. As discussed in Section 4.8.1 of this draft SEIS, the doses resulting from operation of KPS are below regulatory limits and the impacts of these exposures would be SMALL. For the purposes of this analysis, the geographical area considered is within a 50-mile (80-km) radius of the KPS site.

EPA regulations at 40 CFR Part 190 limit the dose to members of the public from all sources in the nuclear fuel cycle, including nuclear power plants, fuel fabrication facilities, waste disposal facilities, storage of spent nuclear fuel in dry casks, and transportation of fuel and waste. In addition, as discussed in Section 4.8.1, KPS has conducted a radiological environmental monitoring program around its site since before operations began in 1974. This program measures radiation and radioactive materials from KPS and all other sources, including the nearby PBNP.

PBNP is located approximately 5 miles south of KPS on the western shore of Lake Michigan in Manitowoc County, Wisconsin. PBNP has two pressurized-water reactors and an independent spent fuel storage installation. In 2005, the NRC completed a supplemental EIS regarding the PBNP license renewal application. The NRC concluded that the cumulative doses from PBNP and KPS were within the dose limits in 10 CFR Part 20 and 40 CFR Part 190 (NRC, 2005).

As discussed in Section 4.8.1 of this report, the staff reviewed the radiological environmental radiation monitoring results for KPS for the five-year period from 2004 through 2008 as part of the cumulative impacts assessment. Cumulative radiological impacts from all uranium fuel cycle facilities within a 50-mile (80-km) radius of the KPS site, which includes PBNP, are limited by the dose limits in 10 CFR Part 20 and 40 CFR Part 190. Based on the NRC staff review of the radiological environmental monitoring data from KPS and the State of Wisconsin, the radioactive effluent release data from KPS, and the SEIS regarding the PBNP license renewal, the cumulative radiological impacts to the public from the operation of KPS during the renewal term would be SMALL. The NRC and the State of Wisconsin will regulate any future development or actions in the vicinity of the KPS site that could contribute to cumulative radiological impacts. Therefore, the NRC staff has concluded that the cumulative radiological impacts to human health from the continued operation of KPS during the license renewal term would be SMALL.

The NRC staff determined that the electric-field-induced currents from the KPS transmission lines are well below the NESC recommendations for preventing electric shock from induced currents. Therefore, the KPS transmission lines do not detectably affect the overall potential for electric shock from induced currents within the analysis area. With respect to chronic effects of EMFs, although the GEIS finding of “not applicable” is appropriate to KPS, the transmission lines associated with KPS are not likely to detectably contribute to the regional exposure to ELF-EMFs. Therefore, the NRC staff determined that the cumulative impacts of the continued operation of the KPS transmission lines would be SMALL. The NRC staff identified a variety of measures that could mitigate potential acute EMF impacts resulting from continued operation of the KPS’s transmission lines. These mitigation measures would include erecting barriers along the length of the transmission line to prevent unauthorized access to the ground beneath the conductors and installing road signs at road crossings. These mitigation measures could reduce human health impacts by minimizing public exposures to electric shock hazards. The NRC staff did not identify any cost benefit studies applicable to these mitigation measures.

4.11.4 Cumulative Impacts on Socioeconomics

As discussed in Section 4.4 of this draft SEIS, continued operation of KPS during the license renewal term would have no impact on socioeconomic conditions in the region beyond those already experienced. Since DEK has no plans to hire additional workers during the license renewal term, overall expenditures and employment levels at KPS would remain relatively constant with no additional demand for permanent housing and public services. In addition, since employment levels and tax payments would not change, there would be no population or tax revenue-related land use impacts. There would also be no disproportionately high and adverse health and environmental impacts on minority and low-income populations in the region. Based on this and other information presented in this chapter there would be no cumulative socioeconomic impacts from the continued operation of KPS during the license renewal term beyond what is currently being experienced.

Any ground disturbing activities during the license renewal term could, however, result in the cumulative loss of historic and archaeological resources. Historic and archaeological resources are non-renewable; therefore, the loss of archaeological resources is cumulative. The continued operation of KPS during the license renewal term has the potential to impact historic and archaeological resources.

As discussed in Section 4.9.6, continued operation of the KPS during the license renewal term would have a SMALL impact on archaeological resources. While archaeological surveys were not conducted prior to the construction of KPS, DEK has conducted a Phase I survey to identify historic and archaeological resources on the KPS site. DEK is also revising its corporate procedures and establishing a “Cultural Resources Protection Plan” to improve the protection of archaeological resources at KPS. DEK could also train staff to ensure that historic and archaeological resources are protected at the KPS site.

DEK has no plans to alter the KPS site for license renewal. Any future land disturbing activities would be carried out under corporate procedures. These procedures have stop work provisions in the case of any inadvertent discoveries. Should plans change, further consultation would be initiated by DEK with the NRC and WHS. Because impacts to historic and archaeological resources from the continued operation of KPS would be SMALL, the cumulative environmental impacts to historic and archaeological resources would be SMALL.

4.11.5 Cumulative Impacts on Air Quality

KPS is located in Kewaunee County, Wisconsin, which belongs to EPA Region 5. Kewaunee County belongs to the Lake Michigan Intrastate Air Quality Control Region (Wisconsin) (AQCR) designated by the EPA and codified in 40 CFR 81.67 and Chapter 404.03 of the Wisconsin Administrative Code. Seventeen counties in the State of Wisconsin belong to the Lake Michigan Intrastate AQCR, three counties among them (Door County, Manitowoc County and Sheboygan County) are currently designated by the EPA as 8-hour ozone non-attainment areas. Kewaunee County is a maintenance county for 8-hour ozone and is in attainment for all other criteria pollutants (EPA, 2009).

As discussed in Air Quality Impacts Section 2.2.2.1, WDNR has primary responsibility for regulating air emission sources within the State of Wisconsin and also conducting ambient air monitoring in the State. WDNR is in the process of registering the Mayville monitoring site as a National Core (NCore) multi-pollutant higher-sensitivity monitoring station, therefore fulfilling the EPA's final amendments to the ambient air monitoring regulations for criteria pollutants contained in 40 CFR Parts 53 and 58. KPS is recognized as a Synthetic Minor facility, non-Part 70 by WDNR due to the quantities of emissions and restrictions on the hours of operation of its stationary sources of criteria pollutants (DEK, 2009a).

In April 2009, the EPA published the official United States inventory of greenhouse gas (GHG) emissions that identifies and quantifies the primary anthropogenic sources and sinks of GHGs (EPA 2009a). GHG inventories, such as this, are mechanisms developed by the United Nations Framework Convention on Climate Change that enable participating countries to compare their relative global contributions from different emission sources and GHGs to assess their impact on climate change. In its report, the EPA estimates that energy-related activities in the United States account for three-quarters of human-generated GHG emissions, mostly in the form of carbon dioxide emissions from burning fossil fuels. More than half of the energy-related emissions come from major stationary sources like power plants, and approximately a third come from transportation. Industrial processes (production of cement, steel, and aluminum), agriculture, forestry, other land use and waste management are also sources of GHG emissions in the United States (EPA, 2009a).

Potential cumulative effects of climate change on the Great Lakes Region, whether from natural cycles or anthropogenic (man-induced) activities, could result in a variety of changes to the air quality of the area. As projected in the "Global Climate Change Impacts in the United States" report by United States Global Change Research Program (USGCRP, 2009), average annual temperatures in the Great Lakes Region and Midwest are expected to rise, causing more frequent extreme weather events. The climate of the Midwest, and Wisconsin in particular, is projected to become drier in summer, causing mild to significant reductions in Great Lakes water levels and reduced ice cover. Reduced ice cover will contribute to faster evaporation in winter, causing water deficits. The projected increase in winter and spring precipitation will cause more frequent occurrences of severe weather events. Increases in average annual temperatures, increased occurrences of intense rainfall or drought, and changes in wind patterns could affect concentrations and long-range transport of air pollutants. The formation of air pollutants partially depends on temperature and humidity and interactions between hourly changes in the physical and dynamic properties of the atmosphere, including circulation features, wind, topography and energy use (IPCC, 2009).

In 1993, WDNR conducted the "Wisconsin Greenhouse Gas Emissions Inventory and Emission Reduction Cost Study" which led to the development of a Climate Change Action Plan in 1998. The Wisconsin GHG emissions inventory is periodically updated per this plan. In 2007, the enactment of E.O. 191 in Wisconsin led to the creation of the Governor's Task Force on Global Warming, which outlined its mission, goals and recommendations in the 2008 final report to the governor, "Wisconsin's Strategy for Reducing Global Warming" (WDNR, 2009). WDNR is also a member of the Wisconsin Initiative on Climate Change Impacts that assesses and evaluates climate change impacts on specific Wisconsin natural resources, industry, agriculture, tourism, and other human activities.

Consistent with the findings in the GEIS, the Staff concludes that the impacts from continued operation of KPS on air quality are SMALL. In addition, as no refurbishment is planned at KPS during the license renewal period, no additional air emissions would result from refurbishment activities. With respect to GHG, the EPA has not established limits on such emission sources, as further evaluation of data is still needed. Therefore, the Staff concludes that, combined with the emissions from other past, present, and reasonably foreseeable future actions, cumulative hazardous and criteria air pollutants emissions on air quality from KPS-related actions would be SMALL.

4.11.6 Summary of Cumulative Impacts

The NRC staff considered the potential impacts resulting from the operation of KPS during the period of extended operation and other past, present, and future actions in its vicinity. The preliminary determination is that most of the potential cumulative impacts resulting from KPS operation during the period of extended operation would be SMALL.

Table 4-17. Summary of Cumulative Impacts on Resource Areas. *The cumulative impacts were determined to be SMALL for most of the resource areas.*

Resource Area	Impact	Discussion
Water/Aquatic Resources	MODERATE	See Section 4.11.1
Terrestrial Resources	SMALL	See Section 4.11.2
Human Resources	SMALL	See Section 4.11.3
Socioeconomics	SMALL	See Section 4.11.4
Air Quality	SMALL	See Section 4.11.5

4.12 REFERENCES

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

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

10 CFR 72. *Code of Federal Regulations*, Title 10, *Energy*, Part 72, “Licensing Requirements for the Independent Storage of Spent Nuclear Fuel, High-Level Waste, and Reactor-Related Greater Than Class C Waste.”

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36 CFR Part 60. *Code of Federal Regulations*, Title 36, *Parks, Forests, and Public Property*, Part 60, Section 4, “Criteria for Evaluation.”

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

40 CFR 53. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 53, “Ambient Air Monitoring Reference and Equivalent Methods.”

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5.0 ENVIRONMENTAL IMPACTS OF POSTULATED ACCIDENTS

This chapter describes the environmental impacts from postulated accidents that might occur during the period of extended operation. The term "accident" refers to any unintentional event outside the normal plant operational envelope that results in a release or the potential for release of radioactive materials into the environment. Two classes of postulated accidents, listed in Table 5-1 below, are evaluated in the generic environmental impact statement (GEIS). These are design-basis accidents (DBAs) and severe accidents.

Table 5-1. Issues Related to Postulated Accidents. *Two issues related to postulated accidents are evaluated under the National Environmental Policy Act (NEPA) in the license renewal review: DBAs and severe accidents.*

Issue	GEIS Section	Category
DBAs	5.3.2; 5.5.1	1
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	2

5.1 DESIGN-BASIS ACCIDENTS

In order to receive U.S. Nuclear Regulatory Commission (NRC) approval to operate a nuclear power facility, an applicant for an initial operating license must submit a safety analysis report (SAR) as part of its 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 or not the plant design meets NRC 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 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 Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50 and 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. The results of these evaluations are found in license documentation such as the applicant's final safety analysis report (FSAR), the safety evaluation report (SER), the final environmental statement (FES), and Section 5.1 of this supplemental environmental impact statement (SEIS). A licensee is required to maintain the acceptable design and performance criteria throughout the life of the plant, including any period of extended operation. The consequences for these events are evaluated for the hypothetical maximum exposed individual; as such, changes in the plant environment will not affect these evaluations. Because of the requirements that continuous acceptability of the consequences and aging management programs must be in effect for the period of extended operation, the environmental impacts as calculated for DBAs should not differ significantly from initial licensing assessments over the life of the plant, including the period of extended operation. Accordingly, the design of the plant relative to DBAs during the period of extended operation is considered to remain acceptable and the environmental impacts of DBAs 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, DBAs are designated as a Category 1 issue. The early resolution of the DBAs makes 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.

No new and or significant information related to DBAs was identified during the review of the Dominion Energy Kewaunee, Inc.’s (DEK) environmental report (ER) (DEK, 2008a), site audit, the scoping process, or evaluation of other available information. Therefore, there are no impacts related to these issues beyond those discussed in the GEIS.

5.2 SEVERE ACCIDENT MITIGATION ALTERNATIVES

Regulation under 10 CFR 51.53(c)(3)(ii)(L) requires that license renewal applicants consider alternatives to mitigate severe accidents if the staff has not previously evaluated severe accident mitigation alternatives (SAMAs) for the applicant's plant in a GEIS 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 Kewaunee Power Station (KPS); therefore, the remainder of Chapter 5 addresses those alternatives.

5.2.1 Introduction

This section presents a summary of the SAMA evaluation for KPS conducted by DEK and the NRC staff's review of that evaluation. The NRC staff performed its review with contract assistance from Information Systems Laboratories. The NRC staff’s review is available in full in Appendix F of this document; the SAMA evaluation is available in full in DEK’s ER.

The SAMA evaluation for KPS was conducted with a four-step approach. In the first step DEK quantified the level of risk associated with potential reactor accidents using the plant-specific probabilistic risk assessment (PRA) and other risk models.

In the second step DEK examined the major risk contributors and identified possible ways (SAMAs) for reducing that risk. Common ways of reducing risk are changes to components, systems, procedures, and training. DEK identified 189 potential SAMAs for KPS. DEK performed an initial screening to determine if any SAMAs could be eliminated because they: (1)

are not applicable at KPS due to design differences, (2) have been effectively implemented at KPS, (3) have estimated costs that would exceed the dollar value associated with completely eliminating all severe accident risk at KPS, or (4) have a very low benefit because they are associated with a non-risk-significant system. This screening reduced the list of potential SAMAs to 64.

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

Finally, in the fourth step, the costs and benefits of each of the remaining SAMAs were compared to determine whether or not the SAMA was cost beneficial, meaning the benefits of the SAMA were greater than the cost (a positive cost benefit). DEK concluded in its ER that several of the SAMAs evaluated are potentially cost-beneficial (DEK, 2008a). However, in response to NRC staff inquiries regarding estimated benefits for certain SAMAs and lower cost alternatives, several additional potentially cost-beneficial SAMAs were identified (DEK, 2009a).

The potentially cost-beneficial 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. DEK's SAMA analyses and the NRC's review are discussed in more detail below.

5.2.2 Estimate of Risk

DEK submitted an assessment of SAMAs for KPS as part of the ER (DEK, 2008a). This assessment was based on the most recent KPS PRA available at that time, a plant-specific offsite consequence analysis performed using the MELCOR Accident Consequence Code System 2 (MACCS2) computer program, and insights from the KPS individual plant examination (IPE) (WPSC, 1992) and individual plant examination of external events (IPEEE) (WPSC, 1994).

For the purpose of the SAMA evaluation, the baseline core damage frequency (CDF) is approximately 7.7×10^{-5} per year. The CDF value is based on the risk assessment for internally-initiated events. DEK did not include the contributions from external events within the KPS risk estimates; however, it did account for the potential risk reduction benefits associated with external events by increasing the estimated benefits for internal events by a factor of two. The breakdown of CDF by initiating event is provided in Table 5-2 that follows.

Table 5-2. Kewaunee Power Station Internal Events Core Damage Frequency

Initiating Event	CDF (Per Year)	% Contribution to CDF
Internal floods	4.5 x 10-5	58
Transient with main feedwater available	6.5 x 10-6	8
Loss of component cooling water	6.0 x 10-6	8
Steam generator tube rupture (SGTR)	4.7 x 10-6	6
Loss of offsite power	3.9 x 10-6	5
Stuck open pressurizer	2.0 x 10-6	3

Initiating Event	CDF (Per Year)	% Contribution to CDF
Loss of service water	1.9 x 10-6	3
Loss of main feedwater	1.6 x 10-6	2
Small loss-of-coolant accident (LOCA)	1.2 x 10-6	2
Vessel failure	9.5 x 10-7	1
Loss of instrument air	8.0 x 10-7	1
All others	2.5 x 10-6	3
Total CDF (internal events)	**7.7 x 10-5**	**100**

As shown in this table, events initiated by internal flooding are the dominant contributors to CDF.

DEK estimated the dose to the population within 50 miles (80 km) of the KPS site to be approximately 0.302 person-sievert (Sv) (30.2 person-rem) per year. The breakdown of the total population dose by containment release mode is summarized in Table 5-3. Containment bypass events (such as transients with an induced SGTR, or SGTR-initiated accidents with a stuck open safety relief valve on the ruptured steam generator) and late containment failures without containment spray dominate the population dose risk at KPS.

Table 5-3. Breakdown of Population Dose by Containment Release Mode

Containment Release Mode	Population Dose (Person-Rem Per Year)	% Contribution
Late containment failure without containment sprays	8.6	29
Interfacing-systems loss-of-coolant accident (ISLOCA) with scrubbing	0.2	<1
ISLOCA without scrubbing	0.9	3
SGTR with failure of secondary side isolation	19.5	64
SGTR with successful secondary side isolation	0.9	3
Other	0.1	1
Total	**30.2**	**100**

[1]One person-rem = 0.01 person-Sv

The NRC staff has reviewed DEK'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 candidate SAMAs. Accordingly, the staff based its assessment of offsite risk on the CDFs and offsite doses reported by DEK.

5.2.3 Potential Plant Improvements

Once the dominant contributors to plant risk were identified, DEK searched for ways to reduce that risk. In identifying and evaluating potential SAMAs, DEK considered insights from the plant-specific PRA, and SAMA analyses performed for other operating plants that have submitted license renewal applications. DEK identified 189 potential risk-reducing improvements (SAMAs) to plant components, systems, procedures and training. A detailed cost-benefit analysis was performed for each of the SAMAs.

DEK removed all but 64 of the SAMAs from further consideration because they are not applicable at KPS due to design differences, have already been effectively implemented at KPS, have estimated costs that would exceed the dollar value associated with completely eliminating all severe accident risk at KPS, or have a very low benefit because they are associated with a non-risk-significant system. A detailed cost-benefit analysis was performed for each of the remaining SAMAs.

The staff concludes that DEK used a systematic and comprehensive process for identifying potential plant improvements for KPS, and that the set of potential plant improvements identified by DEK is reasonably comprehensive and, therefore, acceptable.

5.2.4 Evaluation of Risk Reduction and Costs of Improvements

DEK evaluated the risk reduction potential of the remaining 64 SAMAs. The SAMA evaluations were performed using generally conservative assumptions.

DEK estimated the costs of implementing the candidate SAMAs through the application of engineering judgment, the use of other licensee's estimates for similar improvements, and the use of KPS actual experience 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 contingency costs associated with unforeseen implementation obstacles.

The staff reviewed DEK'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 DEK's risk reduction estimates.

The staff reviewed the bases for the applicant's cost estimates. For certain improvements, the staff also compared the cost estimates to estimates developed elsewhere for similar improvements, including estimates developed as part of other licensee's analyses of SAMAs for operating reactors and advanced light-water reactors. The staff found the cost estimates to be reasonable and generally consistent with estimates provided in support of other plants analyses.

The staff concludes that the risk reduction and the cost estimates provided by DEK are sufficient and appropriate for use in the SAMA evaluation.

5.2.5 Cost Benefit Comparison

The cost benefit analysis performed by DEK was based primarily on NUREG/BR-0184 (NRC, 1997) and was executed consistent with this guidance. NUREG/BR-0058 has recently been revised to reflect the agency's revised policy on discount rates. Revision 4 of NUREG/BR-0058 states that two sets of estimates should be developed─one at three percent and one at seven percent (NRC, 2004). DEK provided both sets of estimates (DEK, 2008a).

DEK identified 14 potentially cost-beneficial SAMAs in the ER's baseline analysis:

- SAMA 66 - Install a new feedwater source. (The evaluated SAMA actually involved proceduralizing use of existing water sources)
- SAMA 80 - Add redundant ventilation systems. (The evaluated SAMA actually involved staging temporary equipment and providing procedures and power source connections)
- SAMA 82, 83, 170, 171 – Add switchgear room ventilation response. (The evaluated SAMA actually involved staging backup fans in switchgear rooms, adding switchgear room high temperature alarm, staging temporary fans and ducts along with power cords for safeguards alley room cooling, and providing high temperature alarms for the safeguards alley)
- SAMA 169 - Provide flood protection for MCC-52E, -62E, and -62H.
- SAMA 172 - Provide additional alarm for extremely low condensate storage tank level.
- SAMA 173 - Protect auxiliary building mezzanine cooling units from spray.
- SAMA 174 - Protect boric acid transfer pumps from spray.
- SAMA 175 - Protect a-train closed cooling water pump from spray.
- SAMA 176 - Install larger sump pumps in safeguards alley.
- SAMA 177 - Install watertight barrier between 480 VAC switchgear rooms.
- SAMA 181 - Install break-away mechanisms on emergency diesel generator (EDG) room doors.

DEK performed additional analyses to evaluate the impact of parameter choices and uncertainties on the results of the SAMA assessment (DEK, 2008a). Based on this, DEK concluded that no additional SAMAs would be cost beneficial even at the 95 percentile risk values.

DEK also considered the impact of simultaneous implementation of several of the SAMAs from both a benefit and a cost standpoint. DEK concluded that while the simultaneous implementation of several SAMAs would not increase the total benefit beyond that for each SAMA individually, the implementation cost could be reduced. Based on the evaluation of similar SAMAs involving improvements in room cooling and ventilation, DEK concluded that the following three additional SAMAs involving diesel room cooling improvements would be cost beneficial:

- SAMA 81 - Add a diesel building high temperature alarm or redundant louver and thermostat
- SAMA 166 - Open doors for alternate (diesel generator (DG) room cooling)
- SAMA 167 - Proceduralize actions to open EDG room doors on loss of heating, ventilation, and air conditioning (HVAC) and implement portable fans

Finally, DEK reviewed the analysis of the K107Aa PRA, prepared subsequent to the SAMA evaluation documented in the ER, and found one new contributor to risk that could be impacted by a candidate SAMA. DEK concluded that a new SAMA addressing this contributor, loss of screenhouse ventilation, could be cost-effectively combined with similar SAMAs 81, 82, 83, 160, 166, 167, 170, and 171.

- Implementation of temporary screenhouse ventilation, including installing additional temperature detectors

DEK committed to further review these SAMAs for implementation as part of DEK's ongoing performance improvement program (DEK 2008a; 2009a).

The staff concludes that, with the exception of the potentially cost-beneficial SAMAs discussed above, the costs of the SAMAs evaluated would be higher than the associated benefits.

5.2.6 Conclusions

The staff reviewed DEK's analysis and concluded that the methods used and the implementation of those methods are sound. The treatment of SAMA benefits and costs support the general conclusion that the SAMA evaluations performed by DEK are reasonable and sufficient for the license renewal submittal.

Based on its review of the SAMA analysis, the staff concurs with DEK's identification of areas in which risk can be further reduced in a cost-beneficial manner through the implementation of all or a subset of potentially cost-beneficial SAMAs. Given the potential for cost-beneficial risk reduction, the staff considers that further evaluation of these SAMAs by DEK is warranted. However, none of the potentially cost-beneficial SAMAs relate to adequately managing the effects of aging during the period of extended operation. Therefore, they need not be implemented as part of the license renewal pursuant to 10 CFR Part 54.

5.3 REFERENCES

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

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

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

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6.0 ENVIRONMENTAL IMPACTS OF THE URANIUM FUEL CYCLE, SOLID WASTE MANAGEMENT, AND GREENHOUSE GAS

6.1 THE URANIUM FUEL CYCLE

This section addresses issues related to the uranium fuel cycle and solid waste management during the period of extended operation. The uranium cycle includes uranium mining and milling, the production of uranium hexafluoride, isotopic enrichment, fuel fabrication, reprocessing of irradiated fuel, transportation of radioactive materials, and management of low-level wastes and high-level wastes related to uranium fuel cycle activities. The generic environmental impact statement (GEIS) (NRC 1996, 1999) details the potential generic impacts of the radiological and nonradiological environmental impacts of the uranium fuel cycle and transportation of nuclear fuel and wastes, as listed in Table 6-1 below. The GEIS is based, in part, on the generic impacts provided in Table S-3, "Table of Uranium Fuel Cycle Environmental Data," in Title 10 of the *Code of Federal Regulations* (CFR), Section 51.51(b), and in Table S-4, "Environmental Impact of Transportation of Fuel and Waste to and from One Light-Water-Cooled Nuclear Power Reactor," in 10 CFR 51.52(c). The GEIS also addresses the impacts from radon-222 and technetium-99.

The staff of the U.S. Nuclear Regulatory Commission (NRC) did not identify any new and significant information related to the uranium fuel cycle during the review of the Dominion Energy Kewaunee, Inc. (DEK) environmental report (ER) (DEK, 2008a), the site audit, and the scoping process. Therefore, there are no impacts related to these issues beyond those discussed in the GEIS. For these Category 1 issues, the GEIS concludes that the impacts are designated as SMALL, except for the collective offsite radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal.

Table 6-1. Issues Related to the Uranium Fuel Cycle and Solid Waste Management *Nine generic issues are related to the fuel cycle and solid waste management. There are no site-specific issues.*

Issues	GEIS Section	Category
Offsite 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	1
Offsite radiological impacts (collective effects)	6.1, 6.2.2.1, 6.2.3, 6.2.4, 6.6	1
Offsite radiological impacts (spent fuel and high-level waste disposal)	6.1, 6.2.2.1, 6.2.3, 6.2.4, 6.6	1
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	1

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Issues	GEIS Section	Category
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	1
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	1
Onsite 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	1
Nonradiological waste	6.1, 6.5, 6.5.1, 6.5.2, 6.5.3, 6.6	1
Transportation	6.1, 6.3.1, 6.3.2.3, 6.3.3, 6.3.4, 6.6, Addendum 1	1

6.2 GREENHOUSE GAS EMISSIONS

This section provides a discussion of potential impacts from greenhouse gases (GHGs) emitted during the nuclear fuel cycle. The GEIS does not directly address these emissions, and its discussion is limited to an inference that substantial carbon dioxide (CO_2) emissions may occur if coal- or oil-fired alternatives to license renewal are implemented.

6.2.1 Existing Studies

Since the development of the GEIS, the relative volumes of GHGs emitted by nuclear and other electricity generating methods have been widely studied. However, estimates and projections of the carbon footprint of the nuclear power lifecycle vary depending on the type of study conducted. Additionally, considerable debate also exists among researchers regarding the relative impacts of nuclear and other forms of electricity generation on GHG emissions. Existing studies on GHG emissions from nuclear power plants generally take two different forms:

(1) Qualitative discussions of the potential to use nuclear power to reduce GHG emissions and mitigate global warming; and

(2) Technical analyses and quantitative estimates of the actual amount of GHGs generated by the nuclear fuel cycle or entire nuclear power plant life cycle and comparisons to the operational or life cycle emissions from other energy generation alternatives.

6.2.1.1 *Qualitative Studies*

The qualitative studies consist primarily of broad, large-scale public policy or investment evaluations of whether an expansion of nuclear power is likely to be a technically, economically, and/or politically feasible means of achieving global GHG reductions. Examples of the studies identified by the NRC staff during the subsequent literature search include:

- Evaluations to determine whether investments in nuclear power in developing countries should be accepted as a flexibility mechanism to assist industrialized nations in achieving their GHG reduction goals under the Kyoto Protocols (Schneider, 2000; IAEA, 2000; NEA, 2002; NIRS/WISE, 2005). Ultimately, the parties to the Kyoto Protocol did not approve nuclear power as a component under the Clean Development Mechanism (CDM) due to safety and waste disposal concerns (NEA, 2002).
- Analyses developed to assist governments, including the United States, in making long-term investment and public policy decisions in nuclear power (Keepin, 1988; Hagen et al., 2001; MIT, 2003).

Although the qualitative studies sometimes reference and critique the existing quantitative estimates of GHGs produced by the nuclear fuel cycle or life cycle, their conclusions generally rely heavily on discussions of other aspects of nuclear policy decisions and investment such as safety, cost, waste generation, and political acceptability. Therefore, these studies are typically not directly applicable to an evaluation of GHG emissions associated with the proposed license renewal for a given nuclear power plant.

6.2.1.2 *Quantitative Studies*

A large number of technical studies, including calculations and estimates of the amount of GHGs emitted by nuclear and other power generation options, are available in the literature and were useful to the NRC staff's efforts in addressing relative GHG emission levels. Examples of these studies include – but are not limited to – Mortimer (1990), Andseta et al. (1998), Spadaro (2000), Storm van Leeuwen and Smith (2005), Fritsche (2006), Parliamentary Office of Science and Technology (POST) (2006), Atomic Energy Authority (AEA) (2006), Weisser (2006), Fthenakis and Kim (2007), and Dones (2007).

Comparing these studies and others like them is difficult because the assumptions and components of the lifecycles the authors evaluate vary widely. Examples of areas in which differing assumptions make comparing the studies difficult include:

- Energy sources that may be used to mine uranium deposits in the future;
- Reprocessing or disposal of spent nuclear fuel;

- Current and potential future processes to enrich uranium and the energy sources that will power them;
- Estimated grades and quantities of recoverable uranium resources;
- Estimated grades and quantities of recoverable fossil fuel resources;
- Estimated GHG emissions other than CO_2, including the conversion to CO_2 equivalents per unit of electric energy produced;
- Performance of future fossil fuel power systems;
- Projected capacity factors for alternatives means of generation; and
- Current and potential future reactor technologies.

In addition, studies may vary with respect to whether all or parts of a power plant's lifecycle are analyzed, i.e., a full lifecycle analysis will typically address plant construction, operations, resource extraction (for fuel and construction materials), and decommissioning, whereas a partial lifecycle analysis primarily focuses on operational differences.

In the case of license renewal, a GHG analysis for that portion of the plant's lifecycle (operation for an additional 20 years) would not involve GHG emissions associated with construction because construction activities have already been completed at the time of relicensing. In addition, the proposed action of license renewal would also not involve additional GHG emissions associated with facility decommissioning, because that decommissioning must occur whether the facility is relicensed or not. However, in some of the aforementioned studies, the specific contribution of GHG emissions from construction, decommissioning, or other portions of a plant's lifecycle cannot be clearly separated from one another. In such cases, an analysis of GHG emissions would overestimate the GHG emissions attributed to a specific portion of a plant's lifecycle. Nonetheless, these studies provide some meaningful information with respect to the relative magnitude of the emissions among nuclear power plants and other forms of electric generation, as discussed in the following sections.

In Tables 6-2, 6-3, and 6-4 the NRC staff presents the results of the aforementioned quantitative studies to provide a weight-of-evidence evaluation of the relative GHG emissions that may result from the proposed license renewal as compared to the potential alternative use of coal-fired, natural gas-fired, and renewable generation. Most studies from Mortimer (1990) onward suggest that uranium ore grades and uranium enrichment processes are leading determinants in the ultimate GHG emissions attributable to nuclear power generation. These studies indicate that the relatively lower order of magnitude of GHG emissions from nuclear power when compared to fossil-fueled alternatives (especially natural gas) could potentially disappear if available uranium ore grades drop sufficiently while enrichment processes continued to rely on the same technologies.

Summary of Nuclear Greenhouse Gas Emissions Compared to Coal

Considering that coal fuels the largest share of electricity generation in the United States and that its burning results in the largest emissions of GHGs for any of the likely alternatives to nuclear power generation, including Kewaunee Power Station (KPS), most of the available quantitative studies focused on comparisons of the relative GHG emissions of nuclear to coal-fired generation. The quantitative estimates of the GHG emissions associated with the nuclear fuel cycle (and, in some cases, the nuclear lifecycle), as compared to an equivalent coal-fired plant, are presented in Table 6-2. The following chart does not include all existing studies, but provides an illustrative range of estimates developed by various researchers.

Table 6-2. Nuclear Greenhouse Gas Emissions Compared to Coal

Source	GHG Emission Results
Mortimer (1990)	Nuclear—230,000 tons CO_2 Coal—5,912,000 tons CO_2 Note: Future GHG emissions from nuclear to increase because of declining ore grade.
Andseta et al. (1998)	Nuclear energy produces 1.4 percent of the GHG emissions compared to coal. Note: Future reprocessing and use of nuclear-generated electrical power in the mining and enrichment steps are likely to change the projections of earlier authors, such as Mortimer (1990).
Spadaro (2000)	Nuclear—2.5 to 5.7 g Ceq/kWh Coal—264 to 357 g Ceq/kWh
Storm van Leeuwen and Smith (2005)	Authors did not evaluate nuclear versus coal.
Fritsche (2006) (Values estimated from graph in Figure 4)	Nuclear—33 g Ceq/kWh Coal—950 g Ceq/kWh
POST (2006) (Nuclear calculations from AEA, 2006)	Nuclear—5 g Ceq/kWh Coal—>1000 g Ceq/kWh Note: Decrease of uranium ore grade to 0.03 percent would raise nuclear to 6.8 g Ceq /kWh. Future improved technology and carbon capture and storage could reduce coal-fired GHG emissions by 90 percent.
Weisser (2006) (Compilation of results from other studies)	Nuclear—2.8 to 24 g Ceq/kWh Coal—950 to 1250 g Ceq/kWh
Fthenakis and Kim (2007)	Authors did not evaluate nuclear versus coal.
Dones (2007)	Author did not evaluate nuclear versus coal.

Summary of Nuclear Greenhouse Gas Emissions Compared to Natural Gas

The quantitative estimates of the GHG emissions associated with the nuclear fuel cycle (and, in some cases, the nuclear lifecycle), as compared to an equivalent natural gas-fired plant, are presented in Table 6-3. The following chart does not include all existing studies, but provides an illustrative range of estimates developed by various researchers.

Table 6-3. Nuclear Greenhouse Gas Emissions Compared to Natural Gas

Source	GHG Emission Results
Mortimer (1990)	Author did not evaluate nuclear versus natural gas.
Andseta (1998)	Author did not evaluate nuclear versus natural gas.
Spadaro (2000)	Nuclear—2.5 to 5.7 g Ceq/kWh Natural Gas—120 to 188 g Ceq/kWh
Storm van Leeuwen and Smith (2005)	Nuclear fuel cycle produces 20 to 33 percent of the GHG emissions compared to natural gas (at high ore grades). Note: Future nuclear GHG emissions to increase because of declining ore grade.
Fritsche (2006) (Values estimated from graph in Figure 4)	Nuclear—33 g Ceq/kWh Cogeneration Combined Cycle Natural Gas—150 g Ceq/kWh
POST (2006) (Nuclear calculations from AEA, 2006)	Nuclear—5 g Ceq/kWh Natural Gas—500 g Ceq/kWh Note: Decrease of uranium ore grade to 0.03 percent would raise nuclear to 6.8 g Ceq/kWh. Future improved technology and carbon capture and storage could reduce natural gas GHG emissions by 90 percent.
Weisser (2006) (Compilation of results from other studies)	Nuclear—2.8 to 24 g Ceq/kWh Natural Gas—440 to 780 g Ceq/kWh
Fthenakis and Kim (2007)	Authors did not evaluate nuclear versus natural gas.
Dones (2007)	Author critiqued methods and assumptions of Storm van Leeuwen and Smith (2005), and concluded that the nuclear fuel cycle produces 15 to 27 percent of the GHG emissions of natural gas.

Summary of Nuclear Greenhouse Gas Emissions Compared to Renewable Energy Sources

The quantitative estimates of the GHG emissions associated with the nuclear fuel cycle, as compared to equivalent renewable energy sources, are presented in Table 6-4. Calculation of GHG emissions associated with these sources is more difficult than the calculations for nuclear energy and fossil fuels because of the large variation in efficiencies due to their different sources and locations. For example, the efficiency of solar and wind energy is highly dependent on the location in which the power generation facility is installed. Similarly, the range of GHG emissions estimates for hydropower varies greatly depending on the type of dam or reservoir involved (if used at all). Therefore, the GHG emissions estimates for these energy sources have a greater range of variability than the estimates for nuclear and fossil fuel sources. The following chart does not include all existing studies, but provides an illustrative range of estimates developed by various researchers.

1 **Table 6-4. Nuclear Greenhouse Gas Emissions Compared to Renewable Energy Sources**

Source	GHG Emission Results
Mortimer (1990)	Nuclear—230,000 tons CO_2 Hydropower—78,000 tons CO_2 Wind power—54,000 tons CO_2 Tidal power—52,500 tons CO_2 Note: Future GHG emissions from nuclear to increase because of declining ore grade.
Andseta (1998)	Author did not evaluate nuclear versus renewable energy sources.
Spadaro (2000)	Nuclear—2.5 to 5.7 g Ceq/kWh Solar PV—27.3 to 76.4 g Ceq/kWh Hydroelectric—1.1 to 64.6 g Ceq/kWh Biomass—8.4 to 16.6 g Ceq/kWh Wind—2.5 to 13.1 g Ceq/kWh
Storm van Leeuwen and Smith (2005)	Author did not evaluate nuclear versus renewable energy sources.
Fritsche (2006) (Values estimated from graph in Figure 4)	Nuclear—33 g Ceq/kWh Solar PV—125 g Ceq/kWh Hydroelectric—50 g Ceq/kWh Wind—20 g Ceq/kWh
POST (2006) (Nuclear calculations from AEA, 2006)	Nuclear—5 g Ceq/kWh Biomass—25 to 93 g Ceq/kWh Solar PV—35 to 58 g Ceq/kWh Wave/Tidal—25 to 50 g Ceq/kWh Hydroelectric—5 to 30 g Ceq/kWh Wind—4.64 to 5.25 g Ceq/kWh Note: Decrease of uranium ore grade to 0.03 percent would raise nuclear to 6.8 g Ceq/kWh.
Weisser (2006) (Compilation of results from other studies)	Nuclear—2.8 to 24 g Ceq/kWh Solar PV—43 to 73 g Ceq/kWh Hydroelectric—1 to 34 g Ceq/kWh Biomass—35 to 99 g Ceq/kWh Wind—8 to 30 g Ceq/kWh
Fthenakis and Kim (2007)	Nuclear—16 to 55 g Ceq/kWh Solar PV—17 to 49 g Ceq/kWh
Dones (2007)	Author did not evaluate nuclear versus renewable energy sources.

6.2.2 Conclusions: Relative GHG Emissions

The sampling of data presented in Tables 6-2, 6-3, and 6-4 above demonstrates the challenges of any attempt to determine the specific amount of GHG emission attributable to nuclear energy production sources, as different assumptions and calculation methodology will yield differing results. The differences and complexities in these assumptions and analyses will further increase when they are used to project future GHG emissions. Nevertheless, several conclusions can be drawn from the information presented.

First, the various studies indicate a general consensus that nuclear power currently produces fewer GHG emissions than fossil-fuel-based electrical generation, e.g., the GHG emissions from a complete nuclear fuel cycle currently range from 2.5 to 55 g C_{eq}/kWh, as compared to the use of coal plants (264 to 1250 g C_{eq}/kWh) and natural gas plants (120 to 780 g C_{eq}/kWh). The studies also provide estimates of GHG emissions from five renewable energy sources based on current technology. These estimates included solar-photovoltaic (17 to 125 g C_{eq}/kWh), hydroelectric (1 to 64.6 g C_{eq}/kWh), biomass (8.4 to 99 g C_{eq}/kWh), wind (2.5 to 30 g C_{eq}/kWh), and tidal (25 to 50 g C_{eq}/kWh). The range of these estimates is wide, but the general conclusion is that current GHG emissions from the nuclear fuel cycle are of the same order of magnitude as from these renewable energy sources.

Second, the studies indicate no consensus on future relative GHG emissions from nuclear power and other sources of electricity. There is substantial disagreement among the various authors regarding the GHG emissions associated with declining uranium ore concentrations, future uranium enrichment methods, and other factors, including changes in technology. Similar disagreement exists regarding future GHG emissions associated with coal and natural gas for electricity generation. Even the most conservative studies conclude that the nuclear fuel cycle currently produces fewer GHG emissions than fossil-fuel-based sources, and is expected to continue to do so in the near future. The primary difference between the authors is the projected cross-over date (the time at which GHG emissions from the nuclear fuel cycle exceed those of fossil-fuel-based sources) or whether cross-over will occur at all.

Considering the current estimates and future uncertainties, it appears that GHG emissions associated with the proposed KPS relicensing action are likely to be lower than those associated with fossil-fuel-based energy sources. The NRC staff based this conclusion on the following rationale:

1. As shown in Tables 6-2 and 6-3, the current estimates of GHG emissions from the nuclear fuel cycle are far below those for fossil-fuel-based energy sources;

2. KPS license renewal will involve continued GHG emissions due to uranium mining, processing, and enrichment, but will not result in increased GHG emissions associated with plant construction or decommissioning (as the plant will have to be decommissioned at some point whether the license is renewed or not); and

3. Few studies predict that nuclear fuel cycle emissions will exceed those of fossil fuels within a timeframe that includes the KPS periods of extended operation. Several studies

suggest that future extraction and enrichment methods, the potential for higher grade resource discovery, and technology improvements could extend this timeframe.

In comparing GHG emissions among the proposed KPS license renewal action and renewable energy sources, it appears likely that there will be future technology improvements and changes in mining, processing, and constructing facilities of all types. Currently, the GHG emissions associated with the nuclear fuel cycle and renewable energy sources are within the same order of magnitude. Because nuclear fuel production is the most significant contributor to possible future increases in GHG emissions from nuclear power, and because most renewable energy sources lack a fuel component, it is likely that GHG emissions from renewable energy sources would be lower than those associated with KPS at some point during the period of extended operation.

The NRC staff provides an additional discussion about the contribution of GHGs to cumulative air quality impacts in Chapter 4.11.5 of this SEIS.

6.3 REFERENCES

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

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

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7.0 ENVIRONMENTAL IMPACTS OF DECOMMISSIONING

Decommissioning is defined as the safe removal of a nuclear facility from service and the reduction of residual radioactivity to a level that permits release of the property for unrestricted use and termination of the license. The U.S. Nuclear Regulatory Commission (NRC) issued a generic environmental impact statement (GEIS) for decommissioning (NRC, 2002) that evaluated environmental impacts from the activities associated with the decommissioning of any reactor before or at the end of an initial or renewed license.

The NRC staff did not identify any new and significant information during the review of the Dominion Energy Kewaunee, Inc. (DEK) environmental report (DEK, 2008a), the site audit, or the scoping process. Therefore, there are no impacts related to these issues beyond those discussed in the GEIS (NRC 1996, 1999). For all of these issues, the GEIS concluded that the impacts are SMALL.

Table 7-1. Issues Related to Decommissioning. *Decommissioning would occur regardless if Kewaunee Power Station (KPS) is shut down at the end of its current operating license or at the end of the period of extended operation. There are no site-specific issues related to decommissioning.*

Issues	GEIS Sections	Category
Radiation doses	7.3.1; 7.4	1
Waste management	7.3.2; 7.4	1
Air quality	7.3.3; 7.4	1
Water quality	7.3.4; 7.4	1
Ecological resources	7.3.5; 7.4	1
Socioeconomic impacts	7.3.7; 7.4	1

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8.0 ENVIRONMENTAL IMPACTS OF ALTERNATIVES

The National Environmental Policy Act of 1969 (NEPA) mandates that each environmental impact statement (EIS) consider alternatives to any proposed major Federal action. U.S. Nuclear Regulatory Commission (NRC) regulations implementing NEPA for license renewal require that a supplemental environmental impact statement (SEIS) considers and weighs the environmental effects of the proposed action [license renewal]; the environmental impacts of alternatives to the proposed action; and alternatives available for reducing or avoiding adverse environmental impacts, per 10 CFR 51.71(d). In this case, the proposed Federal action is issuing a renewed license for the Kewaunee Power Station (KPS), which will allow the plant to operate for 20 years beyond its current license expiration date.

In this chapter, the staff examines the potential environmental impacts of alternatives to issuing a renewed operating license for KPS.

While the *Generic Environmental Impact Statement (GEIS) for License Renewal of Nuclear Plants*, NUREG-1437 (NRC 1996, 1999), reached generic conclusions regarding many environmental issues associated with license renewal, it did not determine which alternatives are reasonable or reach conclusions about site-specific environmental impact levels. Therefore, the staff must evaluate environmental impacts of alternatives on a site-specific basis.

In accordance with the GEIS, alternatives to the proposed action of issuing renewed KPS operating license must meet the purpose and need for issuing a renewed license; they must 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 (10 CFR 51.71(f)).

The staff ultimately makes no decision regarding whether an alternative or the proposed action is implemented, since that decision falls to utility, State, or other Federal officials. Comparing the environmental effects of these alternatives will assist the staff in deciding whether the environmental impacts of license renewal are so great that preserving the option of license renewal for energy-planning decision makers would be unreasonable (10 CFR 51.95(c)(4)). If the NRC acts to issue a renewed license, all of the alternatives, including the proposed action, will be available to energy-planning decision makers. If the NRC decides not to renew the license (or takes no action at all), then energy-planning decision makers may no longer elect to continue operating KPS and will have to resort to another alternative, which may or may not be one of the alternatives the staff considers in this section, in order to meet their energy needs.

In addition to evaluating alternatives to the proposed action, when appropriate the staff also examines alternatives that may reduce or avoid environmental impacts of the proposed action; the staff does so to illustrate how such alternatives may act to mitigate potential impacts of license renewal.

In evaluating alternatives to license renewal, the staff first selects energy technologies or options currently in commercial operation as well as some technologies not currently in commercial operation but likely to be commercially available by the time the current KPS operating license expires. Given that only four years remain before the KPS license expires, the options staff considers in this section are generally commercially available today.

Second, the staff screens the alternatives to remove those that cannot meet future system needs. Then, the staff screens the remaining options to remove those for which the cost or benefits do not justify inclusion in the range of reasonable alternatives. Any alternatives remaining constitute alternatives to the proposed action that the staff evaluates in-depth throughout this section. In Section 8.5, the staff briefly addresses each alternative that was removed during screening.

The staff initially considered 14 discrete potential alternatives to the proposed action and narrowed the list to the two single-source alternatives and two combination alternatives considered in this chapter.

Once the staff identified the in-depth alternatives, it referred to generic environmental impact evaluations in the GEIS. The GEIS provides overviews of some energy technologies available at the time of its publishing in 1996, though it does not reach any conclusions regarding which alternatives are most appropriate, nor does it precisely categorize impacts for each site. Since 1996, many energy technologies have evolved significantly in capability and cost-effectiveness, while regulatory structures have changed to either promote or impede development of particular alternatives.

In-Depth Alternatives:

- **Natural gas-fired combined-cycle**
- **Coal-fired alternative**
- **Combination including gas-fired, conservation, and wind (Combination Option 1) or wood-fired (Combination Option 2)**

Other Alternatives Considered:

- **Wind power**
- **Wood-fired**
- **Conservation**
- **Solar power**
- **Conventional hydroelectric power**
- **Geothermal power**
- **Biofuels**
- **New nuclear**
- **Oil-fired power**
- **Fuel cells**
- **Municipal solid waste**
- **Delayed retirement**

Where applicable, the staff uses information in the GEIS and includes updated information from the Energy Information Administration (EIA), other organizations within the Department of Energy (DOE), the Environmental Protection Agency (EPA), industry sources and publications, and information submitted by Dominion Energy Kewaunee, Inc. (DEK) in the KPS environmental report (ER).

For each in-depth analysis, the staff analyzes environmental impacts across seven impact categories: air quality, groundwater use and quality, surface water use and quality, ecology, human health, socioeconomics, and waste management. As in earlier chapters of this draft SEIS, the staff uses the NRC's three-level standard of significance—SMALL, MODERATE, or LARGE—to indicate the intensity of environmental effects for each alternative that the staff evaluates in-depth.

By placing the detailed alternatives analyses in this order, the staff does not imply which alternative would have the least impact, or which alternative an energy planning decision maker would be most likely to implement. Whenever possible, the staff considers effects from locating the alternative at the existing site, as well as at an alternate site. In general, impacts are smaller at an existing site because infrastructure necessary to support a power plant already exists, nearby populations are accustomed to power plant operations, and the site has already been disturbed to some degree.

Sections 8.1 through 8.3 include the staff's analyses of environmental impacts of alternatives to license renewal. These include a gas-fired alternative located both at the KPS site and at a different site (8.1), a coal-fired alternative at the KPS site and an alternate site (8.2), and two combination alternatives that include gas-fired capacity onsite as well as conservation and either wind power or wood-fired power (8.3). In section 8.4, the staff briefly discusses purchased power. In Section 8.5, the staff addresses alternatives excluded from in-depth analysis and addresses why they were excluded. Finally, in Section 8.6, the staff considers the environmental effects that may occur if NRC takes no action and does not issue renewed licenses for KPS.

Energy Outlook: Each year the EIA, part of the DOE, issues its updated *Annual Energy Outlook (AEO)*. *AEO 2009* indicates that natural gas will account for most new electrical capacity through 2030, with significant contributions from new renewable sources and coal, as well as some growth in nuclear capacity (EIA, 2009a)

"Natural-gas-fired plants account for 53 percent of capacity additions in the reference case [2008-2030], as compared with 22 percent for renewables, 18 percent for coal-fired plants, and 5 percent for nuclear. Escalating construction costs have the largest impact on capital-intensive technologies, including renewables, coal, and nuclear [ ]; but Federal tax incentives, State energy programs, and rising prices for fossil fuels increase the cost-competitiveness of renewable and nuclear capacity. In contrast, uncertainty about future limits on GHG [greenhouse gas] emissions and other possible environmental regulations … reduces the competitiveness of coal."

8.1 GAS-FIRED GENERATION

In this section, the staff evaluates the environmental impacts of natural gas-fired generation at both the KPS site and at an alternate site.

Natural gas fueled 21 percent of electric generation in the United States in 2008, accounting for the second greatest share of electrical power after coal (EIA, 2009b). Like coal-fired power plants, natural gas-fired plants may be affected by perceived or actual action to limit greenhouse gas (GHGs) emissions, though they produce markedly fewer GHGs per unit of electrical output than coal-fired plants. Natural gas-fired power plants are feasible, commercially-available options for providing electrical generating capacity beyond the current license terms for KPS. EIA projects that gas-fired generation will account for the largest share of capacity additions in the United States through 2030 (EIA, 2009a).

Combined-cycle power plants differ significantly from power plants that generate electricity solely from a steam cycle, as almost all coal-fired and all existing domestic nuclear power plants do. Combined-cycle power plants derive the majority of their electrical output from a gas-turbine cycle, and then generate additional power—without burning any additional fuel—through a second, steam-turbine cycle. The first, gas-turbine stage (similar to a large jet engine) burns natural gas that turns a driveshaft to power an electric generator. Ducts carry the hot exhaust from the turbine to a heat recovery steam generator, which then produces steam to drive another turbine and produce additional electrical power. The combined-cycle approach is significantly more efficient than any one cycle on its own; efficiencies can reach or exceed 60 percent. Natural gas combined-cycle generation requires significantly less cooling water and smaller cooling towers than the existing KPS, partly because of greater thermal efficiency and partly because gas turbines do not require condenser cooling like steam turbines do.

In order to replace the 556 megawatts-electric (MWe) output that KPS currently supplies, the NRC staff selected a gas-fired alternative that uses two General Electric Company (GE) MS7001FB combined cycle units, which together produce a net of 560 MWe (roughly 4 percent of gross plant output would power auxiliary systems, so the gross output is approximately 585 MWe). While any number of commercially-available combined-cycle units could be installed in a variety of combinations to replace the power currently produced by KPS, the MS7001FB is an efficient model that operates at a heat rate of 5,950 British thermal units per kilowatt hour (Btu/kWh), or 57.3 percent thermal efficiency (GE, 2007). GE and other manufacturers, like Siemens, offer similar high efficiency models, including several that slightly exceed the thermal efficiency of this model. Cooling towers for this alternative would likely be mechanical draft-type towers approximately 65 feet (20 m) in height.

In addition to cooling towers, other visible structures onsite would include the turbine buildings and heat recovery steam generators (which may be enclosed in the turbine building), two exhaust stacks, an electrical switchyard, and, possibly, equipment associated with a natural gas pipeline, like a compressor station. The GEIS estimated that a 1,000 MWe gas-fired alternative would require 110 acres (40 ha), meaning this 560-MWe plant would require 64 acres (26 ha). In their ER, DEK (2008) indicated that the plant would require 26 acres (11 ha), a number more consistent with minimum utility needs as demonstrated by existing power plants (including Dominion Resources' Fairless Energy Works located in Falls Township, Pennsylvania). The staff uses DEK's estimate for the purposes of the following analysis. According to DEK, a gas-fired plant constructed onsite would also require 272 acres (110 ha) for a natural gas pipeline. A gas-fired plant constructed at an alternate site would likely require a new pipeline spur, as well. For the purpose of this analysis, the staff assumes that a gas-fired alternative at an alternate site would require a similar amount of land for a pipeline and associated right of way (ROW).

This 560-MWe power plant would consume 25.3 billion ft^3 (718 million m^3) of natural gas annually, assuming an average heat content of 1,021 British thermal units per cubic feet (Btu/ft^3) (EIA, 2008). Natural gas would be extracted from the ground through wells in another region of the United States, then treated to remove impurities (like hydrogen sulfide), and blended to meet pipeline gas standards, before being piped through the interstate pipeline system to the power plant site. This gas-fired alternative would produce relatively little waste, which would primarily be in the form of spent catalysts used for emissions controls.

Environmental impacts from the gas-fired alternative will be greatest during construction. Site crews will clear vegetation from the site, prepare the site surface, and begin excavation before other crews begin actual construction on the plant and any associated infrastructure, including a pipeline spur to serve the plant and electricity transmission infrastructure connecting the plant to existing transmission lines.

Constructing the gas-fired alternative on the KPS site would allow the gas-fired alternative to make use of the site's existing transmission system, as well as take advantage of partially cleared areas of the site.

A gas-fired unit constructed offsite may cause additional construction-related impacts depending on the nature of the site selected. A site that has never been developed will likely experience greater impacts than a site that was previously industrial; a site near other power plants or industrial facilities will likely experience smaller impacts than a site surrounded by farmland or relatively natural surroundings.

Table 8-1. Summary of Environmental Impacts of Gas-Fired Combined-Cycle Generation Compared to Continued Kewaunee Power Station Operation

	Gas-fired combined-cycle		Continued KPS Operation
	At KPS site	At alternate site	
Air Quality	MODERATE	MODERATE	SMALL
Groundwater	SMALL	SMALL	SMALL
Surface Water	SMALL	SMALL to MODERATE	SMALL
Ecology	SMALL to MODERATE	SMALL to MODERATE	SMALL
Human Health	SMALL	SMALL	SMALL
Socioeconomics	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE
Waste Management	SMALL	SMALL	SMALL

8.1.1 Air Quality

Kewaunee County, Wisconsin, where KPS is located, is in EPA Region 5 and is in attainment for all criteria pollutants, except ozone. Kewaunee County is a maintenance area for 8-hour ozone (EPA, 2009a).

A new gas-fired generating plant in Kewaunee County would qualify as a new major-emitting industrial facility and require New Source Review (NSR) and Prevention of Significant Deterioration of Air Quality review under the Clean Air Act (CAA), as adopted by Wisconsin Department of Natural Resources (WDNR) in the Wisconsin Administrative Code and its Statutes (EPA, 2008a; Wis. Adm. Code chapters NR400-499; Wis. Stats. Chapter 285). The EPA delegated the authority of regulating the issuance of construction and operating permits to the WDNR, which coordinates the Wisconsin air pollution control permit program for new and existing pollution sources. A natural gas-fired plant would also need to comply with the standards of performance for electric utility steam generating units set forth in Title 40 of the *Code of Federal Regulations* (CFR) Part 60 Subpart Da.

Section 169A of the CAA (42 USC 7491) establishes a national goal of preventing future and remedying existing impairment of visibility in mandatory Class I Federal areas when impairment results from man-made air pollution. The EPA issued a 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 through developing and implementing air quality protection plans to reduce the pollution that causes visibility impairment. There are five regional planning organizations (RPO) that are collaborating on the visibility impairment issue and developing the technical basis for these plans. Wisconsin, Illinois, Indiana, Michigan and Ohio belong to the Midwest Regional Planning Organization (Midwest RPO) that along with tribes, Federal agencies and other interested parties identifies regional haze and visibility issues and develops strategies to address them. The visibility protection regulatory requirements, contained in 40 CFR Part 51, Subpart P, include the review of the new sources that would be constructed in the attainment or unclassified areas and may affect visibility in any Federal Class I area (40 CFR 51.307). If a coal-fired plant were located close to a mandatory Class I area, additional air pollution control requirements would be imposed.

There are no Mandatory Class I Federal areas in the State of Wisconsin or in close proximity to KPS. The closest Mandatory Class I Federal Areas to KPS are Seney Wilderness Area, Michigan, located 149 miles northeast from KPS, and Isle Royale National Park, Michigan, located 255 miles northwest of KPS.

The emissions from the natural gas-fired alternative at the KPS site, based on published EIA data, EPA emission factors and on performance characteristics for this alternative and implemented emission controls, would be:

- Sulfur oxides (SOx) – 43.98 tons (39.90 Metric ton(s) (MT)) per year
- Nitrogen oxides (NOx) – 141.00 tons (127.91 MT) per year
- Carbon monoxide (CO) – 29.31 tons (26.59 MT) per year
- Total suspended particles (TSP) – 24.58 tons (22.30 MT) per year
- Particulate matter (PM) PM_{10} – 24.58 tons (22.30 MT) per year
- Carbon dioxide (CO_2) – 1,513,164.22 tons (1,372,719.49 MT) per year

The new natural gas-fired plant would have to comply with Title IV of the CAA reduction requirements for sulfur dioxide (SO_2) and NOx, which are the main precursors of acid rain and a major cause of reduced visibility. Title IV establishes maximum SO_2 and NOx emission rates for existing plants and a system of SO_2 emission allowances that can be used, sold or saved for future use by new plants. On March 10, 2005, the EPA issued the Clean Air Interstate Rule (CAIR), which would create large permanent reductions in SO_2 and NOx across 28 eastern states and the District of Columbia. However, petitions for review of the CAIR and CAIR Federal Implementation Plans (FIPs), including the provisions establishing the CAIR NOx annual and ozone season and SO_2 trading programs, were filed in the U.S. Court of Appeals for the D.C. Circuit.

On July 11, 2008, the Court issued an opinion vacating and remanding the CAIR and CAIR FIPs. After requested rehearing of the Court's decision, the Court granted rehearing only to the extent that it remanded the rules to EPA without vacating them on December 23, 2008. This ruling leaves CAIR and the CAIR FIPs, including the CAIR trading programs, in place until EPA issues a new rule to replace CAIR in accordance with the July 11, 2008 decision. Wisconsin is among the States covered by this rule (EPA, 2009b). WDNR adopted the rule and is allocating annual NOx allowances for new electricity generating units subject to CAIR as specified in chapter NR 432 of the Wisconsin Administrative Code starting 2009. The NOx allowances are allocated from a "new unit set-aside" reserved pool of allowances, which represents 7 percent of Wisconsin's total budget of NOx allowances.

As stated above, the new natural gas-fired alternative would produce 43.98 tons (39.90 MT) per year of SOx and 141.00 tons (127.91 MT) per year of NOx based on the use of the dry low NOx combustion technology and use of the selective catalytic reduction (SCR) in order to significantly reduce NOx emissions.

The new plant would be subjected to the continuous monitoring requirements of SO_2, NOx and CO_2 specified in 40 CFR Part 75. The natural gas-fired plant would emit approximately 1,513,164.22 tons (1,372,719.49 MT) per year of unregulated CO_2 emissions. As of today, there is no required reporting of GHG emissions. In response to the Consolidated Appropriations Act of 2008, the EPA proposed a rule that would require mandatory reporting of GHG emissions from large sources, such as the presented alternative. The rule would allow for the collection of accurate and comprehensive emissions data to inform future policy decisions. The EPA proposes that suppliers of fossil fuels or industrial greenhouse gases, manufacturers of vehicles and engines, and facilities that emit 25,000 metric tons or more per year of GHG emissions submit annual reports to the EPA. The gases covered by the proposed rule are CO_2, methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFC), perfluorocarbons (PFC), sulfur hexafluoride (SF_6), and other fluorinated gases including nitrogen trifluoride (NF_3) and hydrofluorinated ethers (HFE).

In 1993, WDNR conducted the “Wisconsin Greenhouse Gas Emissions Inventory and Emission Reduction Cost Study,” and, in 1998, developed the Climate Change Action Plan. The Wisconsin GHG emissions inventory is periodically updated. In 2007, following the signing of Executive Order (E.O.) 191 by the governor of Wisconsin, the Governor’s Task Force on Global Warming was created. The Task Force outlined its mission, goals and recommendations in the 2008 final report to the governor, “Wisconsin's Strategy for Reducing Global Warming” (WDNR, 2009).

The gas-fired alternative would emit 24.58 tons (22.30 MT) per year of particulate matter having an aerodynamic diameter less than or equal to 10 micrometer (μm) (PM_{10}) (40 CFR 50.6a). All emitted particulates are PM_{10}.

In December 2000, the EPA issued regulatory findings (EPA, 2000a) on emissions of hazardous air pollutants from electric utility steam-generating units. Natural gas-fired power plants were found by the EPA to emit hazardous air pollutants such as arsenic, formaldehyde and nickel. Unlike coal- and oil-fired power plants, the EPA did not determine that emissions of hazardous air pollutants from natural gas-fired power plants should be regulated under Section 112 of the CAA.

Activities associated with the construction of a new natural gas-fired plant onsite or offsite would cause some additional air effects as a result of equipment emissions and fugitive dust from the operation of the earth moving and material handling equipment. Exhaust emissions from workers' vehicles and motorized construction equipment would be temporary. Construction crews would employ dust-control practices in order to control and reduce fugitive dust, which would be temporary in nature. The staff concludes that the impact of vehicle exhaust emissions and fugitive dust from operation of the earth-moving and material handling equipment would be SMALL.

The overall air-quality impacts of a new natural gas-fired plant located at the KPS site or at an alternate site would be MODERATE, primarily due to emissions released during plant operation.

8.1.2 Groundwater Use and Quality

The use of groundwater for a natural gas-fired combined-cycle plant (onsite or offsite) would likely be limited to supply wells for drinking water and possibly filtered service water for system cleaning purposes. For an onsite alternative, total usage would likely be much less than KPS because fewer workers would be onsite and because the gas-fired alternative would have fewer auxiliary systems requiring service water.

No effects on groundwater quality would be apparent except during the construction phase due to temporary dewatering (if necessary) and run-off control measures. Because of the temporary nature of construction and the likelihood of reduced groundwater usage during operation as compared to KPS, the impact of the gas-fired alternative (onsite or offsite) would be SMALL.

8.1.3 Surface Water Use and Quality

Total withdrawals of surface water from Lake Michigan would be much less for an onsite gas-fired plant than the 401,200 gallons per minute (gpm) (894 cubic feet per second (cfs) or 25.3 cubic meter per second (m^3/s)) average currently used by KPS. However, by switching from the open-cycle cooling system currently used by KPS to a closed-cycle cooling system used by the proposed alternative, consumptive water losses will increase. Because the onsite gas-fired plant would draw water from Lake Michigan and not a small river with reduced flow, the NRC concludes the impact of surface water use from the onsite alternative would be SMALL. If the alternate offsite location is also adjacent to Lake Michigan, the NRC concludes that the impact of surface water use will also be SMALL, but could be MODERATE if the plant withdrew cooling water from a small river with low flow.

A new gas-fired plant (onsite or offsite) would be required to obtain a Wisconsin Pollutant Discharge and Elimination System (WPDES) permit from the WDNR for regulation of industrial wastewater, storm water, and other discharges. Assuming the plant operates within the limits of this permit, the impact from any possible site runoff and effluent discharges on surface water quality would be SMALL.

8.1.4 Aquatic and Terrestrial Ecology

Aquatic Ecology

A new gas-fired plant would require a source of water for the plant's closed-cycle cooling system, and a discharge point for cooling tower blowdown. Locating the plant on the existing KPS site will enable some already-existing buildings and infrastructure to be used; however, impacts to aquatic ecology are likely during construction regardless of where the plant is located. Site disturbance will likely increase erosion and sedimentation runoff into Lake Michigan and nearby streams, increasing turbidity. While site procedures and management practices, as well as using already-existing structures on the KPS site when possible, may limit this effect, the impact will likely be noticeable. Overall construction effects are expected to be less significant for the gas-fired alternative than the coal-fired alternative because the amount of site disturbance is less and many of the major plant components are smaller and require less onsite fabrication.

During operations, the gas-fired alternative would require significantly less water for cooling than either the coal-fired alternative or the existing KPS unit, which would minimize the potential for impingement and entrainment and lessen the thermal discharge from the plant. Spills occurring during onsite activities will need to be appropriately handled, and runoff from new, impervious surfaces (e.g., roads and rooftops) may affect aquatic ecology, as could deposition of airborne pollutants to surface water, though these impacts are likely to be less pronounced than those from the coal-fired alternative.

Overall impacts to aquatic ecology from a gas-fired alternative are expected to be SMALL.

Terrestrial Ecology

Constructing the natural gas alternative, if the location is off site, will require approximately 32 acres (13 ha) of land. Land requirements would be minimal if the location is on the current KPS site. These land disturbances form the basis for impacts to terrestrial ecology. (Gas extraction and collection will also affect terrestrial ecology in offsite gas fields, although, as noted in Section 8.1, much of this land is likely already disturbed by gas extraction, and the incremental effects of this alternative on gas field terrestrial ecology are difficult to gauge.)

Impacts to terrestrial ecology will be minor if the selected site is the current KPS site because the site has been previously disturbed. Impacts to terrestrial ecology could be adverse if the location is off site; however, locating an offsite gas-fired plant on a previously disturbed site would minimize impacts. There is potential for disturbance of some areas with trees, Lake Michigan shoreline, or wetlands, and possible habitat fragmentation would occur. Construction of any additional transmission line ROWs, a lengthy pipeline, or additional roads on undisturbed or less-disturbed areas could adversely impact terrestrial ecology by fragmenting or destroying habitats. However, a pipelined fuel source and a small workforce would help to minimize the need for additional transportation infrastructure.

In addition, construction onsite, if some shorelines are impacted, or some of the forested lands and/or wetlands are converted to building facilities may eliminate onsite habitats and alter the site for a long period of time. Some areas onsite, such as any buffer areas, may remain undeveloped and could still harbor habitat for terrestrial species, though site lighting, noise, and activities may degrade the value of any remaining ecosystems. Deposition of air pollutants from this alternative may affect terrestrial ecology, but it is unlikely to be noticeable. Impacts to terrestrial resources from a natural gas combined-cycle alternative at both the KPS site and an alternate site would like be SMALL to MODERATE. Some of these impacts could be mitigated if the location of the gas-fired alternative is either placed on the current KPS site or on a previously disturbed location.

8.1.5 Human Health

The effects of gas-fired generation on human health are generally low, although in Table 8-2 of the GEIS (NRC, 1996), the staff identified cancer and emphysema as potential health risks from gas-fired plants. These risks are likely attributable to NOx emissions that contribute to ozone formation, which in turn contribute to health risks. It is expected that appropriate emission controls installed on the gas-fired alternative option would maintain NOx emissions well below EPA air quality standards established for the protection of human health. In addition, the use of emissions trading or offset requirements would ensure that the overall NOx in the region will not increase. There are potential health risks to plant workers from handling spent catalysts used to filter the emissions, because they may contain toxic heavy metals. However, the use of protective equipment and adherence to safety requirements would minimize the danger to the workers. It is expected that the facility would operate in compliance with Federal and State safety and emission standards.

Overall, the impacts on human health of the natural gas-fired alternative are likely to be SMALL.

8.1.6 Socioeconomics

Land Use

The analysis of land use impacts focuses on the amount of land area that would be affected by the construction and operation of a two unit natural gas-fired combined-cycle power plant at the KPS site and an alternative site. Land-use impacts would vary depending on where the plant would be located and whether construction would take place on undeveloped land or within a previously disturbed industrial (brownfield) area.

DEK indicated that over 298 acres (121 ha) of land would be needed to support a natural gas-fired alternative capable of replacing the KPS (DEK, 2008) including pipeline. The GEIS, however, estimates 110 acres (45 ha) of land would be needed to support a 1,000-MWe generating station (NRC, 1996). DEK estimated that 272 acres would be needed for a natural gas pipeline connection to KPS. This amount of land use would include other plant structures and associated infrastructure. By scaling the GEIS estimate, the 590-MWe KPS plant could require up to 336 acres (136 ha) of land.

However, if additional land would be necessary for a buffer around plant structures or to support transmission lines at an alternate site and gas pipelines at both KPS and at an alternate site, the staff believes the DEK estimate to be reasonable, although additional land may be used for buffer around plant structures or to support transmission lines. Even assuming additional land use for these purposes, total land required by the natural gas-fired alternative is unlikely to exceed 298 acres (121 ha) for all uses, excluding land for natural gas wells and collection stations. Land use impacts from construction would be SMALL, and could be further reduced if the power plant is collocated at an alternate site with another generating station or on a previously industrial site like KPS. Impacts could be further mitigated at an alternate site by constructing new transmission lines in existing ROWs.

In addition to onsite land requirements, land would be required off site for natural gas wells and collection stations. The GEIS estimates that 3,600 acres (1,457 ha) would be required for wells, collection stations, and pipelines to bring the gas to a 1,000-MWe generating facility. If this land requirement were scaled with generating capacity, a natural gas-fired power plant at the KPS could require 2,124 acres (860 ha). Most of this land requirement would occur on land where gas extraction already occurs. In addition, some natural gas could come from outside of the United States and be delivered as liquefied gas.

The elimination of uranium fuel for the KPS could partially offset offsite land requirements. In the GEIS, the NRC staff estimated that approximately 1,000 acres (405 ha) would not be needed for mining and processing uranium during the operating life of a 1,000-MWe nuclear power plant. For KPS, roughly 590 acres (239 ha) of uranium mining area would no longer be needed. Overall land use impacts from a gas-fired power plant would be SMALL to MODERATE, depending on local land use and the availability of land near the proposed site.

Socioeconomics

Socioeconomic impacts are defined in terms of changes to the demographic and economic characteristics and social conditions of a region. For example, the number of jobs created by the construction and operation of a new natural gas-fired power plant could affect regional employment, income, and expenditures. Two types of job creation may occur: (1) construction-related jobs, which are transient, short in duration, and less likely to have a long-term socioeconomic impact; and (2) operation-related jobs in support of power plant operations, which have the greater potential for permanent, long-term socioeconomic impacts. Staff estimated workforce requirements of power plant construction and operations for the natural gas-fired power plant alternative in order to determine their possible effect on current socioeconomic conditions.

The GEIS projects a workforce of 1,200 for a 1,000-MWe plant, which means a workforce of approximately 708 for a 590-MWe plant. During construction, the communities surrounding the power plant site would experience increased demand for rental housing and public services, although these effects would be moderated if the alternate construction site is located near an urban area with many skilled workers. The relative economic effect of construction workers on local economy and tax base would vary over time.

After construction, local communities may be temporarily affected by the loss of construction jobs and associated loss in demand for business services, and the rental housing market could experience increased vacancies and decreased prices. As noted in the GEIS, the socioeconomic impacts at a rural construction site could be larger than at an urban site, because the workforce would have to move to be closer to the construction site. The impact of construction on socioeconomic conditions could range from SMALL to MODERATE depending on whether the new power plant would be located at KPS or an alternate site. The socioeconomic impacts of power plant construction could be further reduced if the power plant is located near an urban area with many skilled workers.

DEK estimated a power plant operations workforce of 20 (DEK, 2008), while scaled GEIS estimates indicate up to 89 workers (150 operations workers for a 1,000-MWe plant). The DEK estimate appears to be low, but is consistent with trends toward lowering labor costs by reducing the size of power plant operations workforces. Nevertheless, depending on location, the small number of operations workers would not likely have a noticeable effect on socioeconomic conditions in the region. Therefore, socioeconomic impacts associated with the operation of a gas-fired power plant could be SMALL at KPS or an alternate site.

Transportation

During construction, approximately 700 workers would be commuting to the site. In addition to commuting workers, trucks would transport construction materials and equipment to the worksite increasing the amount of traffic on local roads. The increase in vehicular traffic would peak during shift changes resulting in temporary levels of service impacts and delays at intersections. Pipeline construction and modification to existing natural gas pipeline systems could also have an impact.

During plant operations, transportation impacts would almost disappear. As noted in this section, relatively few workers are required to operate the gas-fired alternative. Since fuel is transported by pipeline, most transportation infrastructure would experience little increased use from plant operations.

Overall, the gas-fired alternative would have a SMALL impact on transportation conditions in the region around the KPS or at an alternate site. Transportation impacts at an alternate site would depend on road capacity and average daily volume.

Aesthetics

Aesthetic resources are the natural and manmade features that give a particular landscape its character and aesthetic quality. The aesthetics impact analysis focuses on the degree of contrast between the power plant and the surrounding landscape and the visibility of the power plant.

The two gas-fired units could be approximately 100 feet (30 m) tall, with two exhaust stacks up to 175 feet (53 m) tall or taller depending on the topography at an alternate site. Some structures may require aircraft warning lights. Power plant infrastructure would generally be smaller and less noticeable than the KPS. Mechanical draft cooling towers would generate condensate plumes and operational noise. Noise during power plant operations would be limited to industrial processes and communications. Pipelines delivering natural gas fuel could be audible off site near compressors.

In addition to new power plant structures, the alternate plant site may require the construction of transmission lines and natural gas pipelines. The transmission lines would have a lasting visual effect on the landscape.

In general, aesthetic changes would be limited to the immediate vicinity of the KPS or an alternate site. Impacts would likely to be SMALL to MODERATE at KPS or an alternate site and would depend on the amount of new transmission line required.

Historic and Archaeological Resources

Cultural resources are the indications of human occupation and use of the landscape as defined and protected by a series of Federal laws, regulations, and guidelines. Prehistoric resources are physical remains of human activities that predate written records; they generally consist of artifacts that may alone or collectively yield information about the past. Historic resources consist of physical remains that postdate the emergence of written records; in the United States, they are architectural structures or districts, archaeological objects, and archaeological features dating after 1492. Ordinarily, sites less than 50 years old are not considered historic, but exceptions can be made for such properties if they are of particular importance, such as structures associated with the development of nuclear power (e.g., Shippingport Atomic power Station) or Cold War themes. American Indian resources are sites, areas, and materials important to American Indians for religious or heritage reasons. Such resources may include geographic features, plants, animals, cemeteries, battlefields, trails, and environmental features. The cultural resource analysis encompassed the power plant site and adjacent areas that could potentially be disturbed by the construction and operation of alternative power plants.

The potential for historic and archaeological resources can vary greatly depending on the location of the proposed site. To consider a project's effects on historic and archaeological resources, any proposed areas will need to be surveyed to identify and record historic and archaeological resources, identify cultural resources (e.g., traditional cultural properties), and develop possible mitigation measures to address any adverse effects from ground disturbing activities. Studies will be needed for all areas of potential disturbance at the proposed plant site and along associated corridors where new construction will occur (e.g., roads, transmission corridors, rail lines, or other ROWs). In most cases, project proponents should avoid areas with the greatest sensitivity.

The impact for a gas-fired alternative at the KPS site would be SMALL. As noted in Section 4.9.6, DEK conducted a survey of the KPS site in 2007 and is developing a Cultural Resources Management Plan. This plan includes pre-job briefings for workers and an inadvertent discovery (stop work) provision. Depending on the resource richness of an alternative site ultimately chosen for the gas-fired alternative, impacts could range from SMALL to MODERATE.

<u>Environmental Justice</u>

The environmental justice impact analysis evaluates the potential for disproportionately high and adverse human health and environmental effects on minority and low-income populations that could result from the construction and operation of a new natural gas-fired power plant. Adverse health effects are measured in terms of the risk and rate of fatal or nonfatal adverse impacts on human health. Disproportionately high and adverse human health effects occur when the risk or rate of exposure to an environmental hazard for a minority or low-income population is significant and exceeds the risk or exposure rate for the general population or for another appropriate comparison group. The minority and low-income populations are subsets of the general public residing around the site, and all are exposed to the same hazards generated from various power plant operations.

Minority and low-income populations could be affected by the construction and operation of a new natural gas-fired power plant. Some of these effects have been identified in resource areas discussed in this section. The extent of disproportionate effect is difficult to determine since it would depend on the location of the natural gas-fired power plant. For example, increased demand for rental housing during construction could disproportionately affect low-income populations. However, demand for rental housing could be mitigated if the alternate plant site is constructed near a metropolitan area.

Impacts on minority and low-income populations from the construction and operation of a natural gas-fired power plant alternative could range from SMALL to MODERATE, due to the small number of workers needed to construct and operate the natural gas-fired power plant.

8.1.7 Waste Management

During the construction stage of this alternative, land clearing and other construction activities would generate waste that can be recycled, disposed onsite or shipped to an offsite waste disposal facility. If the alternative were constructed at the KPS site or any previously disturbed site, the amounts of wastes produced during land-clearing would be reduced.

During the operational stage, spent SCR catalysts, which are used to control NOx emissions from the natural gas-fired plants, would make up the majority of the waste generated by this alternative.

The staff concluded in the GEIS (NRC, 1996) that a natural gas-fired plant would generate minimal waste and the waste impacts would be SMALL for a natural gas-fired alternative located at the KPS site or offsite.

8.2 COAL-FIRED GENERATION

Coal-fired generation accounts for a greater share of U.S. electrical power generation than any other fuel (EIA, 2009b). While coal-fired power plants are widely used and are likely to remain widely used, the staff notes that future coal capacity additions may be affected by perceived or actual efforts to limit greenhouse gas emissions. For now, the staff considers a coal-fired alternative to be a feasible, commercially available option that could provide electrical generating capacity after KPS's current license expires.

Supercritical technologies are increasingly common in new coal-fired plants. Supercritical plants operate at higher temperatures and pressures than most existing coal-fired plants (beyond water's “critical point”, where boiling no longer occurs and no clear phase change occurs between steam and liquid water). Operating at higher temperatures and pressures allows this coal-fired alternative to operate at a higher thermal efficiency than many existing coal-fired power plants do. While supercritical facilities are more expensive to construct, they consume less fuel for a given output, reducing environmental impacts. Based on technology forecasts from EIA, the staff expects that a new, supercritical coal-fired plant beginning operation in 2014 would operate at a heat rate of 9,069 Btu/kWh, or approximately 38 percent thermal efficiency (EIA, 2009c).

In a supercritical coal-fired power plant, burning coal heats pressurized water. As the supercritical steam/water mixture moves through plant pipes to a turbine generator, the pressure drops and the mixture flashes to steam. The heated steam expands across the turbine stages, which then spin and turn the generator to produce electricity. After passing through the turbine, any remaining steam is condensed back to water in the plant's condenser.

In most modern U.S. facilities, condenser cooling water circulates through cooling towers or a cooling pond system (either of which are closed-cycle cooling systems). Older plants often withdraw cooling water directly from existing rivers or lakes and discharge heated water directly to the same body of water (called open-cycle cooling). In this case, a coal-fired alternative constructed on the KPS site would withdraw makeup water from and discharge blowdown (water containing concentrated dissolved solids and biocides) from cooling towers back to Lake Michigan. As KPS currently uses a once-through cooling system, it is possible that a new coal-fired plant on the KPS site could continue to use the existing KPS intake for a once-through cooling system. The staff will evaluate a closed-cycle option, as it results in lower operational impacts to aquatic life. At the same time, a closed-cycle option may increase aesthetic impacts as well as construction-stage impacts.

In order to replace the 556 net MWe that KPS currently supplies, the coal-fired alternative would need to produce roughly 618 gross MWe, using about 6 percent of power output for onsite power usage. Onsite electricity demands include scrubbers, cooling towers, coal-handling equipment, lights, communication, and other onsite needs. A supercritical coal-fired power plant equivalent in capacity to KPS and using the same cooling system would require less cooling water than KPS because the alternative operates at a higher thermal efficiency.

The coal-fired power plant would consume 2.27 million tons (2.06 million MT) of coal annually assuming an average heat content of 8,967 British thermal units per pound (Btu/lb) (EIA, 2008). EIA reported that most coal consumed in Wisconsin originates in Wyoming. Given current coal mining operations in the State of Wyoming, the coal used in this alternative would likely be mined in surface mines, then mechanically processed and washed, before being transported—via an existing rail spur—to the power plant site. Limestone for scrubbers would also arrive by rail. This coal-fired alternative would then produce roughly 123,400 tons (112,000 MT) of ash, and roughly 42,300 tons (38,400 MT) scrubber sludge annually. As noted above, much of the coal ash and scrubber sludge could be reused depending on local recycling and reuse markets.

Environmental impacts from the coal-fired alternative will be greatest during construction. Site crews will clear the plant site of vegetation, prepare the site surface, and begin excavation before other crews begin actual construction on the plant and any associated infrastructure.

Table 8-2. Summary of Environmental Impacts of the Coal-Fired Alternative Compared to Continued Kewaunee Power Station Operation

	Coal-fired Alternative		Continued KPS Operation
	At the KPS Site	At an Alternative Site	
Air Quality	MODERATE	MODERATE	SMALL
Groundwater	SMALL	SMALL	SMALL
Surface Water	SMALL	SMALL to MODERATE	SMALL
Ecology	MODERATE	MODERATE	SMALL
Human Health	SMALL	SMALL	SMALL
Socioeconomics	SMALL to LARGE	SMALL to LARGE	SMALL TO MODERATE
Waste Management	MODERATE	MODERATE	SMALL

8.2.1 Air Quality

The coal-fired generation air quality impacts can be substantial because of the significant quantity of SOx, NOx, particulates, CO emissions, hazardous air pollutants (HAPs) such as mercury, and naturally occurring radioactive materials resulting from the process. However, many of these pollutants can be effectively controlled by various technologies.

KPS is located in Kewaunee County, Wisconsin, which is a maintenance area for 8-hour ozone and in attainment for all other criteria air pollutants. A new coal-fired generating plant would qualify as a new major-emitting industrial facility and would require new source review (NSR) and Prevention of Significant Deterioration of Air Quality review under the under CAA (EPA, 2008a). The NSR program requires that a permit be obtained before construction of the new major-emitting industrial facility (42 USC 7475(a)). The EPA delegated the authority of regulating the issuance of the construction and operating permits to the WDNR, which coordinates the Wisconsin air pollution control permit program for new and existing pollution sources. The new coal-fired generating plant would also have to comply with the new source performance standards for coal-fired plants set forth in 40 CFR 60 Subpart Da. The standards establish limits for particulate matter and opacity (40 CFR 60.42(a)), SO_2 (40 CFR 60.43(a)), and NOx (40 CFR 60.44(a)).

Section 169A of the CAA (42 USC 7401) establishes a national goal of preventing future and remedying existing impairment of visibility in mandatory Class I Federal areas when impairment results from man-made air pollution. The 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 through developing and implementing air quality protection plans to reduce the pollution that causes visibility impairment. As noted in 8.1.1, there are Regional Planning Organizations (RPOs) collaborating on the visibility impairment issue, developing the technical basis for these plans. Wisconsin, Illinois, Indiana, Michigan, and Ohio belong to the Midwest RPO that along with tribes, Federal agencies and other interested parties identifies regional haze and visibility issues and develops strategies to address them. The visibility protection regulatory requirements, contained in 40 CFR Part 51, Subpart P, include the review of the new sources that would be constructed in the attainment or unclassified areas and may affect visibility in any Federal Class I area (40 CFR 51.307). If a coal-fired plant were located close to a mandatory Class I area, additional air pollution control requirements would be imposed. There are no Mandatory Class I Federal areas in the State of Wisconsin or in the close proximity to KPS. The closest Mandatory Class I Federal Areas to KPS are Seney Wilderness Area, Michigan, located 149 miles northeast from KPS, and Isle Royale National Park, Michigan, located 255 miles northwest from KPS.

The emissions from the coal-fired alternative at KPS site, based on published Energy Information Administration (EIA) data, EPA emission factors, and on performance characteristics for this alternative and implemented emission controls, would likely be:

- Sulfur oxides (SOx) – 775.81 tons (703.80 MT) per year
- Nitrogen oxides (NOx) – 567.11 tons (514.47 MT) per year
- Total suspended particles (TSP) – 61.70 tons (55.97 MT) per year
- Particulate matter (PM) PM_{10} – 123.40 tons (111.95 MT) per year
- Particulate matter (PM) $PM_{2.5}$ – 61.70 tons (55.97 MT) per year
- Carbon monoxide (CO) – 567.11 tons (514.47 MT) per year
- Mercury (Hg) – 0.09 tons (0.08 MT) per year

Sulfur oxides emissions and nitrogen oxides emissions. The coal-fired alternative at the KPS site would likely use wet, limestone-based scrubbers to remove SOx. The EPA indicates that this technology can remove more than 95 percent of SOx from flue gases. NRC staff projects total SOx emissions would be 775.81 tons (703.80 MT) per year.

On March 10, 2005, the EPA issued the Clean Air Interstate Rule (CAIR), which would create large permanent reductions in SO_2 and NOx across 28 eastern states and the District of Columbia. However, petitions for review of the CAIR and CAIR Federal Implementation Plans (FIPs), including the provisions establishing the CAIR NOx annual and ozone season and SO_2 trading programs, were filed in the U.S. Court of Appeals for the D.C. Circuit. On July 11, 2008, the Court issued an opinion vacating and remanding the CAIR and CAIR FIPs. After requested rehearing of the Court's decision, the Court granted rehearing only to the extent that it remanded the rules to the EPA without vacating them on December 23, 2008. This ruling leaves CAIR and the CAIR FIPs, including the CAIR trading programs, in place until the EPA issues a new rule to replace CAIR in accordance with the July 11, 2008 decision. Wisconsin is among the States covered by this rule (EPA, 2009b). WDNR adopted the rule and is allocating annual NOx allowances for new electricity generating units subject to CAIR as specified in chapter NR 432 of the Wisconsin Administrative Code starting in 2009. The NOx allowances are allocated from a "new unit set-aside" reserved pool of allowances, which represents 7 percent of Wisconsin's total budget of NOx allowances.

SOx emissions from a new coal-fired power plant would be subject to the requirements of Title IV of the CAA. Title IV was enacted to reduce emissions of SO_2 and NOx, the two principal precursors of acid rain, by restricting emissions of these pollutants from power plants. Title IV caps aggregate annual power plant SO_2 emissions and imposes controls on SO_2 emissions through a system of marketable allowances. The EPA issues one allowance for each ton of SO_2

that a unit is allowed to emit. New units do not receive allowances, but are required to have allowances to cover their SO_2 emissions. Owners of new units must therefore purchase allowances from owners of other power plants or reduce SO_2 emissions at other power plants they own. Allowances can be banked for use in future years. Thus, provided a new coal-fired power plant is able to purchase sufficient allowances to operate, it would not add to net regional SO_2 emissions, although it might do so locally.

A coal-fired alternative constructed either at the KPS site or offsite would most likely employ various available NOx-control technologies, which can be grouped into two main categories: combustion modifications and post-combustion processes. Combustion modifications include low-NOx burners, over fire air, flue gas recirculation and operational modifications. Post-combustion processes include SCR, selective noncatalytic reduction and hybrid processes. Effective combination of the combustion modifications and post-combustion processes can reduce NOx emissions by up to 95 percent. DEK would use the combination low-NOx burners, over fire air and SCR technologies in order to reduce NOx emissions from this alternative. Assuming the use of such technologies at KPS site, NOx emissions after scrubbing are estimated at 567.11 tons (514.47 MT) annually.

Section 407 of the CAA establishes technology-based NOx emissions limitations. A new coal-fired power plant would be subject to the new source performance standards for such plants as indicated in 40 CFR 60.44a(d)(1). This regulation, issued on September 16, 1998 (63 FR 49422), limits the discharge of any gases that contain NOx to 200 nanograms (ng) per joule (J) of gross energy output (equivalent to 1.6 lb/megawatt hours (MWh)), based on a 30-day rolling average.

<u>Particulate emissions.</u> The new coal-fired power plant would use fabric filters to remove particulates from flue gases. DEK indicates that fabric filters would remove 99.9 percent of particulate matter (DEK, 2008). The EPA notes that filters are capable of removing in excess of 99 percent of particulate matter and that SO_2 scrubbers further reduce particulate matter emissions (EPA, 2008b). As such, NRC staff believes DEK removal factor is appropriate. Based on this, the new supercritical coal-fired plant would emit 123.40 tons (111.95 MT) per year of PM_{10} and approximately 61.70 tons (55.97 MT) per year of $PM_{2.5}$. In addition, coal-handling equipment would introduce fugitive dust emissions when fuel is being transferred to onsite storage and then reclaimed from storage for use in the plant.

During the construction of a coal-fired plant, onsite activities would also generate fugitive dust. Also vehicles of the workers and motorized equipment would create exhaust emissions during the construction process. However, these impacts would be intermittent and short-termed. There would be dust-control measures implemented in order to minimize dust generation.

<u>Carbon monoxide emissions.</u> Based on EPA emission factors (EPA, 1998), NRC staff estimates that the total CO emissions would be approximately 567.11 tons (514.47 MT) per year.

<u>Hazardous Air Pollutants including mercury</u>. The EPA is in the process of developing emissions standards for power plants under the Clean Air Act (Section 112), including mercury emissions, following the D.C. Circuit Court's February 8, 2008 ruling that vacated EPA's Clean Air Mercury Rule (CAMR) (EPA, 2007). Before CAMR, the EPA determined that coal- and oil-fired electric utility steam-generating units are significant emitters of HAPs (EPA, 2000a). The EPA

determined that coal plants emit arsenic, beryllium, cadmium, chromium, dioxins, hydrogen chloride, hydrogen fluoride, lead, manganese, and mercury (EPA, 2000a). The EPA concluded that mercury is the HAP of greatest concern and that (1) a link exists between coal combustion 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 resulting from mercury exposures caused by the consumption of contaminated fish (EPA, 2000a). In light of the court's decision, the EPA will revisit mercury regulation, although it is possible that the agency will continue to regulate mercury as a HAP, thus requiring the use of best available control technology to prevent its release to the environment. The Wisconsin Mercury Rule, revised in 2008, requires all new coal-fired power plants to achieve Maximum Achievable Control Technology (MACT) in order to reduce emissions of hazardous air pollutants, including mercury, and specifies that the permitted mercury reduction shall not be less than 90 percent of the removal of mercury from combusted coal (WDNR, 2008).

Carbon Dioxide. A coal-fired plant would also have unregulated CO_2 emissions during operations as well as during mining, processing, and transportation. The coal-fired plant would emit between 4,176,024.00 tons (3,788,425.25 MT) to 4,326,548.00 tons (3,924,978.32 MT) of CO_2 per year, depending on the type and quality of the coal.

Summary of Air Quality

While the GEIS analysis mentions global warming from unregulated CO_2 emissions and acid rain from SOx and NOx emissions as potential impacts, it does not quantify emissions from coal-fired power plants. However, the GEIS analysis implies that air impacts would be substantial (NRC, 1996). The above analysis shows that emissions of air pollutants, including SOx, NOx, CO, and particulates, exceed those produced by the existing nuclear power plant, as well as those of the other alternatives considered in this section. Operational emissions of CO_2 are also much greater under the coal-fired alternative. Adverse human health effects such as cancer and emphysema have also been associated with air emissions from coal combustion, and are discussed further in Section 8.2.5.

The NRC analysis for a coal-fired alternative at an alternate site indicates that impacts from the coal-fired alternative would have clearly noticeable effects, but given existing regulatory regimes, permit requirements, and emissions controls, the coal-fired alternative would not destabilize air quality. Therefore, the appropriate characterization of air impacts from coal-fired plant located at KPS site would be MODERATE. Existing air quality would result in varying needs for pollution control equipment to meet applicable local and federal requirements, or varying degrees of participation in emissions trading schemes.

8.2.2 Groundwater Use and Quality

If the onsite coal-fired alternative continued to use groundwater for drinking water and service water, the need for groundwater at the plant would be minor, with supply wells used for potable drinking water and various service water functions. Total usage would likely be much less than KPS because fewer workers would be onsite and because the coal-fired unit would have fewer auxiliary systems requiring service water. No effect on groundwater quality would be apparent. If an alternative site is chosen, the need for groundwater use for plant operations would likely be minor.

Construction of a coal-fired plant (onsite or offsite) could have a localized effect on groundwater due to temporary dewatering and run-off control measures. Because of the temporary nature of construction and the likelihood of reduced groundwater usage during operation, the impact of the coal-fired alternative would be SMALL.

8.2.3 Surface Water Use and Quality

Because the onsite alternative would draw water from Lake Michigan, most of the approximately 8,000 gpm (0.5 m^3/s) needed for maximum withdrawal would be taken from the lake with an average consumptive loss of about 10 million gallons per day (mgd) (0.4 m^3/s). The alternative would use a closed-cycle system with cooling towers, which would increase consumptive water losses from the currently operating open-cycle cooling system used by KPS. However, because the onsite coal-fired plant would draw water from Lake Michigan and not a small river, the NRC concludes the impact of surface water use would be SMALL. If the chosen alternative site is also adjacent to Lake Michigan, the NRC concludes that the impact of surface water use will also be SMALL, but could increase to MODERATE if the plant relies on a small river with low flow for cooling water.

Any new coal-fired plant in the area (onsite or offsite) would be required to obtain a WPDES permit from the WDNR for regulation of industrial wastewater, storm water, and other discharges. Assuming the plant operates within the limits of this permit, the impact from any possible runoff from coal piles and effluent discharges on surface water quality would be SMALL.

8.2.4 Aquatic and Terrestrial Ecology

A new coal-fired plant would require a source of water for the plant's cooling system, most likely a closed-cycle cooling tower system, and a discharge point for cooling tower blowdown. Locating the plant on the existing KPS site will enable some already-existing buildings and infrastructure to be used; however, impacts to aquatic ecology are likely during construction regardless of where the plant is located. Site disturbance will likely increase erosion and sedimentation runoff into Lake Michigan and nearby streams, increasing turbidity. While site procedures and management practices, as well as using already-existing structures on the KPS site when possible, may limit this effect, the impact will likely be noticeable.

Surface mining of coal, which would occur offsite, is associated with degradation of aquatic communities due to acid mine drainage, sedimentation, and diversion or destruction of streams, lakes, and ponds. High sediment levels can kill fish directly, bury spawning beds, and alter water temperature and flow. Federal law requires mining operations to meet standards for protecting surface and groundwater from contamination, which would minimize sedimentation and other contaminants to the extent possible. Transportation of coal and limestone would likely occur via barge and would also contribute to erosion. Manitowoc, located 18 miles (29 km) south-southwest of the KPS site, and Green Bay, located 27 miles (44 km) west-northwest of the site, have coal docks, though no rail spur connects the site to either location. A new docking facility would likely need to be constructed, which would require dredging bottom sediments and construction of breakwaters and docks. Dredging of bottom sediments will disrupt aquatic communities and, depending on the extent of dredging, could impair benthic communities by removing suitable substrate.

Following construction, the greater thermal efficiency of the coal-fired alternative versus the existing KPS unit will result in slightly less consumptive water use for cooling and blowdown. During operations, disposal of waste materials will have to comply with local and State regulations, some of which are intended to prevent runoff into surface water. Management of runoff from coal piles will also be necessary. Spills occurring during onsite activities will need to be appropriately handled, and runoff from new, impervious surfaces (e.g., roads and rooftops) may affect aquatic ecology, as could deposition of acids or chemicals emitted through the plant's stacks. Given current regulations, as well as the emission controls discussed in the Air Quality section, these impacts may be noticeable, but are not likely to be destabilizing.

Overall impacts to aquatic ecology from a coal-fired alternative are expected to be MODERATE.

As indicated in previous sections, constructing the coal-fired alternative will require 129 acres (52 ha) of land if located offsite, and will not require additional land if located on the current KPS site. Coal-mining operation will also affect terrestrial ecology in offsite coal mining areas, although some of the land is likely already disturbed by mining operations. Onsite and offsite land disturbances form the basis for impacts to terrestrial ecology.

Impacts to terrestrial ecology will vary based on the degree to which the proposed plant site is already disturbed. On a previous industrial site, impacts to terrestrial ecology would be minor, unless substantial transmission line ROWs, railways, or roads would need to be constructed through less disturbed areas. These construction activities may have a cumulative effect of fragmenting or destroying habitats. Any onsite or offsite water disposal by landfilling will also affect terrestrial ecology at least through the time period when the disposal area is reclaimed. Some areas onsite, such as buffer areas, may remain undeveloped and could serve as habitat for terrestrial species, though site lighting, noise, and activities may degrade the value of these ecosystems. Deposition of acid rain or other emissions can also affect terrestrial ecology. Given the emission controls discussed in Section 8.2.1, air deposition impacts may be noticeable, but are not likely to be destabilizing. Impacts to terrestrial resources from a coal-fired alternative would be SMALL to MODERATE, and occur mostly during construction. Some of these impacts could be mitigated if the location of the coal-fired alternative is the current KPS site or on a previously disturbed location.

8.2.5 Human Health

Coal-fired power plants introduce worker risks from coal and limestone mining, from coal and limestone transportation, and from disposal of coal combustion and scrubber wastes. In addition, there are public risks from inhalation of stack emissions and the secondary effects of eating foods grown in areas subject to deposition from plant stacks.

In Table 8-2 of the GEIS (NRC, 1996), the staff stated that human health impacts (cancer and emphysema) could result from inhalation of toxins and particulates, but it did not identify the significance of these impacts. Enforcement by the EPA and/or State agencies of regulations restricting harmful emissions from coal-fired plants has significantly reduced the potential health effects, but has not eliminated them. These agencies also impose site-specific emission limits, as needed, to protect human health. Even if the coal-fired alternative were located in a designated nonattainment area, the use of emission trading or offset mechanisms could prevent further regional degradation. However, localized effects could be visible. Many of the byproducts of coal combustion responsible for health effects are largely controlled, captured, or converted to a benign state in modern power plants, although some level of health effects may remain.

Aside from emission impacts, the coal-fired alternative introduces the risk of coal pile fires and for those plants that use coal combustion liquid and sludge waste impoundments, the release of the waste due to a failure of the impoundment. However, the occurrence of these types of events is relatively rare.

It is expected that the facility would operate in compliance with Federal and State safety and emission standards.

Overall, the impacts on human health of the coal-fired alternative are likely to be SMALL.

8.2.6 Socioeconomics

Land Use

As discussed in 8.1.6, the analysis of land use impacts focuses on the amount of land area that would be affected by the construction and operation of a coal-fired power plant at the KPS site and an alternative site. Land-use impacts would vary depending on where the plant would be located and whether construction would take place on undeveloped land or within a previously disturbed industrial (brownfield) area.

DEK indicated that 136 acres (55 ha) of land would be needed to support a coal-fired alternative capable of replacing the KPS. The GEIS estimates 1,700 acres (700 ha) would be needed to support a 1,000-MWe generating station (NRC, 1996). This amount of land use includes power plant structures and associated coal delivery and waste disposal infrastructure. By scaling GEIS estimates, a 590-MWe plant could require approximately 1,000 acres (405 ha) of land.

However, if additional land would be necessary for a buffer around plant structures or to support transmission lines at an alternate site and rail and barge offloading facilities at KPS and an alternate site, the staff believes the DEK estimate to be low and additional land would be needed to support a rail yard and coal offloading facility. Even assuming additional land use for these purposes, total land required by the coal-fired alternative is unlikely to exceed 1,000 acres (405 ha) for all uses, excluding coal mining. The coal-fired alternative would require approximately 30 acres (12 ha) of land area for waste disposal. Land use impacts from construction would be MODERATE to LARGE, and could be reduced if the power plant is collocated at an alternate site with another generating station or on a previously industrial site like KPS. Impacts could be further mitigated at an alternate site by constructing new transmission lines in existing ROWs.

Offsite land use impacts would occur from coal mining in addition to land use impacts from the construction and operation of the new power plant. The GEIS indicates that approximately 22,000 acres (8,903 ha) of land could be affected by mining coal and waste disposal to support a 1,000-MWe coal plant during its operational life (NRC, 1996). Therefore, to replace KPS approximately 12,980 acres (5,253 ha) of land could be affected by coal mining. However, most of the land in existing coal-mining areas has already experienced some level of disturbance. The elimination of the need for uranium mining to supply fuel for the KPS would partially offset this offsite land use impact. The GEIS estimates that approximately 1,000 acres (405 ha) of land would be affected by uranium mining and processing for a 1.000-MWe nuclear plant. For the KPS, roughly 590 acres (239 ha) of land used for uranium mining and processing would no longer be needed.

Based on this information, land use impacts could range from MODERATE to LARGE, depending on local land use and the availability of land near the proposed site. Some portion of this impact could be mitigated by constructing the rail spur in existing ROWs.

Socioeconomics

The GEIS projected a peak workforce of 1,200 to 2,500 workers for a 1,000-MWe plant, or a peak of 708 to 1,475 workers for a replacement for KPS. During construction, the communities surrounding the power plant site would experience increased demand for rental housing and public services, although these effects would be moderated if the alternate construction site is located near an urban area with many skilled workers. The relative economic effect of construction workers on local economy and tax base would vary over time.

After construction, local communities may be temporarily affected by the loss of construction jobs and associated loss in demand for business services, and the rental housing market could experience increased vacancies and decreased prices. As noted in the GEIS, the socioeconomic impacts at a rural construction site could be larger than at an urban site, because the workforce would need to relocate closer to the construction site. The impact of construction on socioeconomic conditions could range from MODERATE to LARGE depending on whether the new power plant would be located at KPS or an alternate site. The socioeconomic impacts of power plant construction could be further reduced if the power plant is located near an urban area with many skilled workers.

DEK estimated an operational workforce of 79 (DEK, 2008), while scaling estimates from the GEIS indicate the need for 148 workers (250 operations workers for a 1,000-MWe plant). The DEK estimate appears low, but is consistent with trends calling for decreased workforces at power facilities. Even at rural sites, impacts are unlikely to be large. The small number of operations workers would not likely have a noticeable effect on socioeconomic conditions in the region. Depending on location, operations impacts would likely be SMALL to MODERATE.

Transportation

During construction, approximately 1,500 workers would be commuting to the site. In addition to commuting workers, trucks would transport construction materials and equipment to the worksite increasing the amount of traffic on local roads. The increase in vehicular traffic would peak during shift changes resulting in temporary levels of service impacts and delays at intersections. Trains and/or barges could also be used to deliver large components to the KPS site or an alternate site. Transportation impacts are likely to be MODERATE to LARGE during construction.

During operations, approximately 150 workers would be commuting to the coal-fired power plant. Frequent deliveries of coal and limestone by rail and barge could add to the overall transportation impact. Onsite coal storage would make it possible to receive several trains per day. Limestone could also likely be delivered by rail and barge, which could add additional traffic (though considerably less traffic than that generated by coal deliveries).

The coal-fired alternative would likely create SMALL to MODERATE transportation impacts during plant operations depending on whether coal and limestone is delivered by rail and barge. Transportation impacts at an alternate site would depend on road capacity and average daily volume.

Aesthetics

The coal-fired alternative's boiler building would be up to 200 feet (61 m) tall and may be visible offsite in daylight hours at KPS and depending on the topography at an alternate site. The exhaust stack would be up to 500 feet (183 m) high. If the coal-fired alternative makes use of natural-draft cooling towers, then additional impacts would occur from the towers, which may be several hundred feet tall and topped with condensate plumes. Mechanical draft towers would also generate condensate plumes but would be markedly shorter than natural-draft towers. Other buildings onsite may also affect aesthetics. Noise and light from plant operations, as well as lighting on plant structures, may be detectable offsite.

In addition to new power plant structures, the alternate plant site may require the construction of transmission lines. The transmission lines would have a lasting visual effect on the landscape.

In general, aesthetic changes would be limited to the immediate vicinity of the KPS or an alternate site. Impacts would likely to be SMALL to MODERATE at KPS and an alternate site and would depend on the amount of new transmission line required.

Historic and Archaeological Resources

Cultural resources are the indications of human occupation and use of the landscape as defined and protected by a series of Federal laws, regulations, and guidelines. Prehistoric resources are physical remains of human activities that predate written records; they generally consist of artifacts that may alone or collectively yield information about the past. Historic resources consist of physical remains that postdate the emergence of written records; in the United States, they are architectural structures or districts, archaeological objects, and archaeological features dating after 1492. Ordinarily, sites less than 50 years old are not considered historic, but exceptions can be made for such properties if they are of particular importance, such as structures associated with the development of nuclear power (e.g., Shippingport Atomic power Station) or Cold War themes. American Indian resources are sites, areas, and materials important to American Indians for religious or heritage reasons. Such resources may include geographic features, plants, animals, cemeteries, battlefields, trails, and environmental features. The cultural resource analysis encompassed the power plant site and adjacent areas that could potentially be disturbed by the construction and operation of alternative power plants.

The potential for historic and archaeological resources can vary greatly depending on the location of the proposed site. To consider a project's effects on historic and archaeological resources, any proposed areas will need to be surveyed to identify and record historic and archaeological resources, identify cultural resources (e.g., traditional cultural properties), and develop possible mitigation measures to address any adverse effects from ground disturbing activities. Studies will be needed for all areas of potential disturbance at the proposed plant site and along associated corridors where new construction will occur (e.g., roads, transmission corridors, rail lines, or other ROWs). In most cases, project proponents should avoid areas with the greatest sensitivity.

The impact for a coal-fired alternative at the KPS site would be SMALL. As noted in Section 4.9.6, DEK conducted a survey of the KPS site in 2007 and is developing a Cultural Resources Management Plan. This plan includes pre-job briefings for workers and an inadvertent discovery (stop work) provision. Depending on the resource richness of an alternative site ultimately chosen for the coal-fired alternative, impacts could range from SMALL to MODERATE.

Environmental Justice

The environmental justice impact analysis evaluates the potential for disproportionately high and adverse human health and environmental effects on minority and low-income populations that could result from the construction and operation of a new coal-fired power plant. Adverse health effects are measured in terms of the risk and rate of fatal or nonfatal adverse impacts on human health. Disproportionately high and adverse human health effects occur when the risk or rate of exposure to an environmental hazard for a minority or low-income population is significant and exceeds the risk or exposure rate for the general population or for another appropriate comparison group. The minority and low-income populations are subsets of the general public residing around the site, and all are exposed to the same hazards generated from various power plant operations.

Minority and low-income populations could be affected by the construction and operation of a new coal-fired power plant. Some of these effects have been identified in resource areas discussed in this section. The extent of disproportionate effect is difficult to determine since it would depend on the location of the coal-fired power plant. For example, increased demand for rental housing during construction could disproportionately affect low-income populations. However, demand for rental housing could be mitigated if the alternate plant site is constructed near a metropolitan area. Impacts on minority and low-income populations from the construction and operation of a coal-fired power plant alternative could range from SMALL to MODERATE.

8.2.7 Waste Management

The coal-fired, supercritical power plant would be constructed either onsite or offsite. Waste would be generated during construction of this alternative. During operation of this alternative, ash (a dry solid) and sludge (a semi-solid by-product of emission control system operation) waste streams would be generated. The staff estimates that 618-MW power plant would generate annually total 60,823.94 tons (55,178.55 MT) of dry solid ash and scrubber sludge. Disposal of the waste from the 40-year operation of this alternative would require approximately 136 acres (55 ha). Disposal of the waste could noticeably affect land use and groundwater quality, but with proper siting and implementation of monitoring and management practices, it would not destabilize resources. After closure of the waste site and revegatation, the land could be available for other uses.

The impacts from waste generated during operation of this coal-fired alternative would be MODERATE; the impacts would be clearly visible, but would not destabilize any important resource.

The impacts from waste generated during the construction stage would be short-term. The amount of construction waste is small compared to the amount of waste generated during operational stage and could be recycled. Overall, the impacts from waste generated during the construction stage would be SMALL.

Therefore, the NRC staff concludes that impacts from construction and operation of this alternative would be MODERATE.

8.3 COMBINATION ALTERNATIVES

In this section, the staff evaluates the environmental impacts that may occur from a combination of alternatives, some of which may not be capable of individually replacing the power from KPS, but which may have relatively low environmental impacts or rely on renewable fuel sources. In this section, staff will evaluate two combination alternatives that include onsite gas-fired generation, energy conservation, and either wind power (in option 1) or wood-fired power (in option 2).

Combination Option 1:

- 280 MW gas-fired capacity on the KPS site
- 229 MW equivalent conservation
- 47 MW wind power (157 MW of wind turbines at several sites; 30 percent capacity factor)

Combination Option 2:

- 280 MW gas-fired capacity on the KPS site
- 229 MW equivalent conservation
- 47 MW wood-fired plant

Wisconsin has substantial conservation resources, but a recent study commissioned by the Wisconsin Public Service Commission (Energy Center of Wisconsin, 2009) indicates that it will take several years to ramp programs to offset the power generated by KPS. By the start of 2014 (KPS license expires on December 21, 2013), Wisconsin could offset 4.8 percent of peak load and 4.8 percent of total energy consumption. These estimates explicitly do not include the potential for behavior-based programs to reduce consumption. Assuming that 50 percent of this potential could offset a base load duty cycle, roughly 229 MW (on a total energy consumption basis) or 360 MW (on a peak load basis) could be achieved by the time the KPS license expires. Using the lower number, 229 MW, to be conservative, conservation/energy efficiency could offset roughly 41 percent of KPS output. Most of the remaining output for both alternatives would come from a 280 MW gas-fired combined cycle power plant at the current plant site (half of the pure gas-fired alternative).

Some wind turbines could be located onsite or across nearby agricultural areas with little long-term land use impact. As noted in 8.5.1, this area is also home to Wisconsin's best wind potential and existing transmission lines. The other option relies on offsite wood-fired power that would likely be located in the northern part of the State near steady wood supply streams.

Table 8-3. Summary of Environmental Impacts of the Combination Alternative Compared to Continued Kewaunee Power Station Operation

	Combination Alternative		Continued KPS Operation
	Option 1 – Gas, Conservation, Wind	Option 2 – Gas, Conservation, Wood	
Air Quality	MODERATE	MODERATE	SMALL
Groundwater	SMALL	SMALL	SMALL
Surface Water	SMALL	SMALL	SMALL
Ecology	SMALL to LARGE	SMALL to LARGE	SMALL
Human Health	SMALL to MODERATE	SMALL to MODERATE	SMALL
Socioeconomics	SMALL to MODERATE	SMALL to MODERATE	SMALL TO MODERATE
Waste Management	SMALL	SMALL	SMALL

8.3.1 Air Quality

Kewaunee County, Wisconsin, where KPS is located, belongs to EPA Region 5 and is in attainment for all criteria pollutants, except ozone. Kewaunee County is a maintenance area for 8-hour ozone (EPA, 2009a).

This alternative is a combination of a 280-MW gas-fired combined cycle power plant, constructed onsite, and two options: option 1 relies on wind power for the remainder of the electrical energy produced; option 2 relies on offsite wood-fired power.

A new gas-fired generating plant, proposed to be built in Kewaunee County, would qualify as a new major-emitting industrial facility and require a new source review (NSR) and Prevention of Significant Deterioration of Air Quality review under the CAA, enforced by WDNR, along with other air pollution control requirements in the Wisconsin Administrative Code and its statutes (EPA, 2008a; Wis. Adm. Code chapters NR400-499). The EPA delegated the authority of regulating the issuance of construction and operating permits to the WDNR, which was codified in NR406 and NR407 of the Wisconsin Administrative Code. The natural gas-fired plant would also need to comply with the standards of performance for electric utility steam generating units set forth in 40 CFR Part 60 Subpart Da.

Section 169A of the CAA (42 USC 7401) establishes a national goal of preventing future and remedying existing impairment of visibility in mandatory Class I Federal areas when impairment results from man-made air pollution. The 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 through developing and implementing air quality protection plans to reduce the pollution that causes visibility impairment. As noted in 8.1.1 and 8.2.1, there are five RPOs collaborating on the visibility impairment issue and developing the technical basis for these plans. The Midwest RPO, along with tribes, Federal agencies and other interested parties identifies regional haze and visibility issues and develops strategies to address them. The visibility protection regulatory requirements, contained in 40 CFR Part 51, Subpart P, include the review of the new sources that would be constructed in the attainment or unclassified areas and may affect visibility in any Federal Class I area (40 CFR 51.307). If a coal-fired plant were located close to a mandatory Class I area, additional air pollution control requirements would be imposed. There are no Mandatory Class I Federal areas in the State of Wisconsin or in the close proximity to KPS. The closest Mandatory Class I Federal Areas to KPS are Seney Wilderness Area, Michigan, located 149 miles northeast from KPS, and Isle Royale National Park, Michigan, located 255 miles northwest from KPS.

The emissions from the natural gas-fired alternative at KPS site, based on published Energy Information Administration (EIA) data, EPA emission factors and on performance characteristics for this alternative and implemented emission controls, would likely be:

- Nitrogen oxides (NOx) – 70.50 tons (63.96 MT) per year
- Carbon monoxide (CO) – 14.66 tons (13.30 MT) per year
- Total suspended particles (TSP) – 12.29 tons (11.15 MT) per year
- Particulate matter (PM) PM_{10} – 12.29 tons (11.15 MT) per year
- Carbon dioxide (CO_2) – 756,582.11 tons (686,359.75 MT) per year

The new natural gas-fired plant would have to comply with Title IV of the CAA reduction requirements for SO_2 and NOx, which are main precursors of acid rain and major causes of reduced visibility. Title IV establishes maximum SO_2 and NOx emission rates for existing plants and a system of SO_2 emission allowances that can be used, sold or saved for future use by new plants.

On March 10, 2005, the EPA issued the Clean Air Interstate Rule (CAIR), which would create large permanent reductions in SO_2 and NOx across 28 eastern states and the District of Columbia. However, petitions for review of the CAIR and CAIR Federal Implementation Plans (FIPs), including the provisions establishing the CAIR NOx annual and ozone season and SO_2 trading programs, were filed in the U.S. Court of Appeals for the D.C. Circuit. On July 11, 2008, the Court issued an opinion vacating and remanding the CAIR and CAIR FIPs. After requested rehearing of the Court's decision, the Court granted rehearing only to the extent that it remanded the rules to the EPA without vacating them on December 23, 2008. This ruling leaves CAIR and the CAIR FIPs, including the CAIR trading programs, in place until the EPA issues a new rule to replace CAIR in accordance with the July 11, 2008 decision. Wisconsin is among the States covered by this rule (EPA, 2009b). WDNR adopted the rule and is allocating annual NOx allowances for new electricity generating units subject to CAIR as specified in chapter NR 432 of the Wisconsin Administrative Code starting in 2009. The NOx allowances are allocated from a "new unit set-aside" reserved pool of allowances, which represents 7 percent of Wisconsin's total budget of NOx allowances.

As stated above, the new natural gas-fired alternative would produce 21.99 tons (19.95 MT) per year of SOx and 70.50 tons (63.96 MT) per year of NOx based on the use of the dry low NOx combustion technology and use of the selective catalytic reduction (SCR) in order to significantly reduce NOx emissions.

The new plant would be subjected to the continuous monitoring requirements of SO_2, NOx and CO_2 specified in 40 CFR Part 75. The natural gas-fired plant would emit approximately 756,582.11 tons (686,359.75 MT) per year of unregulated CO_2 emissions. As of today, there is no required reporting of GHG emissions. In response to the Consolidated Appropriations Act of 2008, the EPA proposed a rule that would require mandatory reporting of GHG emissions from large sources, such as the presented alternative. The rule would allow for the collection of accurate and comprehensive emissions data to inform future policy decisions. The EPA proposes that suppliers of fossil fuels or industrial GHGs, manufacturers of vehicles and engines, and facilities that emit 25,000 metric tons or more per year of GHG emissions submit annual reports to the EPA. The gases covered by the proposed rule are CO_2, CH_4, N_2O, HFC, PFC, SF_6, and other fluorinated gases including NF_3 and HFE.

The natural gas-fired portion of this alternative would emit 12.29 tons (11.15 MT) of particulate matter per year having an aerodynamic diameter less than or equal to 10 μm (PM_{10}) (40 CFR 50.6(a)), based on the assumption that effective fabric filters or electrostatic precipitators would be used to minimize emissions.

In December 2000, the EPA issued regulatory findings (EPA, 2000a) on emissions of hazardous air pollutants from electric utility steam-generating units, which indicated that natural gas-fired plants emit hazardous air pollutants such as arsenic, formaldehyde and nickel and stated that:

". . . the impacts due to HAP emissions from natural gas-fired electric utility steam generating units were negligible based on the results of the study. The Administrator finds that regulation of HAP emissions from natural gas-fired electric utility steam generating units is not appropriate or necessary."

The new natural gas-fired alternative would produce 12.29 tons (11.15 MT) per year of the TSP as PM_{10} emissions.

There would be no emissions from the wind-powered portion of option 1 for this alternative.

When fossil fuels are burned in the production of electricity, a variety of gases and particulates are formed and, if not captured by pollution control equipment, will be released into the atmosphere. The pollutants released during electricity production depend upon complex relationships between factors such as fuel type and mix (sulfur content of coal, gas utilization), operational mode (combustion temperatures), technologies employed (combustion processes, environmental equipment), and regulatory constraints (non-attainment and maintenance areas).

The emissions from the wood-fired component of option 2, based on published EIA data, EPA emission factors, performance characteristics for this alternative, and implemented emission controls, would likely be:

- Sulfur oxides (SOx) – 58.33 tons (52.92 MT) per year

- Nitrogen oxides (NOx) (with SCR) – 285.80 tons (259.27 MT) per year
- Carbon monoxide (CO) – 349.96 tons (317.48 MT) per year
- TSP (filtered) – 233.31 tons (211.66 MT) per year
- PM_{10} (filtered) – 172.65 tons (156.63MT) per year
- $PM_{2.5}$ (filtered) – 151.65 tons (137.58 MT) per year
- Carbon dioxide (CO_2) – 454,950.60 tons (412,724.24 MT) per year

The wood-fired combustion facility would be subject to the Federal and State air emissions regulations described above for the natural gas-fired component of this alternative. Option 2 would also produce 172.65 tons (156.63 MT) per year of particulate matter having an aerodynamic diameter less than or equal to 10 µm (PM_{10}) (40 CFR 50.6(a)) and 151.65 tons (137.58 MT) per year of the particulate matter less than 2.5 µm in diameter ($PM_{2.5}$) which have to meet the national primary and secondary ambient air quality standards (40 CFR 50.7a).

Activities associated with the construction of the new natural gas-fired plant onsite or offsite KPS would cause some additional air effects as a result of equipment emissions and fugitive dust from operation of the earth-moving and material handling equipment. Vehicles of workers and construction motorized equipment exhaust emissions would be temporary. The construction crews would employ dust-control practices in order to control and reduce fugitive dust, which would be temporary in nature. The staff concludes that the impact of vehicle exhaust emissions and fugitive dust from operation of the earth-moving and material handling equipment would be SMALL.

The overall air-quality impacts of the combination alternative consisting of a natural gas-fired plant located at the KPS site and wind power (option 1), or of a natural gas-fired plant located at the KPS site and wood-fired power (option 2) would be MODERATE.

8.3.2 Groundwater Use and Quality

Impacts to groundwater use and quality from the gas-fired portion of the combination alternative would be similar to those identified for the wholly gas-fired alternative in 8.1.2, though roughly half as large in magnitude. These impacts would be SMALL.

An onsite or offsite wind alternative would likely use much less groundwater than KPS uses for its operations. The current average withdrawal rate at KPS is less than 100 gpm (0.01 m^3/s), and pumping tests indicate this rate will not cause an effect on nearby supply wells. A reduction in this withdrawal rate means that impacts of the combination alternative would remain SMALL.

An offsite wood-fired alternative would likely rely on a minimal amount of groundwater for its operations because not many workers would be onsite and because the wood-fired unit would be relatively small and would have few auxiliary systems requiring service water. This combination alternative would use less groundwater than KPS. A reduction in the current KPS withdrawal rate means that impacts of the combination alternative would remain SMALL.

8.3.3 Surface Water Use and Quality

Impacts to surface water use and quality from the gas-fired portion of the combination alternative would be similar to those identified for the wholly gas-fired alternative in 8.1.2, though roughly half as large in magnitude. These impacts would be SMALL.

An onsite or offsite wind alternative would consume significantly less surface water than the amount consumed by KPS for cooling purposes. The maximum consumptive use would be reduced to a fraction of the surface water withdrawn by the open-cycle cooling system currently in use by KPS. A reduction in this withdrawal rate means that impacts of the combination alternative would be SMALL.

An offsite wood-fired alternative would likely consume only a small amount of surface water as compared to the amount consumed by KPS for cooling purposes because the wood-fired unit is relatively small and would have few auxiliary systems requiring service water. This combination alternative would use less surface water than KPS. Assuming that the offsite location utilizes water from a large enough body of water to support its operations, the impacts of the combination alternative would be SMALL.

8.3.4 Aquatic and Terrestrial Ecology

The conservation portion of the combination alternative will have positive impacts on aquatic communities because less power would need to be generated. Requiring less power will decrease the cooling water requirements and pollutant deposition of the gas-fired alternative. The gas-fired portion of the combination alternative would have similar effects to those discussed in Section 8.2.4 Terrestrial and Aquatic Ecology; however, because the gas-fired portion of this alternative would only produce 280 MW, rather than 560 MW for the gas-fired alternative, the imprint of the plant may be smaller, and therefore, erosion and sedimentation during construction, and pollutant deposition during operation are expected to be less. Impacts from wind-powered and wood-fired portions of this alternative would vary depending on the location and ecology of the site, but would likely be minimal. Construction in a previously disturbed area would have lower impacts to aquatic communities than construction in an undisturbed area. Impacts during operation are expected to be minimal as neither option requires a source of cooling water. Some deposition of carbon compounds and particulate matter would occur on nearby waterways as a result of burning wood waste.

Overall impacts to aquatic ecology from a combination alternative are expected to be SMALL.

The largest potential impact to terrestrial resources would occur from the wind turbines. Wind turbines have the potential to require large amounts of undisturbed land. There would be a potential to mitigate some of these impacts by locating the turbines offshore on Lake Michigan. ROW maintenance would continue, although no additional transmission lines would be necessary. The only construction activities that would occur for the combination alternative are the construction of a combined-cycle gas-fired power plant and any retrofit-related construction. These activities would be confined to previously disturbed areas at the KPS site. Some habitat fragmentation impacts on the KPS site may occur. Impacts to terrestrial ecology would be SMALL to LARGE.

8.3.5 Human Health

The human health risks from a combination of alternatives include the combined cycle gas-fired plant already discussed in 8.1.5. The GEIS (NRC, 1996) notes that the environmental impacts of the conservation/demand-side management alternative are likely to be centered on indoor air quality. This is due to increased weatherization of the home in the form of extra insulation and reduced air turnover rates from the reduction in air leaks. However, the actual impact from the conservation alternative is highly site specific and not yet well-established. For wind power, the GEIS notes that, except for a potentially small number of occupational injuries associated with the construction and routine maintenance of the units, human health would not be affected by routine operations. The occupational human health impacts for the operation of a wood-fired facility would be comparable to that of agriculture, which is high. This is primarily due to the routine movement and handling of large amounts of wood waste that would be needed to fuel the plant. The use of protective equipment and adherence to safety requirements would minimize the danger to workers. The burning of the wood would generate air emissions that can impact human health. The most significant would involve the release of particulate matter. However, these emissions can be controlled effectively with existing technology. It is expected that the facilities would operate in compliance with Federal and State safety and emission standards.

The human health risks from the combination of alternatives are uncertain, but considered to be SMALL to MODERATE.

8.3.6 Socioeconomics

Land Use

The GEIS generically evaluates the impacts of nuclear power plant operations on land use both on and off each power plant site. The analysis of land use impacts for the combination alternative focuses on the amount of land area that would be affected by the construction and operation of a single natural gas-fired unit power plant at the KPS, an offsite wind energy generating power, and demand-side energy conservation.

Approximately 285 acres (115 ha) would be needed to support a single natural gas-fired unit combination alternative including the gas pipeline, according to staff scaling of DEK estimates. By scaling the GEIS estimate, a 292-MWe (gross capacity) plant could require up to approximately 304 acres (123 ha) of land including pipeline. The NRC staff believes that the DEK estimate is reasonable. Nevertheless, land use impacts from construction of the natural gas-fired power plant at KPS would be SMALL.

In addition to onsite land requirements, land would be required off site for natural gas wells and collection stations. The GEIS estimates that 3,600 acres (1,457 ha) would be required for wells, collection stations, and pipelines to bring the gas to a 1,000-MWe generating facility. If this land requirement were scaled with a 292-MWe generating capacity, the natural gas-fired power plant at the KPS could require 1,051 acres (425 ha). Most of this land requirement would occur on land where gas extraction already occurs. In addition, some natural gas could come from outside of the United States and be delivered as liquefied gas.

The wind farm option of the combination alternative producing 47 MWe of electricity would require approximately 10,000 acres (4,050 ha) spread over several locations with approximately 40 acres (16 ha) in actual use. The wood-fired option of the combination alternative producing 47 MWe of electricity would require approximately 90 acres (36 ha).

Since existing transmission lines would be used, land use impacts from the energy conservation alternative would be SMALL. Quickly replacing and disposing of old inefficient appliances could generate waste material and potentially increase the size of landfills. Given the time for program development and implementation, the replacement process would need to begin as soon as possible. Some older appliances would simply be replaced by more efficient appliances as they fail (especially in the case of frequently replaced items, like light bulbs). In addition, many items (like home appliances or industrial equipment) have substantial recycling value and would likely not be disposed of in landfills.

The elimination of uranium fuel for KPS could partially offset offsite land requirements. In the GEIS, the staff estimated that approximately 1,000 acres (405 ha) would not be needed for mining and processing uranium during the operating life of a 1,000-MWe nuclear power plant. For the KPS, roughly 590 acres (239 ha) of uranium mining area would no longer be needed. Overall land use impacts from the combination alternative would be SMALL to MODERATE.

Socioeconomics

As previously discussed, socioeconomic impacts are defined in terms of changes to the demographic and economic characteristics and social conditions of a region. For example, the number of jobs created by the construction and operation of a new single natural gas-fired power plant at the KPS site and wind farm or wood-fired power generating plant could affect regional employment, income, and expenditures. Two types of job creation would occur: (1) construction-related jobs, which are transient, short in duration, and less likely to have a long-term socioeconomic impact; and (2) operation-related jobs in support of power generating operations, which have the greater potential for permanent, long-term socioeconomic impacts. Construction and operations workforce requirements for the combination alternative were determined in order to measure their possible effect on current socioeconomic conditions.

Based on GEIS projections and a workforce of 1,200 for a 1,000-MWe plant, a single 292-MWe unit at KPS would require a peak estimated construction workforce of 350 workers. Additional estimated construction workforce requirements for this combination alternative would include 300 construction workers for the wind farm option and 131 construction workers for the wood-fired option. The number of additional workers would cause a short-term increase in the demand for services and temporary (rental) housing in the region around the construction site.

After construction and depending on the size of the community, some local communities may be temporarily affected by the loss of the construction jobs and associated loss in demand for business services. The rental housing market could also experience increased vacancies and decreased prices. The impact of construction on socioeconomic conditions for each of the three power generating facilities would be SMALL.

Following construction, a single unit gas-fired power plant at the KPS could provide up to 10 jobs, based on scaled DEK estimates, or up to 44 jobs based on GEIS estimates. Additional estimated operations workforce requirements for this combination alternative would include 50 operations workers for the wind farm option and 13 operations workers for the wood-fired option. Given the small numbers of operations workers at these facilities, socioeconomic impacts associated with the operation of the natural gas-fired power plant at the KPS, wind farm, and wood-fired power generating plant would be SMALL.

Socioeconomic effects of an energy efficiency program would be SMALL. As noted in the GEIS, the program would likely employ additional workers. Lower-income families, in particular, could benefit from weatherization and insulation programs because low-income households experience home energy burdens four times greater than the average household (OMB, 2007).

Transportation

Transportation impacts would be SMALL, because the number of employees commuting to the KPS, wind farm, and wood-fired power generating plant would be small. Any transportation effects from the energy efficiency alternative would be widely distributed across the State and would not be noticeable.

Construction and operation of a natural gas-fired power plant, wind farm, and wood-fired power generating plant would increase the number of vehicles on roads in the vicinity of these facilities. During construction, cars and trucks would deliver workers, materials, and equipment to the worksite. The increase in vehicular traffic would peak during shift changes resulting in temporary levels of service impacts and delays at intersections. Pipeline construction and modification to existing natural gas pipeline systems could also have an impact.

During plant operations, transportation impacts would almost disappear. Given the small number of workers at these facilities, impacts on local roads from the operation of the natural gas-fired power plant at the KPS, the wind farm, and wood-fired power generating plant would be SMALL. Transportation impacts at the wind farm and wood-fired power generating plant would also depend on current road capacities and average daily traffic volumes.

Aesthetics

As previously discussed, aesthetic resources are the natural and manmade features that give a particular landscape its character and aesthetic quality. The aesthetics impact analysis focuses on the degree of contrast between the power plant and the surrounding landscape and the visibility of the power plant.

A single natural gas-fired unit located at the KPS could be approximately 100 feet (30 m) tall, with an exhaust stack up to 175 feet (53 m) tall. The impact would be moderated by higher elevations and vegetation. Power plant infrastructure would generally be smaller and less noticeable than the KPS containment and turbine buildings. Mechanical draft cooling towers would generate condensate plumes and operational noise. Noise during power plant operations would be limited to industrial processes and communications. In addition to the power plant structures, construction of natural gas pipelines would have a short-term impact. Noise from the pipelines could be audible offsite near compressors.

In general, aesthetic changes would be limited to the immediate vicinity of the KPS and the wind farm facilities. The wind farm would have the greatest aesthetic effect. Compared to a fossil-fueled power plant unit on 46 to 1,400 acres, the 32,000-acre (13,000 ha) wind farm (with wind turbines over 300 feet (100 m) tall) would dominate the view and would be the major focus of viewer attention. Therefore, overall aesthetic impacts from the construction and operation of combination alternative would be SMALL to MODERATE.

In addition to seeing new power plant structures at KPS, the wind farm and wood-fired power generating plant may require the construction of transmission lines. The transmission lines would have a lasting visual effect on the landscape.

Impacts from energy efficiency programs would be SMALL. American Transmission Corporation (ATC) would continue to use the existing transmission lines. Some noise impacts could occur in instances of energy efficiency upgrades to major building systems, though this impact would be intermittent and short-lived.

In general, aesthetic changes would be limited to the immediate vicinity of the KPS, the wind farm, and wood-fired power generating plant. Impacts would likely be SMALL to MODERATE at KPS and other sites and would depend on the amount of new transmission line required.

Historic and Archaeological Resources

Cultural resources are the indications of human occupation and use of the landscape as defined and protected by a series of Federal laws, regulations, and guidelines. Prehistoric resources are physical remains of human activities that predate written records; they generally consist of artifacts that may alone or collectively yield information about the past. Historic resources consist of physical remains that postdate the emergence of written records; in the United States, they are architectural structures or districts, archaeological objects, and archaeological features dating after 1492. Ordinarily, sites less than 50 years old are not considered historic, but exceptions can be made for such properties if they are of particular importance, such as structures associated with the development of nuclear power (e.g., Shippingport Atomic power Station) or Cold War themes. American Indian resources are sites, areas, and materials important to American Indians for religious or heritage reasons. Such resources may include geographic features, plants, animals, cemeteries, battlefields, trails, and environmental features. The cultural resource analysis encompassed the power plant site and adjacent areas that could potentially be disturbed by the construction and operation of alternative power plants.

The analysis of land use impacts for the combination alternative focuses on the amount of land that would be affected by the construction and operation of a single natural gas-fired unit power plant at KPS, an offsite wind energy generating plant, a wood-fired facility, and demand-side energy conservation. The impact of constructing and operating a combination alternative at the KPS site would be SMALL, due to previous onsite survey work and Dominion’s commitment to develop a Cultural Resources Management Plan. As discussed in Section 8.2.6, depending on the resource richness of an alternative site ultimately chosen for the wind power alternative, impacts will range from SMALL to MODERATE.

Impacts to historic and archaeological resources from implementing the energy efficiency programs would be SMALL. A conservation alternative would not affect land use or historical or cultural resources onsite or elsewhere in the State.

Environmental Justice

The environmental justice impact analysis evaluates the potential for disproportionately high and adverse human health and environmental effects on minority and low-income populations that could result from the construction and operation of a new natural gas-fired power plant, wind farm, and wood-fired power generating plant. Adverse health effects are measured in terms of the risk and rate of fatal or nonfatal adverse impacts on human health. Disproportionately high and adverse human health effects occur when the risk or rate of exposure to an environmental hazard for a minority or low-income population is significant and exceeds the risk or exposure rate for the general population or for another appropriate comparison group. The minority and low-income populations are subsets of the general public residing around the site, and all are exposed to the same hazards generated from various power plant operations.

Minority and low-income populations could be affected by the construction and operation of a new natural gas-fired power plant, wind farm, and wood-fired power generating plant. The extent of disproportionate effect is difficult to determine since it would depend on the location of these power generating facilities. Some of these effects have been identified in resource areas discussed in this section. For example, increased demand for rental housing during construction could disproportionately affect low-income populations. However, demand for rental housing could be mitigated if the power generating facilities are constructed near a metropolitan area.

Impacts on minority and low-income populations under the combination alternative could range from SMALL to MODERATE, due to the small number of workers needed to construct and operate the natural gas-fired power plant, wind farm, and wood-fired power generating plant.

Weatherization programs could target low-income residents as a cost-effective energy efficiency option since low-income populations tend to spend a larger proportion of their incomes paying utility bills (according to the Office of Management and Budget, low income populations experience energy burdens more than four times as large as those of average households (OMB, 2007)). Impacts to minority and low-income populations from energy efficiency programs would be SMALL, depending on program design and enrollment.

8.3.7 Waste Management

During the construction stage of this alternative, land clearing and other construction activities would generate waste that can be recycled, disposed onsite or shipped to an offsite waste disposal facility. If the alternative were constructed at the KPS site or any previously disturbed site, the amounts of wastes produced during land-clearing would be reduced.

During operational stage, spent SCR catalysts, which are used to control NOx emissions from the natural gas-fired plants, would make up the majority of the waste generated by this alternative.

There would be a small amount of waste generated during the construction of the wind power facilities and minimal waste associated with its maintenance.

As stated in the GEIS (NRC, 1996), wood-fired component of this alternative would produce considerable amount of fly ash, which can be successfully used as beneficial fertilizer and soil conditioner.

The NRC staff concludes that overall waste impacts of the combination alternative consisting of natural gas-fired plant located at the KPS site and the wind power (option 1), or of the natural gas-fired plant located at KPS and wood-fired power (option 2) would be SMALL.

8.4 PURCHASED POWER

In the ER (DEK, 2008), DEK indicated that it was unlikely that purchased power would be available in sufficient capacity over the 20-year period of extended operation in order to serve as an alternative to license renewal. DEK further indicated that it was likely that relying on purchased power would simply shift the responsibility to construct new facilities to replace KPS to other generators. In addition, DEK indicated that transmission constraints in northeastern Wisconsin make it unlikely that out-of-State purchased power could be imported in sufficient quantity to offset KPS's capacity. The staff has reviewed these assertions and finds them to be reasonably reflective of the challenges facing purchased power as an alternative to license renewal. As a result, the staff has not separately evaluated purchased power as an alternative to license renewal.

8.5 ALTERNATIVES CONSIDERED BUT DISMISSED

In this section, the staff discusses the energy alternatives that it determined either would not individually meet the purpose and need identified in the GEIS or whose costs preclude consideration in greater depth. The staff considered several of these alternatives in the combination alternatives in Sections 8.2 and 8.3.

8.5.1 Wind Power

The American Wind Energy Association and the U.S. Department of Energy indicate that Wisconsin currently has 449 MW of installed wind capacity (AWEA Undated; http://www.windpoweringamerica.gov/wind_installed_capacity.asp). The greatest potential for wind power generation in Wisconsin is in the east-central and northeast part of the State, which includes the KPS site. Wind power potential ranges from class 3 to class 4 in this area, according to wind speed maps published by the Wisconsin Office of Energy Independence (2008).

Despite Wisconsin's good wind power potential, wind power is not yet suitable for stand-alone large base load capacity. When paired with energy storage or a readily dispatchable power source like hydropower, wind could serve as a means of providing base load power. Even if suitable, additional backup capacity could be found to support a completely wind-powered option, replacing KPS with wind turbines would require more than a doubling of Wisconsin's current capacity by 2013.

Given wind power's intermittency and the lack of available backup, as well as the current level of implementation in Wisconsin, the NRC staff will not consider wind power as a stand-alone alternative to license renewal. However, given Wisconsin's significant wind resource, the staff will consider wind power as a portion of a combination alternative.

8.5.2 Wood-Fired Power

Two generating stations in Wisconsin currently rely on wood for a portion of their fuel. In 2007, these facilities burned 315,811 tons of wood with a heat output of 3,437 billion British thermal units (Btu) (Wisconsin Office of Energy Independence, 2008). Further, wood currently constitutes the primary renewable energy source in the State.

In 1999, DOE researchers estimated that Wisconsin has biomass fuel resources consisting of urban, mill, agricultural, and forest residues, as well as speculative potential for energy crops. Excluding potential energy crops, DOE researchers projected that Wisconsin had 7,149,128 tons (6,485,579 MT) of plant-based biomass available at $50 per ton delivered (Walsh et al., 2000; costs are in 1995 dollars). Wood-fired power plants in Wisconsin report an average heat content of 5441.5 Btu/lb of wood fuel. Assuming a 33 percent conversion efficiency, using all plant-based biomass available in Wisconsin at $50 or less per ton (the maximum price the researchers considered) would generate roughly 7.6 terawatt-hours (TWh) of electricity. This is roughly two-thirds more electricity than KPS generated in 2008. However, most of this potential comes from agricultural residues, almost all of which (97 percent) are from corn production. Excluding agricultural residues (many of which are traditionally left on fields following harvest and provide fertilization for the following years crops), the total potential is 2 TWh, or less than half of KPS's 2008 production.

Walsh et al. (2000) go on to note that these estimates of biomass capacity contain substantial uncertainty and that potential availability does not mean biomass will actually be available at the prices indicated or that resources will be usably free of contamination. Some of these plant wastes already have reuse value and would likely be more costly to deliver because of competition. Others, such as forest residues, may prove unsafe and unsustainable to harvest on a regular basis.

As a result of limited resource availability, staff will not consider wood-fired as a stand-alone alternative to license renewal. The staff will, however, consider wood-fired as a portion of a combination alternative.

8.5.3 Energy Conservation

The Public Service Commission of Wisconsin commissioned a Statewide study of energy efficiency and customer-sited renewal energy potential in 2009 (Energy Center of Wisconsin, 2009). The study's base case results indicated that by 2018, the achievable potential of efficiency savings could amount to 13 percent of total electricity sales, 12.9 percent of peak demand, and 8.7 percent of natural gas sales in the State. These estimates are a small fraction of the total economic potential identified in the State. The study estimates that by 2012, the State could save 1200 gigawatt hours (GWh) or 250 MW in peak electricity demand. KPS's operating license will expire in 2013, by which time an additional 1.6 percent of electricity demand and total energy could be saved. This amount is less than the power produced by KPS in the course of a year, and so energy efficiency will not be considered as a stand-alone alternative to license renewal.

The energy efficiency potential in the State is significant, however, and energy efficiency measures tend to have low environmental consequences. As a result, the staff will consider energy efficiency as a portion of a combination alternative.

8.5.4 Solar Power

Solar technologies use the sun's energy to produce electricity. Wisconsin receives between 4 and 4.5 kilowatt-hours (kWh) per square meter per day, or approximately 0.4 kWh of solar radiation per square foot per day, for solar collectors oriented at an angle equal to the installation's latitude (NREL, 2009). At this level of incident solar radiation, photovoltaics are likely to be more effective than solar thermal power plants. Because flat-plate photovoltaics tend to be roughly 25 percent efficient, a solar-powered alternative would require roughly 3,200 acres (1,300 ha) of collectors to provide an amount of electricity equivalent to that generated by KPS in 2008. Space between collectors and associated infrastructure increase this land requirement. This amount of land, while large, is consistent with the land required for coal and natural gas fuel cycles. This amount of power generation, however, would occur only during the day and would necessitate some sort of power storage, introducing additional efficiency losses. As noted in the wind energy section, 8.4.1, energy storage technologies are in the early stages of development and are not yet large enough to provide enough backup capacity to replace KPS.

Given the challenges in meeting base load requirements, the staff did not evaluate solar power as an alternative to license renewal of KPS.

8.5.5 Hydroelectric Power

According to researchers at Idaho National Energy and Environmental Laboratory, Wisconsin has an estimated 452.9 MWe of technically available, undeveloped hydroelectric resources at 102 project sites throughout the State (INEEL, 1996). As such, the average potential project is small, with no potential sites having greater than 20-MW potential.

The staff notes that the total available hydroelectric potential is smaller than the capacity of KPS, and thus will not consider hydroelectric power as an alternative to license renewal.

8.5.6 Geothermal Power

Geothermal energy has an average capacity factor of 90 percent and can be used for base load power where available. However, geothermal electric generation is limited by the geographical availability of geothermal resources (NRC, 1996). As illustrated by Figure 8.4 in the GEIS, no feasible location for geothermal capacity exists to serve as an alternative to KPS. The NRC staff concluded that geothermal energy is not a reasonable alternative to license renewal of KPS.

8.5.7 Biofuels

In addition to wood and municipal solid-waste fuels, discussed in 8.5.11, there are other concepts for biomass-fired electric generators, including direct burning of energy crops (crops grown specifically as fuel or feedstock for fuel), conversion to liquid biofuels, and biomass gasification. In the GEIS, the staff indicated that none of these technologies had progressed to the point of being competitive on a large scale or of being reliable enough to replace a base load plant such as KPS. After reevaluating current technologies, the staff finds that other biomass-fired alternatives are still unable to reliably serve as an alternative to the continued operation of KPS and does not consider biofuels to be a viable alternative to KPS license renewal.

8.5.8 New Nuclear Power

Sources in the nuclear industry have recently indicated that reactor projects currently under development are likely eight or nine years from completion, or possibly online in the 2016–2017 timeframe (Nucleonics Week, 2008). This is three to four years after the expiration of the license for KPS. Further, potential plant owners or operators wishing to submit a new proposal specifically to offset the capacity of KPS would require additional time to develop an application. Given the relatively short time remaining on the current KPS operating license compared to the time to license and construct a new nuclear power plant, the staff has not evaluated new nuclear generation as an alternative to license renewal.

8.5.9 Oil-fired Power

EIA's 2009 *Annual Energy Outlook* indicates that oil-fired power will not account for any additions to capacity in the United States (EIA, 2009a). The variable costs of oil-fired generation tend to be greater than those of the nuclear or coal-fired options, and oil-fired generation tends to have greater environmental impacts than natural gas-fired generation. The high cost of oil (even prior to the record-high prices of 2008) has prompted a steady decline in its use for electricity generation. Thus the staff did not consider oil-fired generation as an alternative KPS license renewal.

8.5.10 Fuel Cells

Fuel cells oxidize fuels without combustion and related environmental side effects. Power is produced electrochemically by passing a hydrogen-rich fuel over an anode and air (or oxygen) over a cathode and separating the two by an electrolyte. The only byproducts (depending on fuel characteristics) are heat, water, and CO_2. Hydrogen fuel can come from a variety of hydrocarbon resources by subjecting them to steam under pressure. Natural gas is typically used as the source of hydrogen.

At the present time, fuel cells are not economically or technologically competitive with other alternatives for base load electricity generation. EIA projects that fuel cells may cost $5,360 per installed kilowatts (kWs) (total overnight costs), or 2.5 times the construction cost of new coal-fired generating capacity and 5.7 times the cost of new, advanced gas-fired, combined-cycle capacity (EIA, 2009c). In addition, fuel cell units are likely to be small in size (the EIA reference plant is 10 MWe). While it may be possible to use a distributed array of fuel cells to provide an alternative to KPS, it would be extremely costly to do so and would require 56 reference-size units. Accordingly, the staff does not consider fuel cells as an alternative to KPS license renewal.

8.5.11 Municipal Solid Waste

Municipal solid waste combustors incinerate waste to produce steam, hot water, or electricity. Combustors use three types of technologies—mass burn, modular, and refuse-derived fuel.

Mass burning is currently the method used most frequently in the United States and involves little to no sorting, shredding, or separation. Consequently, toxic or hazardous components present in the waste stream are combusted, and toxic constituents are exhausted to the air or become part of the resulting solid wastes. Currently, approximately 89 waste-to-energy plants operate in the United States. These plants generate approximately 2,700 MWe, or an average of approximately 30 MWe per plant (IWSA, 2007). Approximately 19 average-sized plants will be necessary to provide the same level of output as the other alternatives to KPS license renewal.

The GEIS indicates that the overall level of construction impact from a waste-fired plant will be similar to that for a coal-fired power plant. The GEIS also indicates that waste-fired plants have the same or greater operational impacts than coal-fired technologies (including impacts on the aquatic environment, air, and waste disposal). The initial capital costs for municipal solid-waste plants are greater than for comparable steam-turbine technology at coal-fired facilities or at wood-fired facilities because of the need for specialized waste separation and handling equipment (NRC, 1996).

Regulatory structures that once supported municipal solid waste incineration no longer exist. For example, the Tax Reform Act of 1986 made capital-intensive projects such as municipal waste combustion facilities more expensive relative to less capital-intensive waste disposal alternatives such as landfills. Also, the 1994 Supreme Court decision C&A Carbone, Inc. v. Town of Clarkstown, New York, 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. Additionally, environmental regulations have increased the capital cost necessary to construct and maintain municipal waste combustion facilities.

Given the small average installed size of municipal solid waste plants and the unfavorable regulatory environment, the staff does not consider municipal solid waste combustion to be a feasible alternative to KPS license renewal.

8.5.12 Delayed Retirement

In the KPS ER, DEK indicated that few base load plants are likely to retire in the near future in Wisconsin. DEK identified roughly 315 MW of capacity operated by other generators in the State, which is significantly less than the 590 MW currently produced by KPS. Further, delaying retirement of older, coal-fired plants is likely to carry additional environmental impacts, as they typically have less-advanced emissions controls. As a result, the staff will not consider delayed retirement as an alternative to KPS license renewal.

8.6 NO-ACTION ALTERNATIVE

This section will examine the environmental effects that will occur if the NRC takes no action. No action in this case means that the NRC does not issue a renewed operating license for KPS and its license simply expires at the end of the current license term, in 2013. If the NRC takes no action, the plant will shutdown at or before the end of the current license. After shutdown, plant operators will initiate decommissioning according to 10 CFR 50.82.

The staff notes that no action is the only alternative considered in-depth that does not satisfy the purpose and need for this draft SEIS, as it does not meet system needs beyond the term of the current license. The no-action alternative would not meet the energy needs currently met by KPS or that the alternatives evaluated in sections 8.1 through 8.3 would satisfy. Assuming that a need currently exists for the power generated by KPS, the no-action alternative would require the appropriate energy planning decision makers to rely on another alternative or conservation to replace or offset KPS's capacity.

In this section, the staff addresses only those impacts that arise directly as a result of plant shutdown. The staff has already addressed environmental impacts from decommissioning and related activities in several other documents. These documents include the *Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities*, NUREG-0586, Supplement 1 (NRC, 2002); the license renewal GEIS (Chapter 7; NRC, 1996); and Chapter 7 of this draft SEIS. These analyses either directly address or bound the environmental impacts of decommissioning whenever DEK ceases operating KPS.

The staff notes that, even with a renewed operating license, KPS will eventually shut down, and the environmental effects addressed in this section will occur at that time. Since these effects have not otherwise been addressed in this draft SEIS, the staff will address the impacts in this section. As with decommissioning effects, it is likely that shutdown effects will be similar whether they occur at the end of the current license or at the end of a renewed license. The only difference is that the impacts will occur 20 years sooner if no action is taken.

Table 8-4. Summary of Environmental Impacts of No Action Compared to Continued Kewaunee Power Station Operation

	No Action	Continued KPS Operation
Air Quality	SMALL	SMALL
Groundwater	SMALL	SMALL
Surface Water	SMALL	SMALL
Ecology	SMALL	SMALL
Human Health	SMALL	SMALL
Socioeconomics	SMALL	SMALL TO MODERATE
Waste Management	SMALL	SMALL

8.6.1 Air Quality

When the plant stops operating, there would be a reduction in emissions from activities related to plant operation such as the use of diesel generators and employees' vehicles. In Chapter 4, NRC staff determined that these emissions would have a SMALL impact on air quality during the renewal term. Therefore, if the emissions decrease, the impact to air quality would also decrease and would be SMALL.

8.6.2 Groundwater Use and Quality

The use of groundwater would diminish as plant personnel are removed from the site and operations cease. Some consumption of groundwater may continue as a small staff remains onsite to maintain facilities prior to decommissioning. Overall impacts would be smaller than during operations, but would remain SMALL.

8.6.3 Surface Water Use and Quality

The rate of consumptive use of surface water would decrease as the plant is shut down and the reactor cooling system continues to remove the heat of decay. Wastewater discharges would also be reduced considerably. Shutdown would reduce the already SMALL impact on surface water resources and quality.

8.6.4 Aquatic and Terrestrial Resources

Plant shutdown will minimally affect aquatic resources. In Chapter 4 of this draft SEIS, the NRC staff concludes that the impacts of continued operation on aquatic resources will be SMALL. No additional land disturbances on or offsite would occur. Maintenance of transmission line ROWs will continue, regardless of plant operation. Shutdown will reduce the already SMALL impacts to aquatic ecology. As such, the staff concludes that impacts to aquatic resources as a result of plant shutdown will be SMALL

Shutdown will minimally affect terrestrial resources. In Chapter 4 of this draft SEIS, the staff concluded that the impacts of continued operation on terrestrial resources will be SMALL. No additional land disturbances onsite or offsite would occur. Maintenance of transmission line ROWs would continue through 20 years, regardless of plant operation. Shutdown would reduce the already SMALL impacts to terrestrial ecology. Accordingly, the staff concludes that impacts to terrestrial resources as a result of plant shutdown would be SMALL.

8.6.5 Human Health

Human health risks would decrease following plant shutdown. The plant, which is currently operating within regulatory limits, would release less radioactive gaseous and liquid material into the environment. Thus, members of the public would receive less radiation exposure. Also, after shutdown, the variety of potential accidents (radiological and industrial) at the plant would be reduced to a limited set associated with shutdown events and fuel handling and storage. In Chapter 4 of this draft SEIS, the staff concluded that the impacts of continued plant operation on human health would be SMALL. In Chapter 5, the staff concluded that the impacts of accidents during operation would be SMALL. Therefore, shutdown of the plant at the end of its license will decrease radioactive emissions and the variety of potential accidents. The staff concludes that the impacts to human health following plant shutdown would be SMALL.

The no-action alternative would cause KPS to enter the decommissioning phase. Environmental impacts from the decommissioning activities of any reactor before or at the end of an initial or renewed license are evaluated in the *Generic Environmental Impact Statement for Decommissioning of Nuclear Facilities*: Supplement 1, Regarding the Decommissioning of Nuclear Power Reactors, NUREG-0586, Supplement 1 (NRC, 2002). The document concluded that the human health impacts from decommissioning a power reactor are SMALL. In Chapter 7 of this draft SEIS, the staff used information contained in NUREG-0586, Supplement 1, its review of the applicant's environmental report, the site audit, and the public scoping process to conclude that the impacts to human health during the decommissioning phase of KPS would be SMALL.

The staff concludes that the impacts to human health for the no action alternative would be SMALL.

8.6.6 Socioeconomics

Land Use

Plant shutdown would not affect onsite land use. Plant structures and other facilities would remain in place until decommissioning. Most transmission lines connected to KPS would remain in service after the plant stops operating. Maintenance of most existing transmission lines would continue as before. Impacts on land use from plant shutdown would be SMALL.

Socioeconomics

Plant shutdown would have an impact on socioeconomic conditions in the region around KPS. Plant shutdown would eliminate up to 735 jobs and would reduce tax revenue in the region. The loss of these contributions, which may not entirely cease until after decommissioning, would have a SMALL to MODERATE impact. See Appendix J to NUREG 0586, Supplement 1 (NRC, 2002), for additional discussion of the potential socioeconomic impacts of plant decommissioning.

Transportation

Traffic volumes on the roads in the vicinity of KPS would be reduced after plant shutdown. Most of the reduction in traffic volume would be associated with the loss of jobs at the plant. Deliveries to the plant would be reduced until decommissioning. Transportation impacts would be SMALL as a result of plant shutdown.

Aesthetics

Plant structures and other facilities would remain in place until decommissioning, and plumes from the plant's cooling towers would disappear entirely. Noise caused by plant operation would cease. Aesthetic impacts of plant closure would be SMALL.

Historic and Archaeological Resources

Plant shutdown will likely have no noticeable immediate impacts on historic and archaeological resources. Decommissioning methods would be described in a post-shutdown decommissioning activities report, which is required to be submitted to NRC within two years following cessation of operations. NRC requirements ensure that the decommissioning activities would be subject to a Section 106 review in accordance with the National Historic Preservation Act (NHPA). It is unlikely that plant staff will begin deconstruction or remediation before decommissioning. Because existing transmission lines will remain energized, transmission line ROW maintenance would continue. In Chapter 4 of this draft SEIS, the NRC concluded that the impacts of continued plant operation on historic and archaeological resources could be SMALL.

Impacts from the no-action alternative would also be SMALL, since KPS would be decommissioned with no alternative power plant to replace it. A separate environmental and Section 106 review would be conducted for decommissioning. That assessment will address the protection of historic and archaeological resources.

Environmental Justice

Termination of power plant operations would not disproportionately affect minority and low-income populations outside of the immediate vicinity of KPS, because minority and low-income populations are generally concentrated in urban areas. Impacts to all other resource areas would be SMALL to MODERATE. Thus, impacts from plant shutdown would be SMALL. See Appendix J of NUREG 0586, Supplement 1 (NRC, 2002), for additional discussion of these impacts.

8.6.7 Waste Management

If the no-action alternative were implemented the generation of high-level waste would stop and the generation of low-level and mixed waste would decrease. Impacts from implementation of the no-action alternative are expected to be SMALL.

8.7 ALTERNATIVES SUMMARY

In this chapter, we considered the following alternatives to KPS license renewal:

- A gas-fired combined-cycle plant at the KPS site and an undetermined alternate site;
- A coal-fired plant at the KPS site and an undetermined alternative site, and;
- Two combinations of alternatives including gas-fired capacity, energy conservation and either wind power (option 1), or wood-fired power (option 2).

Finally, the staff considered the effects of no action by the NRC. Impacts for all alternatives are summarized in Table 8.5. The impacts of license renewal for KPS are similar to or smaller than the impacts of the alternatives considered in this chapter in all resource areas, with the exception of no action. No action, however, would necessitate additional action on the part of other entities to either replace or offset the power produced by KPS, and thus would result in additional impacts similar to those discussed in the other sections of this chapter.

Table 8-5. Summary of Environmental Impacts of Proposed Action and Alternatives

	KPS License Renewal	Gas-fired at KPS Site	Gas-fired at Alternate Site	Coal-Fired at KPS Site	Coal-Fired at Alternate Site	Combination Option 1	Combination Option 2	No-Action Alternative
Air Quality	SMALL	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	SMALL
Groundwater	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Surface Water	SMALL	SMALL	SMALL to MODERATE	SMALL	SMALL	SMALL to MODERATE	SMALL	SMALL
Ecology	SMALL	SMALL to MODERATE	SMALL to MODERATE	MODERATE	MODERATE	SMALL to LARGE	SMALL to LARGE	SMALL
Human Health	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL to MODERATE	SMALL to MODERATE	SMALL
Socioeconomics	SMALL TO MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to LARGE	SMALL to LARGE	SMALL to LARGE	SMALL to MODERATE	SMALL to MODERATE
Waste Management	SMALL	SMALL	SMALL	MODERATE	MODERATE	SMALL	SMALL	SMALL

8.8 REFERENCES

10 CFR 51. *U.S. Code of Federal Regulations,* Title 10, *Energy*, Part 50, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

40 CFR 50. *U.S. Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 50, "Domestic Licensing of Production and Utilization Facilities."

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

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

40 CFR 75, *U.S. Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 75, "Continuous Emission Monitoring."

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9.0 CONCLUSION

This supplemental environmental impact statement (SEIS) contains the preliminary environmental review of Dominion Energy Kewaunee, Inc. (DEK) application for the renewed operating license for Kewaunee Power Station (KPS) as required by Title 10, Part 51, of the *Code of Federal Regulations* (10 CFR Part 51) that implement the National Environmental Policy Act (NEPA). This chapter presents the conclusions and recommendations from the site-specific environmental review of KPS and summarizes site-specific environmental issues of license renewal that were identified during the review. The environmental impacts of license renewal are summarized in Section 9.1; a comparison of the environmental impacts of license renewal and energy alternatives is presented in Section 9.2; unavoidable impacts of license renewal and energy alternatives and resource commitments are discussed in Section 9.3; and conclusions and U.S. Nuclear Regulatory Commission (NRC) recommendations are presented in Section 9.4.

9.1 ENVIRONMENTAL IMPACTS OF LICENSE RENEWAL

Our review of site-specific environmental issues in this SEIS leads the staff to conclude that issuing a renewed license would have SMALL impacts for the 23 Category 2 issues applicable to license renewal of KPS.

The requirements for the assessment of refurbishing in a license renewal of operating nuclear power plants include the preparation of an integrated plant assessment (IPA) under 10 CFR 54.21. The IPA must identify and list systems, structures, and components subject to an aging management review. Items that are subject to aging and might require refurbishment include, for example, the reactor vessel, piping, supports, and pump casings, as well as those that are not subject to periodic replacement. In the case of KPS, the IPA did not identify the need of major refurbishment or replacement actions to maintain the functionality of important systems, structures, and components during the KPS license renewal period. Also, the IPA did not identify the need for modifications to any of the KPS facilities associated with the license renewal.

Currently, no threatened or endangered aquatic species are known to occur within Lake Michigan on or in the vicinity of the KPS site or within any streams crossed by in-scope transmission line right of ways (ROWs); therefore, license renewal of KPS would have no effect on any Federally or State-listed aquatic species, and mitigation measures need not be considered.

Operation of the KPS site and its associated transmission lines is not expected to adversely affect any threatened or endangered species during the license renewal term; therefore, the staff concludes that adverse impacts to threatened or endangered species during the period of extended operation would be SMALL. There are several mitigation measures currently in place at the KPS site and along its associated transmission lines which NRC finds to be adequate. Mitigation measures include: nest construction and placement for the peregrine falcon, environmental review checklists, environmental evaluation forms, and best management practices.

9.2 COMPARISON OF THE ENVIRONMENTAL IMPACTS OF LICENSE RENEWAL AND ALTERNATIVES

In the conclusion to Chapter 8, the staff determined that impacts from license renewal are generally similar to, or smaller than the impacts of alternatives to license renewal. In comparing likely environmental impacts from gas-fired, coal-fired, two combinations of alternatives including gas-fired capacity, energy conservation and either wind power (option 1), or wood-fired power (option 2), and environmental impacts from license renewal, the staff found that the no action alternative would result in the lowest environmental impact. The no action alternative, however, would necessitate additional action on the part of other entities to either replace or offset the power produced by KPS, and thus would result in additional impacts similar to those discussed in Chapter 8. On the basis of its analysis, the staff found that the impacts of license renewal are reasonable in light of the impacts from alternatives to the license renewal.

9.3 RESOURCE COMMITMENTS

9.3.1 Unavoidable Adverse Environmental Impacts

Unavoidable adverse environmental impacts are impacts that would occur after implementation of all feasible mitigation measures. Implementing any of the energy alternatives considered in this SEIS, including the proposed action, would result in some unavoidable adverse environmental impacts.

Minor unavoidable adverse impacts on air quality would occur due to the emission and release of various chemical and radiological constituents from power plant operations. Nonradiological emissions resulting from power plant operations are expected to comply with Environmental Protection Agency (EPA) emissions standards, though the alternative of operating a fossil-fueled power plant in some areas may worsen existing attainment issues. Chemical and radiological emissions would not exceed the National Emission Standards for Hazardous Air Pollutants.

During nuclear power plant operations, workers and members of the public would face unavoidable exposure to radiation and hazardous and toxic chemicals. Workers would be exposed to radiation and chemicals associated with routine plant operations and the handling of nuclear fuel and waste material. Workers would have higher levels of exposure than members of the public, but doses would be administratively controlled and would not exceed any standards or administrative control limits. Construction and operation of non-nuclear power generating facilities would also result in unavoidable exposure to hazardous and toxic chemicals to workers and the general public.

Also unavoidable would be the generation of spent nuclear fuel and waste material, including low-level radioactive waste, hazardous waste, and nonhazardous waste. Hazardous and nonhazardous wastes would also be generated at non-nuclear power generating facilities. Wastes generated during plant operations would be collected, stored, and shipped for suitable treatment, recycling, or disposal in accordance with applicable Federal and State regulations. Due to the costs of handling these materials, power plant operators would be expected to conduct all activities and optimize all operations in a way that would generate the smallest amount of waste practical.

9.3.2 Relationship Between Local Short-Term Uses of the Environment and the Maintenance and Enhancement of Long-Term Productivity

The operation of power generating facilities would result in short-term uses of the environment as described in Chapters 4, 5, 6, 7, and 8. “Short term” is the period of time during which continued power generating activities would take place.

Power plant operations would necessitate short-term use of the environment and commitments of resources, and would also commit certain resources (e.g., land and energy) indefinitely or permanently. Certain short-term resource commitments would be substantially greater under most energy alternatives, including license renewal, than under the No Action alternative due to the continued generation of electrical power, as well as continued use of generating sites and associated infrastructure. During operations, all energy alternatives would entail similar relationships between local short-term uses of the environment and the maintenance and enhancement of long-term productivity.

Air emissions from power plant operations would introduce small amounts of radiological and nonradiological constituents to the region around the plant site. Over time, these emissions would result in increased concentrations and exposure, but are not expected to impact air quality or radiation exposure to the extent that public health and long-term productivity of the environment would be impaired.

Continued employment, expenditures, and tax revenues generated during power plant operations would directly benefit local, regional, and state economies over the short term. Local governments investing project-generated tax revenues into infrastructure and other required services could enhance economic productivity over the long term.

The management and disposal of spent nuclear fuel, low-level radioactive waste, hazardous waste, and nonhazardous waste would require an increase in energy and would consume space at treatment, storage, or disposal facilities. Regardless of the location, the use of land to meet waste disposal needs would reduce the long-term productivity of the land.

Power plant facilities would be committed to electricity production over the short term. After decommissioning these facilities and restoring the area, the land could be available for other future productive uses.

9.3.3 Irreversible and Irretrievable Commitments of Resources

Irreversible and irretrievable commitments of resources for electrical power generation would include the commitment of land, water, energy, raw materials, and other natural and manmade resources required for power plant operations. This section describes the irreversible and irretrievable commitments of resources that have been identified in this SEIS. A commitment of resources is irreversible when primary or secondary impacts limit the future options for a resource. An irretrievable commitment refers to the use or consumption of resources neither renewable nor recoverable for future use. In general, the commitment of capital, energy, labor, and material resources would also be irreversible.

Conclusion

The implementation of any of the energy alternatives considered in this SEIS would entail the irreversible and irretrievable commitments of energy, water, chemicals, and, in some cases, fossil fuels. These resources would be committed during the license renewal term and over the entire life cycle of the power plant and would essentially be unrecoverable.

Energy expended would be in the form of fuel for equipment, vehicles, and power plant operations and electricity for equipment and facility operations. Electricity and fuels would be purchased from offsite commercial sources. Water would be obtained from existing water supply systems. These resources are readily available, and the amounts required are not expected to deplete available supplies or exceed available system capacities.

The irreversible and irretrievable commitments of material resources include materials that cannot be recovered or recycled, materials that are rendered radioactive and cannot be decontaminated, and materials consumed or reduced to unrecoverable forms of waste; however, none of the resources used by these power generating facilities is in short supply, and, for the most part, are readily available.

Various materials and chemicals, including acids and caustics, would be required to support operations activities. These materials would be derived from commercial vendors, and their consumption is not expected to affect local, regional, or national supplies.
The treatment, storage, and disposal of spent nuclear fuel, low-level radioactive waste, hazardous waste, and nonhazardous waste would require the irretrievable commitment of energy and fuel and would result in the irreversible commitment of space in disposal facilities.

9.4 RECOMMENDATION

Based on (1) the analysis and findings in the GEIS; (2) information provided in the environmental report (ER) submitted by DEK; (3) consultation with Federal, State, and local agencies; (4) a review of pertinent documents and reports; and (5) consideration of public comments received during scoping, the preliminary recommendation of the NRC staff is that the adverse environmental impacts of license renewal for KPS are not so great that preserving the option of license renewal for energy planning decisionmakers would be unreasonable.

10.0 LIST OF PREPARERS

This supplemental environmental impact statement (SEIS) was prepared by members of the Office of Nuclear Reactor Regulation, with assistance from other U. S. Nuclear Regulatory Commission (NRC) organizations and contract support from Pacific Northwest National Laboratory.

Table 10-1. List of Preparers. *Pacific Northwest National Laboratory provided contract support for the severe accident mitigation alternatives (SAMA) analysis, presented in Chapter 5 and Appendix F.*

Name	Affiliation	Function or Expertise
Nuclear Regulatory Commission		
Briana Balsam	Nuclear Reactor Regulation	Ecology, Project Support
Dennis Beissel	Nuclear Reactor Regulation	Hydrology
Richard Bulavinetz	Nuclear Reactor Regulation	Aquatic Ecology
Jennifer Davis	Nuclear Reactor Regulation	Historic and Archaeological Resources
Nathan Goodman	Nuclear Reactor Regulation	Terrestrial Ecology
Samuel Hernandez	Nuclear Reactor Regulation	Project Manager
Stephen Klementowicz	Nuclear Reactor Regulation	Radiation Protection
Ekaterina Lenning	Nuclear Reactor Regulation	Air Quality
Dennis Logan	Nuclear Reactor Regulation	Ecology
Sarah Lopas	Nuclear Reactor Regulation	Nonradiological Waste
Robert Palla	Nuclear Reactor Regulation	Severe Accident Mitigation Alternatives
Vanice Perin	Nuclear Reactor Regulation	Project Manager
Jeffrey Rikhoff	Nuclear Reactor Regulation	Socioeconomics; Land Use; Environmental Justice
Andrew Stuyvenburg	Nuclear Reactor Regulation	Alternatives
Allison Travers	Nuclear Reactor Regulation	Hydrology
SAMA Contractor[a]		
Steve Short	Pacific Northwest National Laboratory	Severe Accidents Mitigation Alternatives
Bruce Schmitt	Pacific Northwest National Laboratory	Severe Accidents Mitigation Alternatives
Tye Blackburn	Pacific Northwest National Laboratory	Severe Accidents Mitigation Alternatives

[a] Pacific Northwest National Laboratory is operated by Batelle for the U.S. Department of Energy

APPENDIX A
COMMENTS RECEIVED ON THE ENVIRONMENTAL REVIEW

A. COMMENTS RECEIVED ON THE ENVIRONMENTAL REVIEW

A.1. Comments Received During Scoping

The scoping process related to the review of the Kewaunee Power Station (KPS) license renewal application submitted by Dominion Energy Kewaunee, Inc. (DEK), began on October 9, 2008, with the publication of the U.S. Nuclear Regulatory Commission's (NRC's) Notice of Intent to conduct scoping in the *Federal Register* (73 FR 59678). The scoping process included two public meetings held at the Town Hall in Carlton, Wisconsin, on October 22, 2008. Approximately 60 members of the public attended the meetings. After the NRC's prepared statements pertaining to the license renewal process, the meetings were open for public comments. Attendees provided oral statements that were recorded and transcribed by a certified court reporter. All written statements submitted at the public meeting were appended to the transcript. Transcripts of the entire meeting are an attachment to the Scoping Meeting Summary dated November 17, 2008 (NRC, 2008a). In addition to the comments received during the public meetings, comments were received by letter and by electronic mail and were addressed by the NRC staff.

Each commenter was given a unique identifier so that every comment could be traced back to its author. Table A-1 identifies individuals providing comments applicable to the environmental review and their Commenter ID, and each person's set of comments. The individuals are listed in the order in which they spoke at the public meeting, and in alphabetical order for the comments received by letter or e-mail. To maintain consistency with the Scoping Summary Report, the unique identifier used in that report for each set of comments is retained in this appendix. Specific comments were categorized and consolidated by topic. Comments with similar and specific objectives were combined to capture the common essential issues raised by participants. Comments fall into one of the following general groups:

- Specific comments that address environmental issues within the purview of the NRC environmental regulations related to license renewal. These comments address Category 1 (generic), or Category 2 (site-specific) issues or issues not addressed in the GEIS or Category 2 (site-specific) issues. They also address alternatives to license renewal and related Federal actions.

- 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 KPS license renewal application.

- Comments that do not identify new information for the NRC to analyze as part of its environmental review.

- Comments that address issues that do not to fall within or are specifically excluded from the purview of NRC environmental regulations related to license renewal. These comments typically address issues such as the need for power, emergency preparedness, security, current operational safety issues, and safety issues related to operation during the renewal period.

Table A-1. Commenters on the Scope of the Environmental Review. *Each commenter is identified along with their affiliation and how their comment was submitted.*

Commenter ID	Commenter	Affiliation (If Stated)	Comment Source; ML No(s).
KPS-A	Dave Hardtke	Local Citizen	Afternoon Scoping Meeting; Evening Scoping Meeting; ML083190734; ML083190744
KPS-B	Stanley Lacrosse	Local Citizen	Afternoon Scoping Meeting; Written Comments; ML083190734; ML083100095; ML090440072
KPS-C	Ken Paplham	Board Supervisor, Town of Carlton	Afternoon Scoping Meeting; ML083190734
KPS-D	Francis Wojta	Local Citizen	Afternoon Scoping Meeting; ML083190734
KPS-E	Rich Langan	Congressman Steve Kagen's Office	Afternoon Scoping Meeting; ML083190734
KPS-F	Bob Garfinkel	Kewaunee County Board; Literacy Partners of Kewaunee County	Afternoon Scoping Meeting; ML083190734
KPS-G	Jennifer Brown	Kewaunee County Economic Development Corporation	Afternoon Scoping Meeting; ML083190734
KPS-H	Lori Hucek	Kewaunee County Emergency Management	Afternoon Scoping Meeting; ML083190734
KPS-I	Jim Soletzki	State of Wisconsin Assembly Representative	Afternoon Scoping Meeting; Written Comment; ML083100092
KPS-J	Mr. Carrole	Local Citizen	Evening Scoping Meeting; ML083190744
KPS-K	Steve Tadisch	Local Citizen	Evening Scoping Meeting; ML083190744
KPS-L	Bob Ziegelbauer	State Representative, 25th Assembly District; Manitowoc County Executive	Letter; ML083100586; ML083100094
KPS-M	Nancy Crowley	Manitowoc County Emergency Services Coordinator	Letter; ML083100093
KPS-N	Gregory Veith	IUOE Local 310 President; Dominion Energy Kewaunee, Inc.	E-mail; ML083380455

Comments received during scoping applicable to this environmental review are presented in this section along with the NRC response. Comments general or outside the scope of the environmental review for KPS are not included here. Those comments can be found in the Scoping Summary Report (NRC, 2009a).

Scoping comments are grouped in the following categories:

- Socioeconomics

- Uranium Fuel Cycle and Waste Management

A.1.1. Socioeconomics (Taxes and Distribution of Revenues)

Comment: The nuclear plant also pays over $6 million in utility taxes to the State of Wisconsin every year. Wisconsin is the only State in which that utility does not stay in the municipality where the plant is located. Why is that? All property owners in the town of Carlton are currently paying full taxes as well, and deserve to be compensated. (KPS-B-1)

Comment: One reason the people of the Township of Carlton are upset is the distribution of the money from the utility tax which the Kewaunee Nuclear Power Plant pays. The plant occupies 1000 acres of what was once prime agricultural land. It purchased said land from 13 "small farms" which includes 1 mile of lake frontage where it is possible to walk out to the water's shore. Now the rest of the taxpayers have had to pay extra property taxes to help make up for the lost valuation of those farms. It is simply a matter of getting compensated for what the town has lost. (KPS-B-2)

Comment: Okay. Ms. Lopas you said that your committee oversees the, like land use and the water and the natural resources and all that. I have a question about land use. I'm from the town of Carlton. I live about three miles north of the nuclear plant. The way I understand it right now the utility taxes that we get from having that plant here just about equals the taxes that we would have gotten from homes that would have been built on that property. That means that in my opinion that means that nothing is gained by having the nuclear waste being stored here on this property which is what is going on right now. Above ground is the waste storage. The pools are full. So my question is what, what's going to happen when the plant closes and then the utility tax no longer applies? The waste is still going to be there. We're not getting anything for that waste. What do we have to gain by extending the license, having more and more waste being piled up there, high level waste. That's part of my concern. (KPS-A-1)

Comment: You know, it, it's a shame to listen and we have to listen and it's not fair because I can tell you right now the perception of our town of Carlton by the public service commission, the NRC and all our elected officials as being a tax free township is not true. We pay more taxes than our neighboring town. And this is not right for the simple reason we had 480 signatures out of a possibly I think there's maybe a little over 600 people that are voting in this town and we had 480 signatures against letting them put the caskets on top of the ground unless we get compensated. And our town officials gave them the building permit. They scared them into it. Giving them a line. And this is what's all wrong because they ruined our zoning book because they said they didn't need a variance, they didn't need a conditional use, they didn't need that so they turned around and gave them the building permit and now they don't even, they don't know us no more. They're supposed to work without trying to get a little more money out of the State. The State gets six million, very close, for utility tax but none of it stays. We have to share it with the county for 19 percent.

And I have to sort of correct Cindy a little bit. If they could put this town back the way it was without the nuclear plant we would pay less taxes. And this is what really makes it bad because in 1968 when they broke ground they bought this land real cheap. And the State says the assessor will be within ten percent of 100 so the assessor has to keep raising the rest of us to make up the difference so that's why our taxes are higher than the Town of Franklin or the Town of Kewaunee. And I don't think this is right and that's why I'm opposing it and all the 480 signatures are opposing relicensing that plant until this gets settled.

I've got them all, all our officials, even the governor. They want to take the moratorium off to build a nuclear plant because it's the safest, the cleanest. Like I wrote in a letter to them when I sent them all the signatures. Where are you going to put the waste. We've stored it for 34 years under water and we finally got 50,000 and then Dominion devaluated the plant and we lost, how much? $37,000. Now you just said just a few minutes ago that they update, update, update. It's running at full capacity. How come you can devaluate it? I mean that's not your doing, but it, that's lost us $37,000. (KPS-B-3)

Comment: I would like to like to make a little comment on that. It's only pocket change for Dominion. But at the same time -- all this volunteer that we have to take is on our fire departments. And the fire departments don't get a penny to do exactly what Dominion wants to get in so that everything is perfect. Us guys never get a penny. We don't even get paid for the gas in the, in the trucks that do all the running. So I don't -- The volunteer, the volunteer fire departments don't get paid. (KPS-B-4)

Comment: I'd like to differ with that. They do get paid. Any type of response that they have with us whether it's training or for real they bill us. We pay them from our county's budget that we get reimbursed from the plant. If a person has to take off of work we pay their wages that day because they have responded to a training or an exercise or a real event. That is not true. (KPS-H-2)

Comment: If NRC can come over here and overrule our zoning because they are that big and they can step on us, it's like I told our State senator, we have only 600 voting people in the town and you don't give a damn about us. And that was Herb Cole. And it's the same with Kagen's office and it's the same with every one of them. We met with them all. And Gary Visor is the only one that is trying to fight for us. But the State of Wisconsin is the only State that takes all the utility tax and sends back what they want.(KPS-J-1)

There's no incentive for Yucca Mountain to have something done when the rods can be stored at the facility when they get 95 percent of the money. We get the five percent of the money where I think if we got compensated at the very least maybe Yucca Mountain would say hey this is goes here we should get that. That's just the way I feel.(KPS-D-1)

Response: Chapter 2 of this SEIS includes a discussion of the regional tax structure and the distribution of present revenues to each jurisdiction and district, however, the NRC has no role in how States and local jurisdictions tax their utilities, assess power plant value, or how tax money is distributed.

A.1.2. Uranium Fuel Cycle and Waste Management

Comment: I'm Ken Paplham. I'm on the town board here for 34 years as supervisor. And back in January of '93 the town board passed a resolution that there would be no outdoor storage at the power plant. We passed a resolution at that time. And now we're getting these stored outside and I think the municipality should be compensated from the Federal government of $250,000 a year plus $40,000 for each containment that's stored there as long as they're stored there. I don't know why these municipalities have to put up with this storage when we had a resolution back in '93 that there was going to be no storage. I know the plant is in problems with Yucca Mountain but so I think something has to be done. Why should we live with that and like Cindy said right out in the open and Yucca Mountain is going to be a mile under the ground or in the, in a shaft there so. (KPS-C-1)

Comment: I am sending this letter to our officials on behalf of the citizens and taxpayers from the town of Carlton, in Kewaunee County. State and Federal officials need to take a good look at an alternative storage facility in order to keep the Kewaunee Nuclear Power Plant in operation. The storage the plant has in existence will soon be depleted; by the year 2011 operation may have to be suspended until a suitable solution is found. We have come to know that nuclear energy is the most affordable, cleanest, most reliable, and safest way to achieve the emission savings that our nation has to strive for. That is why it is important to address this matter with the attention it deserves.

The nuclear plants new owners, Dominion, recently came to the town meeting seeking approval to construct the dry storage facility for spent fuel rods on site. This is due to the fact that the pools which currently store the spent rods are reaching their maximum capacity. It had been promised by the Wisconsin Public Service that the rods were to be moved to Yucca Mountain, yet they are unfairly being forced to be stored in the town without being fully compensated. The nuclear plant has paid millions, if not billions, of dollars to the Federal Government over more than a 30 year span for a place to store the spent rods. And yet, regrettable, nothing has ever happened. Every spent rod since operation began in 1974 is still stored at the plant site.

The dry storage location needs serious consideration. If nuclear power is less expensive than coal or natural gas, as well as cleaner, all the more important to work our hardest to maintain operation of the Kewaunee nuclear plant. We need our State and U.S. senators as well as Representatives to help do what is necessary and fair for the property owners here in the town of Carlton. The need for this dry storage is present and understood; let us work together for the benefit of everyone to create a workable solution. (KPS-B-5)

Comment: “We the undersigned believe that if Dominion (Kewaunee Nuclear Power Plant) is allowed to construct the dry storage facility on site which is being proposed the land owners of the town of Carlton should be compensated accordingly. Meaning until the spent rods are moved to an alternate location, only then would it be fair if compensation were to cease.” (KPS-B-6)

The complete petition is available at accession number ML083100095.

Comment: We have sent this letter to our officials on behalf of the citizens and taxpayers from the Town of Carlton, in Kewaunee County. State and Federal officials need to take a good look at an alternative storage facility in order to keep the Kewaunee Nuclear Power Plant in operation. The storage the plant has in existence will soon be depleted; by the year 2011 operation may have to be suspended until a suitable solution is found. We have come to know that nuclear energy is the most affordable, cleanest, most reliable, and safest way to achieve the emission savings that our nation has to strive for. That is why it is important to address this matter with the attention it deserves.

Another concern is the “promise” once made that the spent fuel rods from this plant would be moved to Yucca Mountain, that has failed to happen as of yet. We are all concerned for our well-being and also that of our families and neighbors, the entire community. We believe this is God’s country and need to protect what we have for our future generations, our grandchildren and great-grandchildren.

The nuclear plants new owners, Dominion, recently came to the town meeting seeking approval to construct a dry storage facility for spent fuel rods on site. This is due to the fact that the pools which currently store the spent fuel rods are reaching their maximum capacity. It has been promised by the Wisconsin Public Service that the rods were to be moved to Yucca Mountain, yet they are unfairly being forced to be stored in the town without being fully compensated. The nuclear plant has paid millions, if not billions of dollars to the Federal government over more than a 30 year span for a place to store the spent rods. And yet, regrettably, nothing has ever happened. Every spent rod since operation began in 1974 is still stored at the plant site.

The dry storage location needs serious consideration. If nuclear power is less expensive than coal or natural gas, as well as cleaner, all the more important to work our hardest to maintain operation of the Kewaunee nuclear plant. We need our State and U.S. senators as well as Representatives to help do what is necessary and fair for the property owners here in the town of Carlton. The need for this dry storage is presenting and understood; let us work together for the benefit of everyone to create a workable solution. (KPS-B-7)

Comment: Resolution of Conditional Approval

> The town board of the town of Carlton, Kewaunee County, Wisconsin, meeting in a regularly scheduled session on the 12 day January, 1993, upon consideration of the matter and upon vote duly taken, hereby resolves that:
>
> The town board of the town of Carlton, Kewaunee County, Wisconsin, approves and supports the proposal before the State of Wisconsin to modify the addendum payment formula of utility tax if, and only if, all affected utilities are prohibited by law from moving or removing any spent fuel currently stored in pools, or to be stored in pools in the future, unless such removal is for the sole purpose of immediate transport out of the town of Carlton.
>
> The basis for this Resolution is that the town board strongly believes that the renumeration to the town of Carlton from and on behalf of the nuclear power plant in the Town is unfairly and disproportionately low, in light of the environmental and health risks to the residents, livestock, and land of the town of Carlton and surrounding communities. (KPS-B-8)

The above Resolution is available at accession number ML090440072. The town of Carlton board meeting proceedings dated May 13, June 10, and July 10, 2008, were attached to the resolution, and are also available at ML090440072.

Comment: How can it be just as safe above ground with a fence around it compared to being under the ground about a mile under the ground with a 5,000 I believe, 5,000 foot high mountain on top of it? How can it be just as safe sitting out there a few miles from my house and who knows how long it's going to sit there? (KPS-A-2)

Comment: My name is Stanley Lacrosse and I've lived in this town for 54 years and I've heard nothing but lies all the way through. I've attended every meeting. And what I'm against, strongly oppose licensing this plant until we get these issues solved for the simple reason we have these caskets up there. We have to take your word for it, the NRC word for it that they're safe. And you say they'll be moved. That's not true. They'll never move because I got the CRS report updates since October of 2008 and it says right in there possibly the year 2020 they might start receiving. But it also states that if everyone goes there there's not enough room. So you know the furthest one away will never go. (KPS-B-9)

Comment: Yeah, I'm Francis Wojta. I'm just a dairy farmer down the road. I'm probably just an average joe farmer. But, whoops, I just, you know, the NRC takes care of the licensing process, the DOE takes care of the energy process of it. And I know it's, the Federal government is a big bureaucracy. And if somehow they could get together because we say our concerns to you well that's the department, DOE, you have to talk to those people. And we never, the local people never get clear cut answers, you know. You started out with public service they said no rods would be stored here. Dominion came, we have rods stored here. They're a good partner I feel and they do everything safely. We feel safe with the plant but now we're storing nuclear rods.

Part of the, part of our tax money goes to pay for the electric bill, goes to Washington for fuel storage which is supposed to go to Yucca Mountain. So Yucca Mountain gets 95 percent of our tax money to build Yucca Mountain that was supposed to be done in 1998. Now they're saying it's supposed to be done in 2018, okay. Or whatever date it's supposed to be done. We aren't sure of that, okay. Here the rods sit here. There's no incentive for Yucca Mountain to have something done when the rods can be stored at the facility when they get 95 percent of the money. We get the five percent of the money where I think if we got compensated at the very least maybe Yucca Mountain would say hey this is goes here we should get that. That's just the way I feel. (KPS-D-2)

Comment: I just want to inform you a little bit that 26 plants already have gotten billions of dollars from the Department of Energy. One just got 56 million last March. So it's, the Department of Energy is paying it out but it is not coming from the, the nuclear fund. It has come from us taxpayers. (KPS-C-2)

Comment: I'm from Congressman Kagen's office. Okay. When we talk about suing the Federal government what happens is that anybody who is served by a nuclear power plant there's a surcharge put on your electric bill. I live in Ashwaubenon and a couple of communities away. It's served by and I pay a surcharge. That surcharge goes into a big pot of dollars to the Department of Energy. The Department of Energy holds these dollars for the formulation of a place like Yucca Mountain. Now some of these nuclear plants are running out of room. So they're saying what do you want us to do about this Federal government you're not taking our garbage. We want the garbage taken out. And the Federal government, DOE is saying sorry we can't accept it just yet. So what happens here now is that okay we're going to sue you. Well yes, that's fine, we're not suing the NRC we're going to sue the DOE because the DOE is charged with formulating Yucca Mountain here. So Congress said okay if you're going to sue we're not going to let this money come from the Yucca Mountain fund. We're going to put a pot of dollars over here in another pot from the general treasury of the United States. And if any nuclear plant is successful in suing the Federal government the money will not come out of Yucca Mountain fund it will come out of the general treasury fund. So what happens now is that that money that's coming out of the general treasury fund is not as, has never been issued or given out to municipalities. It has only been given back to the nuclear plant that has successfully sued the government and the only use of this money is for constructing dry cask storages, okay. So that's the long and the short of it. It's only going to be used for construction of casks and it's not going to go back to the municipality that is, right where the light waste is located. So I hope that kind of gives everybody a little bit of heads up on when we are able to sue successfully sue Uncle Sam. (KPS-E)

Comment: Yeah, let's just clear the issue up here. This isn't against Carlton against Dominion. Dominion is a good electrical provider and that. We need, we need power. Nuclear power is, we hope it's safe. The big problem with nuclear power is the waste issue. Dominion's good as far as civil projects and helping people out and being a good neighbor, okay. We're not against that. We want to get the issue of the, the waste solved and we just don't like to have it here, you know. (KPS-D-3)

Comment: I just want to ask a question here. Do anyone of these people that they would take one of those dry casks in their village or the city of Green Bay. Or like I asked Senator Cole if I put one in his parking lot -- over in the ballpark. You know what the answer is? You know what the answer is? No, no not in my backyard. And Mr. Soletzki said the same thing. Human error. Human error is all it takes just remember that. This is what we're all worried about is that human error. Mr. Munsin said it's so safe. I told him I'll tell you what if it's that safe how about putting it in writing so I can have it recorded in the courthouse that it's good for a hundred years, so then I don't have to worry about my grandkids and my great grandkids. You know I've been here first. (KPS-B-10)

Comment: I think that's what's broken in the system. You stand up there and say it's not your issue. We go to the DOE. DOE is not in control of those rods yet. They belong to Dominion. And so we're stuck with them. So who do we talk to? Dominion says they, they aren't going to settle anything with us. You said you aren't in control. The DOE says they aren't in control but now whose taking responsibility for them? (A-3)

Comment: Well, I've got the CRS report here. And it's an updated one for October 9th. And Yucca Mountain might be ready by the year 2020. It says might be. But it also says that every, every nuclear plant is getting reimbursed from DOE because they're being sued so they'll get it. So this is the big thing right now is when Dominion put in for theirs there was no reason why they couldn't have put in for compensation for this because that would have been an expense for them. (KPS-J-2)

Comment: I'm Steve Tadisch. I'm a resident here. And we're talking about this high level waste storage. How is that going to affect an addition to the plant or any new plants in the State or the United States? Are they going to give new licenses even though Yucca Mountain is not going to be running at the time or are they going to just prorate it kind of and -- then hope that it's running? The only thing is I was going to say it also says that those spent fuel rods have to be in the water for five years -- before it can go in the casks. (KPS-K)

Comment: Okay. Ms. Lopas you said that your committee oversees the, like land use and the water and the natural resources and all that. I have a question about land use. I'm from the town of Carlton. I live about 3 miles north of the nuclear plant. The way I understand it right now the utility taxes that we get from having that plant here just about equals the taxes that we would have gotten from homes that would have been built on that property. That means that in my opinion that means that nothing is gained by having the nuclear waste being stored here on this property which is what is going on right now. Above ground is the waste storage. The pools are full. So my question is what, what's going to happen when the plant closes and then the utility tax no longer applies? The waste is still going to be there. We're not getting anything for that waste. What do we have to gain by extending the license, having more and more waste being piled up there, high level waste. That's part of my concern. (KPS-A-1)

Comment: I've got them all, all our officials, even the governor. They want to take the moratorium off to build a nuclear plant because it's the safest, the cleanest. Like I wrote in a letter to them when I sent them all the signatures. Where are you going to put the waste. We've stored it for 34 years under water and we finally got 50,000 and then Dominion devaluated the plant and we lost, how much? $37,000. Now you just said just a few minutes ago that they update, update, update. It's running at full capacity. How come you can devaluate it? I mean that's not your doing, but it, that's lost us $37,000. (KPS-B-3)

Comment: Okay. My name is Dave Hardtke. I have a question on the financial environmental issue with this plant. If they are allowed to continue to operate we are sitting on a growing pile of nuclear waste. And when this plant shuts down, and it's going to shut down someday, I have kids and grandchildren in the area, who is going to make up the financial loss to the town when this plant shuts down because we will not be getting any money from the utility tax at that point. And we are sitting on a pile of growing waste out here and some day our kids are going to have to pay the price for it. So I am against the, the license renewal right now. (A-4)

Response: The safety and environmental effects of spent fuel storage on site have been evaluated by the NRC and, as set forth in the Waste Confidence Rule (10 CFR 51.23), the NRC generically determined that such storage could be accomplished without significant environmental impacts. In the Waste Confidence Rule, the Commission determined that spent fuel can be safely stored onsite for at least 30 years beyond the plant’s life, including license renewal. Onsite spent fuel storage is considered a Category 1 issue, which was evaluated in the GEIS, NUREG-1437; therefore, accidents would be included within the analysis of the Category 1 issue of onsite spent fuel storage. The GEIS is based upon the assumption that storage of the spent fuel onsite is not permanent. The GEIS considered a variety of spent fuel and waste storage scenarios, including onsite storage of these materials for up to 30 years following expiration of the operating license, transfer of these materials to a different plant, and transfer of these materials to an independent spent fuel storage installation (ISFSI). For each potential scenario, the GEIS determined that existing regulatory requirements, operating practices, and radiological monitoring programs were sufficient to ensure that impacts resulting from spent fuel and waste storage practices would be SMALL, and therefore were a Category 1 issue.

Furthermore, requirements for dry cask storage are outside the scope of license renewal. During dry cask storage, spent nuclear fuel must be "encased" in NRC-approved casks. An NRC-approved cask is one that has undergone a technical review of its safety aspects and been found to meet all of the NRC's requirements. These requirements are specified in 10 CFR Part 72. The comments provide no new and significant information and, therefore, will not be evaluated further.

A.2. References

U.S. Nuclear Regulatory Commission (NRC). 2008a: "Summary of Public License Renewal Overview and Environmental Scoping Meetings related to the review of the Kewaunee Power Station (KPS) license renewal application submitted by Dominion Energy Kewaunee, Inc," November 17, 2008. ADAMS Accession No. ML083090452.

U.S. Nuclear Regulatory Commission (NRC). 2009a. "Issuance of Environmental Scoping Summary Report Associated with the Staff's Review of the Application by Dominion Energy Kewaunee, Inc., for Renewal of the Operating License for Kewaunee Power Station," April 6, 2009. ADAMS Accession No. ML090770880.

APPENDIX B
NATIONAL ENVIRONMENTAL POLICY ACT ISSUES FOR LICENSE RENEWAL OF NUCLEAR POWER PLANTS

NATIONAL ENVIRONMENTAL POLICY ACT ISSUES FOR LICENSE RENEWAL OF NUCLEAR POWER PLANTS

Table B-1. Summary of Issues and Findings. *This table is taken from Table B-1 in Appendix B, Subpart A, to Title 40 of the Code of Federal Regulations (CFR) Part 51. Data supporting this table are contained in NUREG-1437, Generic Environmental Impact Statement for License Renewal of Nuclear Plants.*

Issue	Type of Issue	Finding
Surface Water Quality, Hydrology, and Use		
Impacts of refurbishment on surface water quality	Generic	SMALL. Impacts are expected to be negligible during refurbishment because best management practices are expected to be employed to control soil erosion and spills.
Impacts of refurbishment on surface water use	Generic	SMALL. Water use during refurbishment will not increase appreciably or will be reduced during plant outage.
Altered current patterns at intake and discharge structures	Generic	SMALL. Altered current patterns have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.
Altered salinity gradients	Generic	SMALL. Salinity gradients 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.
Altered thermal stratification of lakes	Generic	SMALL. Generally, lake stratification 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.
Temperature effects on sediment transport capacity	Generic	SMALL. These effects have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.
Scouring caused by discharged cooling water	Generic	SMALL. Scouring has not been found to be a problem at most operating nuclear power plants and has caused only localized effects at a few plants. It is not expected to be a problem during the license renewal term.
Eutrophication	Generic	SMALL. Eutrophication has not been found to be a problem at operating nuclear power plants and is not expected to be a problem during the license renewal term.
Discharge of chlorine or other biocides	Generic	SMALL. Effects are not a concern among regulatory and resource agencies, and are not expected to be a problem during the license renewal term.
Discharge of sanitary wastes and minor chemical spills	Generic	SMALL. Effects are readily controlled through National Pollutant Discharge Elimination System (NPDES) permit and periodic modifications, if needed, and are not expected to be a problem during the license renewal term.

Issue	Type of Issue	Finding
Discharge of other metals in wastewater	Generic	SMALL. These discharges have not been found to be a problem at operating nuclear power plants with cooling-tower-based heat dissipation systems and have been satisfactorily mitigated at other plants. They are not expected to be a problem during the license renewal term.
Water use conflicts (plants with once-through cooling systems)	Generic	SMALL. These conflicts have not been found to be a problem at operating nuclear power plants with once-through heat dissipation systems.
Water use conflicts (plants with cooling ponds or cooling towers using make-up water from a small river with low flow)	Site-specific	SMALL OR MODERATE. The issue has been a concern at nuclear power plants with cooling ponds and at plants with cooling towers. Impacts on instream and riparian communities near these plants could be of moderate significance in some situations. See § 51.53(c)(3)(ii)(A).
		Aquatic Ecology
Refurbishment	Generic	SMALL. During plant shutdown and refurbishment there will be negligible effects on aquatic biota because of a reduction of entrainment and impingement of organisms or a reduced release of chemicals.
Accumulation of contaminants in sediments or biota	Generic	SMALL. Accumulation of contaminants has been a concern at a few nuclear power plants but has been satisfactorily mitigated by replacing copper alloy condenser tubes with those of another metal. It is not expected to be a problem during the license renewal term.
Entrainment of phytoplankton and zooplankton	Generic	SMALL. Entrainment of phytoplankton and zooplankton has not been found to be a problem at operating nuclear power plants and is not expected to be a problem during the license renewal term.
Cold shock	Generic	SMALL. Cold shock has been satisfactorily mitigated at operating nuclear plants with once-through cooling systems, has not endangered fish populations or been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds, and is not expected to be a problem during the license renewal term.
Thermal plume barrier to migrating fish	Generic	SMALL. Thermal plumes have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.
Distribution of aquatic organisms	Generic	SMALL. Thermal discharge may have localized effects but is not expected to affect the larger geographical distribution of aquatic organisms.
Premature emergence of aquatic insects	Generic	SMALL. Premature emergence has been found to be a localized effect at some operating nuclear power plants but has not been a problem and is not expected to be a problem during the license renewal term.

Issue	Type of Issue	Finding
Gas supersaturation (gas bubble disease)	Generic	SMALL. Gas supersaturation was a concern at a small number of operating nuclear power plants with once-through cooling systems but has been satisfactorily mitigated. It has not been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds and is not expected to be a problem during the license renewal term.
Low dissolved oxygen in the discharge	Generic	SMALL. Low dissolved oxygen has been a concern at one nuclear power plant with a once-through cooling system but has been effectively mitigated. It has not been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds and is not expected to be a problem during the license renewal term.
Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses	Generic	SMALL. These types of losses have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.
Stimulation of nuisance organisms (e.g., shipworms)	Generic	SMALL. Stimulation of nuisance organisms has been satisfactorily mitigated at the single nuclear power plant with a once-through cooling system where previously it was a problem. It has not been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds and is not expected to be a problem during the license renewal term.
Aquatic Ecology (for plants with once-through and cooling pond heat dissipation systems)		
Entrainment of fish and shellfish in early life stages	Site-specific	SMALL, MODERATE, OR LARGE. The impacts of entrainment are small at many plants but may be moderate or even large at a few plants with once-through and cooling-pond cooling systems. Further, ongoing efforts in the vicinity of these plants to restore fish populations may increase the numbers of fish susceptible to intake effects during the license renewal period, such that entrainment studies conducted in support of the original license may no longer be valid. See § 51.53(c)(3)(ii)(B).
Impingement of fish and shellfish	Site-specific	SMALL, MODERATE, OR LARGE. The impacts of impingement are small at many plants but may be moderate or even large at a few plants with once-through and cooling-pond cooling systems. See § 51.53(c)(3)(ii)(B).
Heat shock	Site-specific	SMALL, MODERATE, OR LARGE. Because of continuing concerns about heat shock and the possible need to modify thermal discharges in response to changing environmental conditions, the impacts may be of moderate or large significance at some plants. See § 51.53(c)(3)(ii)(B).
Aquatic Ecology (for plants with cooling-tower-based heat dissipation systems)		
Entrainment of fish and shellfish in early life stages	Generic	SMALL. Entrainment of fish has not been found to be a problem at operating nuclear power plants with this type of cooling system and is not expected to be a problem during the license renewal term.

Issue	Type of Issue	Finding
Impingement of fish and shellfish	Generic	SMALL. The impingement has not been found to be a problem at operating nuclear power plants with this type of cooling system and is not expected to be a problem during the license renewal term.
Heat shock	Generic	SMALL. Heat shock has not been found to be a problem at operating nuclear power plants with this type of cooling system and is not expected to be a problem during the license renewal term.
Groundwater Use and Quality		
Impacts of refurbishment on groundwater use and quality	Generic	SMALL. Extensive dewatering during the original construction on some sites will not be repeated during refurbishment on any sites. Any plant wastes produced during refurbishment will be handled in the same manner as in current operating practices and are not expected to be a problem during the license renewal term.
Groundwater use conflicts (potable and service water; plants that use <100 gpm)	Generic	SMALL. Plants using less than 100 gallons per minute (gpm) are not expected to cause any ground-water use conflicts.
Groundwater use conflicts (potable and service water, and dewatering plants that use >100 gpm)	Site-specific	SMALL, MODERATE, OR LARGE. Plants that use more than 100 gpm may cause ground-water use conflicts with nearby ground-water users. See § 51.53(c)(3)(ii)(C).
Groundwater use conflicts (plants using cooling towers withdrawing makeup water from a small river)	Site-specific	SMALL, MODERATE, OR LARGE. Water use conflicts may result from surface water withdrawals from small water bodies during low flow conditions which may affect aquifer recharge, especially if other groundwater or upstream surface water users come on line before the time of license renewal. See § 51.53(c)(3)(ii)(A).
Groundwater use conflicts (Ranney wells)	Site-specific	SMALL, MODERATE, OR LARGE. Ranney wells can result in potential ground-water depression beyond the site boundary. Impacts of large ground-water withdrawal for cooling tower makeup at nuclear power plants using Ranney wells must be evaluated at the time of application for license renewal. See § 51.53(c)(3)(ii)(C).
Groundwater quality degradation (Ranney wells)	Generic	SMALL. Ground-water quality at river sites may be degraded by induced infiltration of poor-quality river water into an aquifer that supplies large quantities of reactor cooling water. However, the lower quality infiltrating water would not preclude the current uses of groundwater and is not expected to be a problem during the license renewal term.

Issue	Type of Issue	Finding
Groundwater quality degradation (saltwater intrusion)	Generic	SMALL. Nuclear power plants do not contribute significantly to saltwater intrusion.
Groundwater quality degradation (cooling ponds in salt marshes)	Generic	SMALL. Sites with closed-cycle cooling ponds may degrade ground-water quality. Because water in salt marshes is brackish, this is not a concern for plants located in salt marshes.
Groundwater quality degradation (cooling ponds at inland sites)	Site-specific	SMALL, MODERATE, OR LARGE. Sites with closed-cycle cooling ponds may degrade ground-water quality. For plants located inland, the quality of the groundwater in the vicinity of the ponds must be shown to be adequate to allow continuation of current uses. See § 51.53(c)(3)(ii)(D).
	Terrestrial Ecology	
Refurbishment impacts	Site-specific	SMALL, MODERATE, OR LARGE. Refurbishment impacts are insignificant if no loss of important plant and animal habitat occurs. However, it cannot be known whether important plant and animal communities may be affected until the specific proposal is presented with the license renewal application. See § 51.53(c)(3)(ii)(E).
Cooling tower impacts on crops and ornamental vegetation	Generic	SMALL. Impacts from salt drift, icing, fogging, or increased humidity associated with cooling tower operation have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.
Cooling tower impacts on native plants	Generic	SMALL. Impacts from salt drift, icing, fogging, or increased humidity associated with cooling tower operation have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.
Bird collisions with cooling towers	Generic	SMALL. These collisions have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.
Cooling pond impacts on terrestrial resources	Generic	SMALL. Impacts of cooling ponds on terrestrial ecological resources are considered to be of small significance at all sites.
Power line right of way management (cutting and herbicide application)	Generic	SMALL. The impacts of right of way (ROW) maintenance on wildlife are expected to be of small significance at all sites.
Bird collisions with power lines	Generic	SMALL. Impacts are expected to be of small significance at all sites.

Issue	Type of Issue	Finding
Impacts of electromagnetic fields on flora and fauna	Generic	SMALL. No significant impacts of electromagnetic fields on terrestrial flora and fauna have been identified. Such effects are not expected to be a problem during the license renewal term.
Floodplains and wetland on power line ROW	Generic	SMALL. Periodic vegetation control is necessary in forested wetlands underneath power lines and can be achieved with minimal damage to the wetland. No significant impact is expected at any nuclear power plant during the license renewal term.
Threatened and Endangered Species		
Threatened or endangered species	Site-specific	SMALL, MODERATE, OR LARGE. Generally, plant refurbishment and continued operation are not expected to adversely affect threatened or endangered species. However, consultation with appropriate agencies would be needed at the time of license renewal to determine whether threatened or endangered species are present and whether they would be adversely affected. See § 51.53(c)(3)(ii)(E).
Air Quality		
Air quality during refurbishment (non-attainment and maintenance areas)	Site-specific	SMALL, MODERATE, OR LARGE. Air quality impacts from plant refurbishment associated with license renewal are expected to be small. However, vehicle exhaust emissions could be cause for concern at locations in or near nonattainment or maintenance areas. The significance of the potential impact cannot be determined without considering the compliance status of each site and the numbers of workers expected to be employed during the outage. See § 51.53(c)(3)(ii)(F).
Air quality effects of transmission lines	Generic	SMALL. Production of ozone and oxides of nitrogen is insignificant and does not contribute measurably to ambient levels of these gases.
Land Use		
Onsite land use	Generic	SMALL. Projected onsite land use changes required during refurbishment and the renewal period would be a small fraction of any nuclear power plant site and would involve land that is controlled by the applicant.
Power line ROW	Generic	SMALL. Ongoing use of power line ROWs would continue with no change in restrictions. The effects of these restrictions are of small significance.
Human Health		
Radiation exposures to the public during refurbishment	Generic	SMALL. During refurbishment, the gaseous effluents would result in doses that are similar to those from current operation. Applicable regulatory dose limits to the public are not expected to be exceeded.

Issue	Type of Issue	Finding
Occupational radiation exposures during refurbishment	Generic	SMALL. Occupational doses from refurbishment are expected to be within the range of annual average collective doses experienced for pressurized-water reactors and boiling-water reactors. Occupational mortality risk from all causes including radiation is in the mid-range for industrial settings.
Microbiological organisms (occupational health)	Generic	SMALL. Occupational health impacts are expected to be controlled by continued application of accepted industrial hygiene practices to minimize worker exposures.
Microbiological organisms (public health)(plants using lakes or canals, or cooling towers or cooling ponds that discharge to a small river)	Site-specific	SMALL, MODERATE, OR LARGE. These organisms are not expected to be a problem at most operating plants except possibly at plants using cooling ponds, lakes, or canals that discharge to small rivers. Without site-specific data, it is not possible to predict the effects generically. See § 51.53(c)(3)(ii)(G).
Noise	Generic	SMALL. Noise has not been found to be a problem at operating plants and is not expected to be a problem at any plant during the license renewal term.
Electromagnetic fields—acute effects (electric shock)	Site-specific	SMALL, MODERATE, OR LARGE. Electrical shock resulting from direct access to energized conductors or from induced charges in metallic structures have not been found to be a problem at most operating plants and generally are not expected to be a problem during the license renewal term. However, site-specific review is required to determine the significance of the electric shock potential at the site. See § 51.53(c)(3)(ii)(H).
Electromagnetic fields—chronic effects	Uncategorized	UNCERTAIN. Biological and physical studies of 60-Hz electromagnetic fields have not found consistent evidence linking harmful effects with field exposures. However, research is continuing in this area and a consensus scientific view has not been reached.
Radiation exposures to public (license renewal term)	Generic	SMALL. Radiation doses to the public will continue at current levels associated with normal operations.
Occupational radiation exposures (license renewal term)	Generic	SMALL. Projected maximum occupational doses during the license renewal term are within the range of doses experienced during normal operations and normal maintenance outages, and would be well below regulatory limits.
Socioeconomic Impacts		

Issue	Type of Issue	Finding
Housing impacts	Site-specific	SMALL, MODERATE, OR LARGE. Housing impacts are expected to be of small significance at plants located in a medium or high population area and not in an area where growth control measures that limit housing development are in effect. Moderate or large housing impacts of the workforce associated with refurbishment may be associated with plants located in sparsely populated areas or in areas with growth control measures that limit housing development. See § 51.53(c)(3)(ii)(I).
Public services: public safety, social services, and tourism, and recreation	Generic	SMALL. Impacts to public safety, social services, and tourism and recreation are expected to be of small significance at all sites.
Public services: public utilities	Site-specific	SMALL OR MODERATE. An increased problem with water shortages at some sites may lead to impacts of moderate significance on public water supply availability. See § 51.53(c)(3)(ii)(I).
Public services: education (refurbishment)	Site-specific	SMALL, MODERATE, OR LARGE. Most sites would experience impacts of small significance but larger impacts are possible depending on site- and project-specific factors. See § 51.53(c)(3)(ii)(I).
Public services: education (license renewal term)	Generic	SMALL. Only impacts of small significance are expected
Offsite land use (refurbishment)	Site-specific	SMALL OR MODERATE. Impacts may be of moderate significance at plants in low population areas. See § 51.53(c)(3)(ii)(I).
Offsite land use (license renewal term)	Site-specific	SMALL, MODERATE, OR LARGE. Significant changes in land use may be associated with population and tax revenue changes resulting from license renewal. See § 51.53(c)(3)(ii)(I).
Public services: transportation	Site-specific	SMALL, MODERATE, OR LARGE. Transportation impacts (level of service) of highway traffic generated during plant refurbishment and during the term of the renewed license are generally expected to be of small significance. However, the increase in traffic associated with the additional workers and the local road and traffic control conditions may lead to impacts of moderate or large significance at some sites. See § 51.53(c)(3)(ii)(J).
Historic and archaeological resources	Site-specific	SMALL, MODERATE, OR LARGE. Generally, plant refurbishment and continued operation are expected to have no more than small adverse impacts on historic and archaeological resources. However, the National Historic Preservation Act requires the Federal agency to consult with the State Historic Preservation Officer to determine whether there are properties present that require protection. See § 51.53(c)(3)(ii)(K).
Aesthetic impacts (refurbishment)	Generic	SMALL. No significant impacts are expected during refurbishment.

Issue	Type of Issue	Finding
Aesthetic impacts (license renewal term)	Generic	SMALL. No significant impacts are expected during the license renewal term.
Aesthetic impacts of transmission lines (license renewal term)	Generic	SMALL. No significant impacts are expected during the license renewal term.
Postulated Accidents		
Design basis accidents	Generic	SMALL. The Nuclear Regulatory Commission (NRC) staff has concluded that the environmental impacts of design basis accidents are of small significance for all plants.
Severe accidents	Site-specific	SMALL. The probability weighted consequences of atmospheric releases, fallout onto open bodies of water, releases to groundwater, 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. See § 51.53(c)(3)(ii)(L).
Uranium Fuel Cycle and Waste Management		
Offsite radiological impacts (individual effects from other than the disposal of spent fuel and high level waste)	Generic	SMALL. Off-site impacts of the uranium fuel cycle have been considered by the Commission in Table S-3 of this part. Based on information in the Generic Environmental Impact Statement (GEIS), impacts on individuals from radioactive gaseous and liquid releases including radon-222 and technetium-99 are small.

Issue	Type of Issue	Finding
Offsite radiological impacts (collective effects)	Generic	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 roentgen equivalent man (rem), or 12 cancer fatalities, for each additional 20-year power reactor operating term. Much of this, especially the contribution of radon releases from mines and tailing piles, consists of tiny doses summed over large populations. This same dose calculation can theoretically be extended to include many tiny doses over additional thousands of years as well as doses outside the U.S. The result of such a calculation would be thousands of cancer fatalities from the fuel cycle, but this result assumes that even tiny doses have some statistical adverse health effect, which will not ever be mitigated (for example no cancer cure in the next thousand years), and that these doses projected over thousands of years are meaningful. However, these assumptions are questionable. In particular, science cannot rule out the possibility that there will be no cancer fatalities from these tiny doses. For perspective, the doses are very small fractions of regulatory limits, and even smaller fractions of natural background exposure to the same populations. Nevertheless, despite all the uncertainty, some judgment as to the regulatory NEPA implications of these matters should be made and it makes no sense to repeat the same judgment in every case. Even taking the uncertainties into account, the Commission concludes that these impacts are acceptable in that these impacts would not be sufficiently large to require the NEPA conclusion, for any plant, that the option of extended operation under 10 CFR Part 54 should be eliminated. Accordingly, while the commission has not assigned a single level of significance for the collective effects of the fuel cycle, this issue is considered Category 1 [Generic].

Issue	Type of Issue	Finding
Offsite radiological impacts (spent fuel and high level waste disposal)	Generic	For the high level waste and spent fuel disposal component of the fuel cycle, there are no current regulatory limits for offsite releases of radionuclides for the current candidate repository site. However, if we assume that limits are developed along the lines of the 1995 National Academy of Sciences (NAS) report, "Technical Bases for Yucca Mountain Standards," and that in accordance with the Commission's Waste Confidence Decision, 10 CFR 51.23, a repository can and likely will be developed at some site, which will comply with such limits, peak doses to virtually all individuals will be 100 millirem per year or less. However, while the Commission has reasonable confidence that these assumptions will prove correct, there is considerable uncertainty since the limits are yet to be developed, no repository application has been completed or reviewed, and uncertainty is inherent in the models used to evaluate possible pathways to the human environment. The NAS report indicated that 100 millirem per year should be considered as a starting point for limits for individual doses, but notes that some measure of consensus exists among national and international bodies that the limits should be a fraction of the 100 millirem per year. The lifetime individual risk from 100 millirem annual dose limit is about 3 x 10-3. Estimating cumulative doses to populations over thousands of years is more problematic. The likelihood and consequences of events that could seriously compromise the integrity of a deep geologic repository were evaluated by the Department of Energy in the "Final Environmental Impact Statement: Management of Commercially Generated Radioactive Waste," October 1980. The evaluation estimated the 70-year whole-body dose commitment to the maximum individual and to the regional population resulting from several modes of breaching a reference repository in the year of closure, after 1,000 years, after 100,000 years and after 100,000,000 years. Subsequently, the NRC and other federal agencies have expended considerable effort to develop models for the design and for the licensing of a high level waste repository, especially for the candidate repository at Yucca Mountain. More meaningful estimates of doses to population may be possible in the future as more is understood about the performance of the proposed Yucca Mountain repository. Such estimates would involve very great uncertainty, especially with respect to cumulative population doses over thousands of years. The standard proposed by the NAS is a limit on maximum individual dose. The relationship of potential new regulatory requirements, based on the NAS report, and cumulative population impacts has not been determined, although the report articulates the view that protection of individuals will adequately protect the population for a repository at Yucca Mountain. However, EPA's generic repository standards in 40 CFR Part 191 generally provide an indication of the order of magnitude of cumulative risk to population that could result from the licensing of a Yucca Mountain repository, assuming the ultimate standards will be within the range of standards now under consideration. The standards in 40 CFR Part 191 protect the population by imposing amount of radioactive material released over 10,000 years. (continued)

Issue	Type of Issue	Finding
Offsite radiological impacts (spent fuel and high level waste disposal) (continued)	Generic	The cumulative release limits are based on EPA's population impact goal of 1,000 premature cancer deaths worldwide for a 100,000 metric ton (MTHM) repository. Nevertheless, despite all the uncertainty, some judgment as to the regulatory NEPA implications of these matters should be made and it makes no sense to repeat the same judgment in every case. Even taking the uncertainties into account, the Commission concludes that these impacts are acceptable in that these impacts would not be sufficiently large to require the NEPA conclusion, for any plant, that the option of extended operation under 10 CFR Part 54 should be eliminated. Accordingly, while the Commission has not assigned a single level of significance for the impacts of spent fuel and high level waste disposal, this issue is considered in Category 1 [Generic].
Nonradiological impacts of the uranium fuel cycle	Generic	SMALL. The nonradiological impacts of the uranium fuel cycle resulting from the renewal of an operating license for any plant are found to be small.
Low-level waste storage and disposal	Generic	SMALL. The comprehensive regulatory controls that are in place and the low public doses being achieved at reactors ensure that the radiological impacts to the environment will remain small during the term of a renewed license. The maximum additional onsite land that may be required for low-level waste storage during the term of a renewed license and associated impacts will be small. Nonradiological impacts on air and water will be negligible. The radiological and nonradiological environmental impacts of long-term disposal of low-level waste from any individual plant at licensed sites are small. In addition, the Commission concludes that there is reasonable assurance that sufficient low-level waste disposal capacity will be made available when needed for facilities to be decommissioned consistent with NRC decommissioning requirements.
Mixed waste storage and disposal	Generic	SMALL. The comprehensive regulatory controls and the facilities and procedures that are in place ensure proper handling and storage, as well as negligible doses and exposure to toxic materials for the public and the environment at all plants. License renewal will not increase the small, continuing risk to human health and the environment posed by mixed waste at all plants. The radiological and nonradiological environmental impacts of long-term disposal of mixed waste from any individual plant at licensed sites are small. In addition, the Commission concludes that there is reasonable assurance that sufficient mixed waste disposal capacity will be made available when needed for facilities to be decommissioned consistent with NRC decommissioning requirements.
Onsite spent fuel	Generic	SMALL. The expected increase in the volume of spent fuel from an additional 20 years of operation can be safely accommodated onsite with small environmental effects through dry or pool storage at all plants. if a permanent repository or monitored retrievable storage is not available.

Issue	Type of Issue	Finding
Nonradiological waste	Generic	SMALL. No changes to generating systems are anticipated for license renewal. Facilities and procedures are in place to ensure continued proper handling and disposal at all plants.
Transportation	Generic	SMALL. The impacts of transporting spent fuel enriched up to 5 percent uranium-235 with average burnup for the peak rod to current levels approved by NRC up to 62,000 megawatt days per metric ton of uranium (MWd/MTU) and the cumulative impacts of transporting high-level waste to a single repository, such as Yucca Mountain, Nevada, are found to be consistent with the impact values contained in 10 CFR 51.52(c), Summary Table S–4 – Environmental Impact of Transportation of Fuel and Waste to and from One Light-Water-Cooled Nuclear Power Reactor. If fuel enrichment or burnup conditions are not met, the applicant must submit an assessment of the implications for the environmental impact values reported in § 51.52.
		Decommissioning
Radiation doses	Generic	SMALL. Doses to the public will be well below applicable regulatory standards regardless of which decommissioning method is used. Occupational doses would increase no more than 1 man-rem caused by buildup of long-lived radionuclides during the license renewal term.
Waste management	Generic	SMALL. Decommissioning at the end of a 20-year license renewal period would generate no more solid wastes than at the end of the current license term. No increase in the quantities of Class C or greater than Class C wastes would be expected.
Air quality	Generic	SMALL. Air quality impacts of decommissioning are expected to be negligible either at the end of the current operating term or at the end of the license renewal term.
Water quality	Generic	SMALL. The potential for significant water quality impacts from erosion or spills is no greater whether decommissioning occurs after a 20-year license renewal period or after the original 40-year operation period, and measures are readily available to avoid such impacts.
Ecological resources	Generic	SMALL. Decommissioning after either the initial operating period or after a 20-year license renewal period is not expected to have any direct ecological impacts.
Socioeconomic impacts	Generic	SMALL. Decommissioning would have some short-term socioeconomic impacts. The impacts would not be increased by delaying decommissioning until the end of a 20-year relicense period, but they might be decreased by population and economic growth.
		Environmental Justice

Issue	Type of Issue	Finding
Environmental Justice	Uncategorized	NONE. The need for and the content of an analysis of environmental justice will be addressed in plant-specific reviews.

References

40 CFR Part 51. Code of Federal Regulations, Title 40, Protection of Environment, Part 51, “Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions.”

Department of Energy (DOE). 1980. "Final Environmental Impact Statement: Management of Commercially Generated Radioactive Waste," October 1980.

National Academy of Sciences (NAS) report, "Technical Bases for Yucca Mountain Standards," and that in accordance with the Commission's Waste Confidence Decision, 10 CFR 51.23.

APPENDIX C
APPLICABLE REGULATIONS, LAWS, AND AGREEMENTS

APPLICABLE REGULATIONS, LAWS, AND AGREEMENTS

The Atomic Energy Act authorizes States to establish programs to assume U.S. Nuclear Regulatory Commission (NRC) regulatory authority for certain activities. For example, through the Agreement State Program, started on August 11, 2003, Wisconsin assumed regulatory responsibility over certain byproduct, source, and small quantities of special nuclear material. The Wisconsin Department of Natural Resources (WDNR) is responsible for implementing the laws of the state and where applicable, the laws of the federal government.

In addition to implementing some Federal programs, State legislatures develop their own laws. State statutes supplement as well as implement Federal laws for protection of air, water quality, and groundwater. State legislation may address solid waste management programs, locally rare or endangered species, and historic and cultural resources.

The Clean Water Act (CWA) allows for primary enforcement and administration through State agencies, provided the State program is at least as stringent as the Federal program and must conform to the CWA and delegation of authority for the Federal national pollutant discharge elimination system (NPDES) program from the EPA to the state. The primary mechanism to control water pollution is the requirement that direct dischargers to obtain an NPDES permit or in the case of states where the authority has been delegated from the EPA, a SPDES permit, pursuant to the CWA.

One important difference between Federal regulations and certain State regulations is the definition of waters regulated by the State. Certain State regulations may include underground waters while the CWA only regulates surface waters.

State Environmental Requirements

Certain environmental requirements, including some discussed earlier, may have been delegated to State authorities for implementation, enforcement, or oversight. Table C-1 provides a list of representative State environmental requirements that may affect license renewal applications for nuclear power plants.

Table C-1. State Environmental Requirements. *Kewaunee Power Station (KPS) is subject to State requirements regarding their environmental program. Those requirements are briefly described below. See Section 1.9 for KPS's compliance status with these requirements.*

Law/Regulation	Requirements
Air Quality Protection	
Federal Clean Air Act (42 USC 7401 et seq.), Ch. 285 Wisconsin Statutes	Operation permit is required for air emissions and is issued by WDNR. Note: Dominion Energy Kewaunee (DEK) is considering conversion of this permit to a "Type A Registration Operation Permit," Air Pollution Control Permit Number ROP-A01, issued by the WDNR.
Water Resources Protection	
Clean Water Act (CWA) (33 USC 1251 et seq.), Ch. 283 Wisconsin Statutes	The NPDES permit is required for plant industrial, sanitary, and stormwater discharges to Lake Michigan and the unnamed tributary. The NPDES permit requires the compliance of each point source with authorized discharge levels, monitoring requirements, and other appropriate requirements. The WDNR is the responsible State agency for NPDES permitting.
CWA, Ch. 281 Wisconsin Statutes	Permit to construct and operate sanitary sewage treatment system.
CWA (33 USC 1251 et seq.), Ch. 283 Wisconsin Statutes	General Wisconsin Pollutant Discharge Elimination System (WPDES) industrial storm water discharge permit for storm water runoff from industrial facilities.
CWA, Chs. 280 and 281 Wisconsin Statutes	Registration for non-transient non-community water supply for KPS.
WDNR, Ch. 283 Wisconsin Statutes	Permit for construction of water intake and discharge structures in Lake Michigan for KPS's cooling water system.
U.S. Army Corps of Engineers, 33 USC 403	Permit for construction of water intake and discharge structures in Lake Michigan for KPS's cooling water system.
WDRN, Ch. 281 Wisconsin Statutes	High-capacity well approval for wells with combined capacity >100,000 gallons per day (gpd).
Wisconsin Department of Commerce (WDC), Ch. 101.09 Wisconsin Statutes	Registration for aboveground storage tanks.
Federal Resource Conservation and Recovery Act (42 USC 6901 et seq.), Ch. 101.09 Wisconsin Statutes	Registration for underground storage tanks.
Waste Management	
CWA, Ch. 281 Wisconsin Statutes	Permit to construct and operate sanitary sewage treatment system.
CWA, Ch. 283 Wisconsin Statutes	A land spreading of Wastewater Treatment Facility pretreatment sludge permit is required by the WPDES.

Operating Permits and Other Requirements

Several operating permit applications may be prepared and submitted, and regulator approval and permits would be received prior to license renewal approval by the NRC. Table C-2 lists representative Federal, State, and local permits.

Table C-2. Federal, State, and Local Permits and Other Requirements. *KPS is subject to other requirements regarding various aspects of their environmental program. Those requirements are briefly described below.*

License, Permit, or Other Required Approval	Responsible Agency	Authority	Relevance and Status
Waste Management and Pollution Prevention			
Transportation of radioactive waste to disposal facility in South Carolina.	South Carolina Department of Health and Environment Control	South Carolina Radioactive Waste Transportation and Disposal Act (S.C. Code of Laws 13-7-110 et seq.)	KPS is a radioactive waste generator. The radioactive waste is sent to disposal facility in South Carolina.
License to ship radioactive material to processing facility in Tennessee.	Tennessee Department of Environment and Conservation	Tennessee Code Annotated 68-202-206	KPS radioactive material is shipped to processing facility in Tennessee.
Site access permit for disposal of radioactive material in Utah.	Utah Department of Environmental Quality	R313-26 of Utah Radiation Control Rules	KPS radioactive material is disposed in Utah in land disposal site.
Emergency Planning and Response			
Shipment of hazardous materials.	U.S. Department of Transportation (DOT)	KPS hazardous materials shipments registration 062706 552 0750Q	KPS hazardous materials shipments to comply with DOT packing, labeling, and routing requirements.
Biotic Resource Protection			
Threatened and Endangered Species Consultation: Required between the responsible Federal agencies and affected States to ensure that the project is not likely to: (1) jeopardize the continued existence of any species listed at the Federal or State level as endangered or threatened; or (2) result in destruction of critical habitat of such species.	WDNR Endangered Resources Review	Endangered and Threatened Species Laws (State Statute 29.604 & Administrative Rule NR 27)	Review explains what rare species, natural communities, or natural features tracked in the Natural Heritage Inventory database are found in or near the proposed project area. Includes any additional steps to assure compliance with the Wisconsin Endangered Species Law.
Threatened and Endangered Species Consultation: Required between the responsible Federal agencies and affected States to ensure that the project is not likely to: (1) jeopardize the continued existence of any species listed at the Federal or State level as endangered or threatened; or, (2) result in destruction of critical habitat of such species.	U.S. Fish and Wildlife Service (USFWS)	Endangered Species Act, Section 7 (16 USC 1536)	NRC consulted with USFWS. The Federal agency issuing a license is required to consult with USFWS regarding the impact of license renewal on threatened or endangered species or their critical habitat.
State must concur with the DEK's request for certification of KPS license renewal.	Wisconsin Department of Administration	Federal Coastal Zone Management Act (16 USC 1451 et seq.)	Requires applicant to provide certification to the NRC that the license renewal would be consistent with the federally approved state coastal zone

License, Permit, or Other Required Approval	Responsible Agency	Authority	Relevance and Status
			management program.
Cultural Resources Protection			
Archaeological and Historical Resources Consultation: Required before a Federal agency approves a project in an area where archaeological or historic resources might be located.	Wisconsin Historical Society	National Historic Preservation Act, Section 106 (16 USC 470f)	NRC consulted with State, Tribal Historic Preservation Officers, and Indian Tribes representatives regarding impacts of license renewal. Federal agency issuing a license is required to consider cultural impacts and consult with State Historic Preservation Officer.

APPENDIX D
CONSULTATION CORRESPONDENCES

CONSULTATION CORRESPONDENCES

The Endangered Species Act of 1973, as amended; the Magnuson-Stevens Fisheries Management Act of 1996, as amended; and the National Historic Preservation Act of 1966 require that Federal agencies consult with applicable State and Federal agencies and groups prior to taking action that may affect threatened and endangered species, essential fish habitat, or historic and archaeological resources, respectively. This appendix contains consultation documentation.

Table D-1. Consultation Correspondences. *The following is a list of the consultation documents sent between the U.S. Nuclear Regulatory Commission (NRC) and other agencies in accordance with National Environmental Policy Act (NEPA) requirements.*

Author	Recipient	Date of Letter
U.S. Nuclear Regulatory Commission (D. Pelton)	U.S. Fish and Wildlife Service (L. Clemency)	September 30, 2008
U.S. Nuclear Regulatory Commission (D. Pelton)	Advisory Council on Historic Preservation (D. Klima)	October 8, 2008
U.S. Nuclear Regulatory Commission (D. Pelton)	Wisconsin Historical Society (S. Baker)	October 10, 2008
U.S. Nuclear Regulatory Commission (D. Petlon)	Wisconsin Coastal Management Program (K. Angel)	October 10, 2008
U.S Nuclear Regulatory Commission (D. Pelton)	Wisconsin Department of Natural Resources (R. Kazmierczak)	October 10, 2008
U.S Nuclear Regulatory Commission (D. Pelton)	Menominee Indian Tribe of Wisconsin (L. Boivin)	October 16, 2008(a)
U.S. Fish and Wildlife Service (L. Clemency)	U.S. Nuclear Regulatory Commission (D. Pelton)	October 28, 2008

[a]Similar letters went to 23 other Native American Tribes listed in Section 1.8 and Appendix E.

Consultation Correspondences

The following pages contain copies of the letters listed in Table D-1. Figures contained in pages D-5 and D-6 were included with each letter.

September 30, 2008

Ms. Louise Clemency
Field Supervisor
Green Bay Ecological Services Office
U.S. Fish and Wildlife Service
2661 Scott Tower Drive
Green Bay, WI 54229

SUBJECT: REQUEST FOR LIST OF STATE PROTECTED SPECIES WITHIN THE AREA UNDER EVALUATION FOR THE KEWAUNEE POWER STATION LICENSE RENEWAL APPLICATION REVIEW

Dear Ms. Clemency:

The U.S. Nuclear Regulatory Commission (NRC or the staff) is reviewing an application submitted by Dominion Energy Kewaunee, Inc., for the renewal of the operating license for Kewaunee Power Station (KPS). KPS is located on the west-central shore of Lake Michigan in Kewaunee County, Wisconsin, approximately 30 miles east-southeast of Green Bay and eight miles south of the City of Kewaunee. As part of the review of the license renewal application (LRA), the NRC is preparing a Supplemental Environmental Impact Statement (SEIS) under the provisions of Title 10 of the *Code of Federal Regulations* Part 51 (10 CFR Part 51), the NRC's regulation that implements the National Environmental Policy Act of 1969. The SEIS includes an analysis 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 of 1973, as amended, and the Fish and Wildlife Coordination Act of 1934, as amended.

The proposed action would include the use and continued maintenance of existing plant facilities and transmission lines. The KPS site covers approximately 908 acres, of which approximately 60 acres contain structures, facilities, and parking lots associated with KPS. Approximately 450 acres are used for agriculture, and the remainder of the site is a mixture of woods, fields in various stages of succession, small wetlands and watercourses, and open areas. The site also contains approximately two miles of Lake Michigan western shoreline. A site map is enclosed (Enclosure 1) with this letter.

KPS utilizes a once-through cooling system that withdraws water from and discharges to Lake Michigan. The intake structure is located approximately 1600 feet from the shore, where the water depth is approximately 15 feet. The intake structure consists of a cluster of three 22-foot diameter inlets with 2-foot by 2-foot trash grills to prevent large debris from entering the intake; water velocity at the surface of the intake inlets is less than 1 foot per second when the plant is running at full power. Three 6-foot diameter pipes join to form one 10-foot diameter intake pipe, which is buried approximately three feet below the lake surface. Two auxiliary water intake tees are located 50 and 100 feet shoreward of the intake. Each tee has a 30-inch, screened opening approximately one foot above the lake bottom. The auxiliary water intakes each can supply water in excess of 24,000 gallons per minute (gpm).

The buried intake pipe brings water to the onshore forebay. From the forebay, water passes through 10-foot wide by 36-foot long traveling screens with 3/8-inch mesh. Water is pumped by two vertical dry-pit circulating water pumps, each designed to supply 210,000 gpm. Normal flow rate throughout the cooling system is approximately 400,000 gpm.

Water velocity through the traveling screens is less than 2.4 feet per second. Fish and debris are automatically backwashed from the traveling screens and returned to the lake via the 10-foot diameter discharge tunnel. The discharge tunnel connects to a discharge structure located on the shoreline, just south of the forebay. During periods of sub-freezing weather, recirculating pumps route water to the intake inlet grills and traveling screens to prevent icing. Cooling water is intermittently treated with sodium hypochlorite to prevent micro- and macro-fouling within the cooling system.

For the specific purpose of connecting KPS to the regional transmission system, there are four transmission lines totaling approximately 75 miles of corridor, comprising approximately 1270 acres of land. These transmission line corridors are being evaluated as part of the SEIS process. The transmission lines run north and south of KPS through Kewaunee and Manitowoc Counties, and west through Kewaunee, Brown, and Outagamie Counties. Land along the corridors is approximately 84 percent farmland, 7 percent woodland, 7 percent scrubland, and 2 percent wetlands. A map of the KPS transmission system is enclosed (Enclosure 2) with this letter.

To support the SEIS preparation process and to ensure compliance with Section 7 of the Endangered Species Act, the NRC requests information on state-listed, proposed, and candidate species and critical habitat that may be in the vicinity of KPS and its associated transmission line corridors. In addition, please provide any information you consider appropriate under the provisions of the Fish and Wildlife Coordination Act.

The NRC staff plans to hold two public license renewal and environmental scoping meetings on October 22, 2008, at the Carlton Town Hall, N1296, Town Hall Road, Kewaunee, Wisconsin 54216. The first meeting will convene at 1:30 p.m. and will continue until 4:30 p.m., as necessary. The second meeting will convene at 7:00 p.m., with a repeat of the overview portions of the first meeting, and will continue until 10:00 p.m., as necessary. A separate NRC meeting notice with a more detailed agenda is forthcoming. You will be provided a copy of that notice. In addition, during the week of January 12, 2009, the NRC plans to conduct a site audit. You and your staff are invited to attend both the public meetings and the site audit. Your office will receive a copy of the draft SEIS along with a request for comments. The anticipated publication date for the draft SEIS is August 2009.

L. Clemency - 3 -

The KPS LRA is available on the internet at www.nrc.gov/reactors/operating/licensing/renewal/applications/kewaunee.html. If you have any questions concerning the NRC staff's review of this LRA, please contact Ms. Sarah Lopas, License Renewal Project Manager, at 301-415-1147 or sarah.lopas@nrc.gov.

Sincerely,

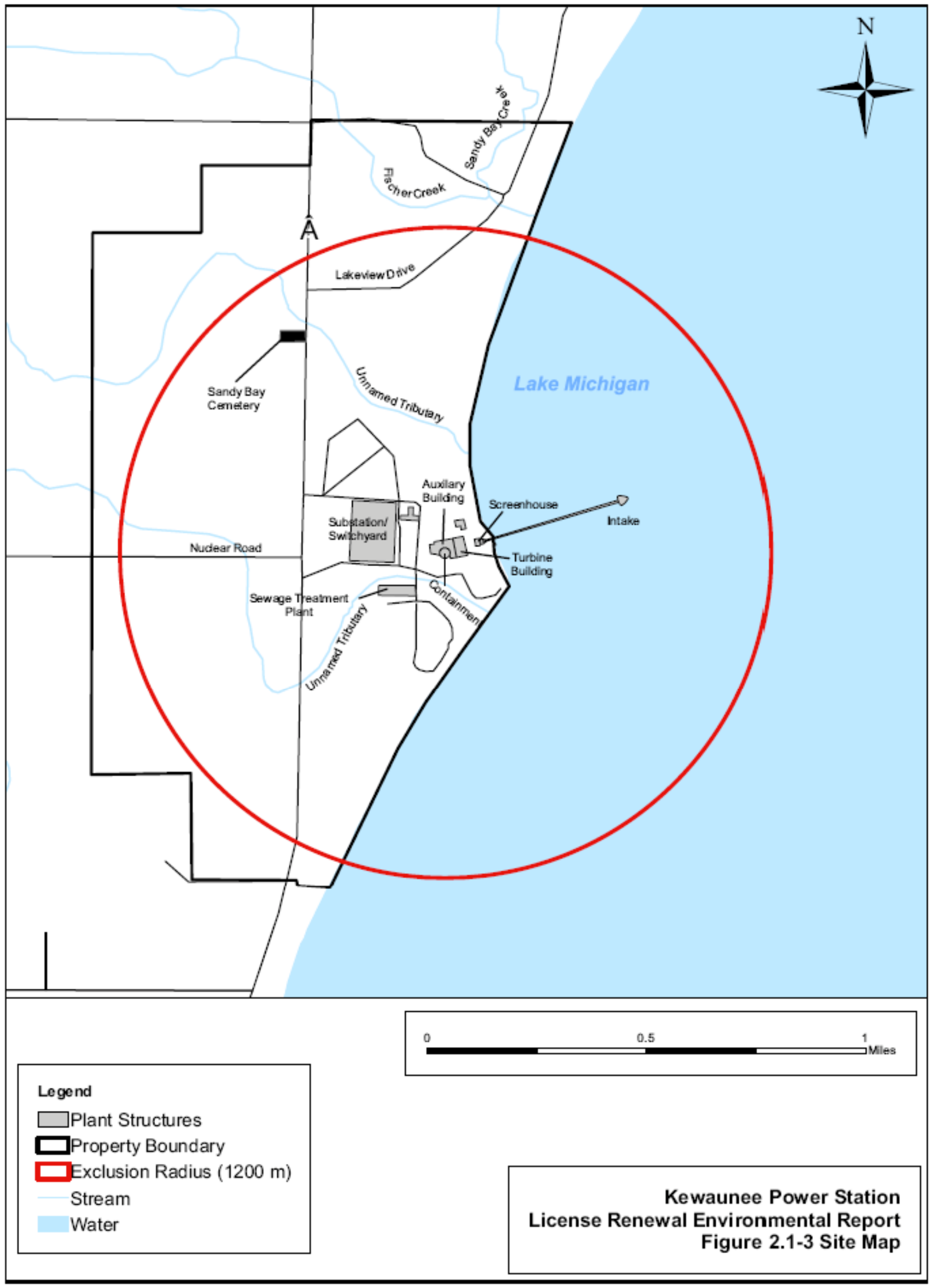
\RA

David Pelton, Branch Chief
Projects Branch 1
Division of License Renewal
Office of Nuclear Reactor Regulation

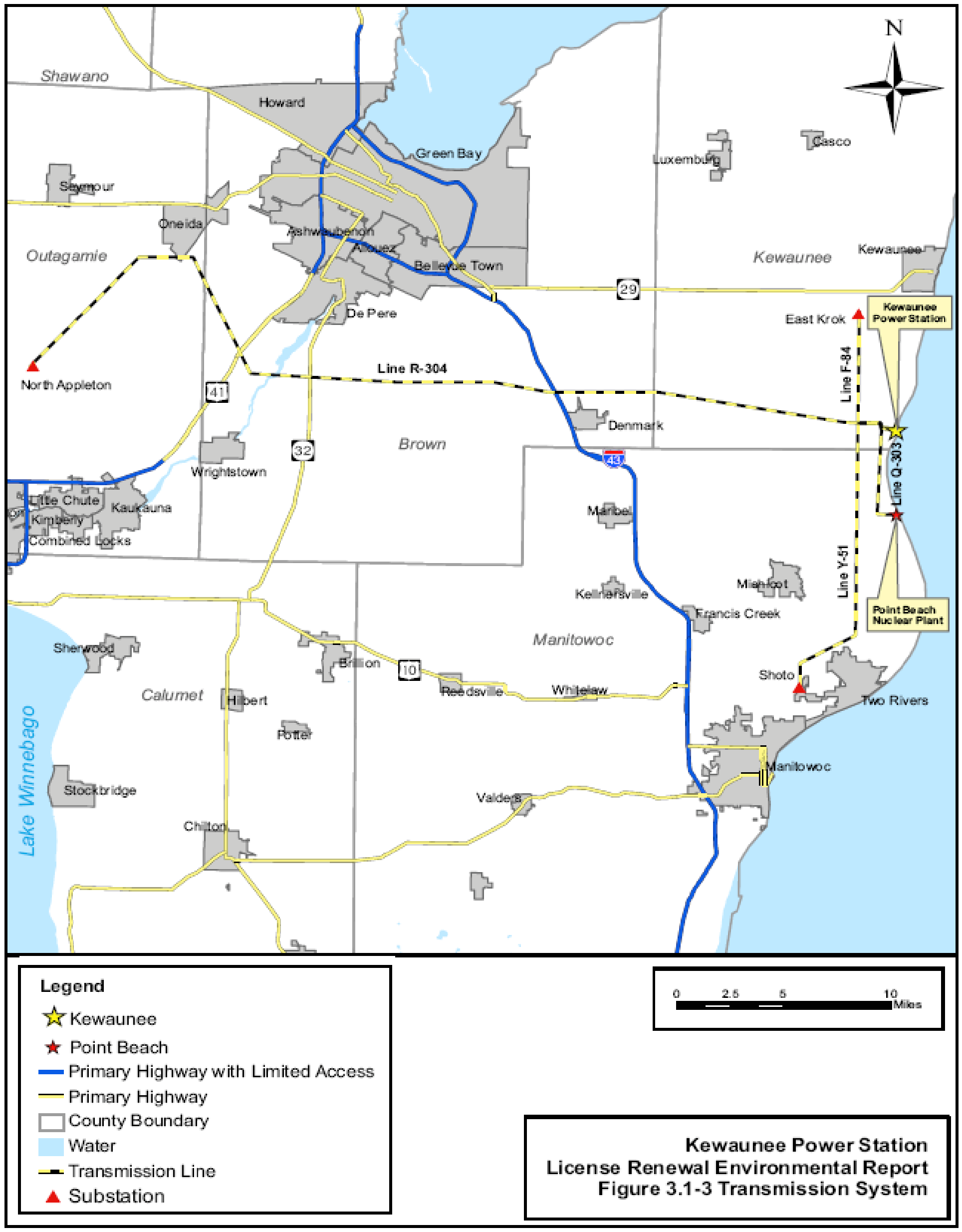
Docket No. 50-305

Enclosures:
1. KPS Site Map
2. KPS Transmission System

cc w/encls: See next page


N
Sandy Bay Creek
Fischer Creek
Lakeview Drive
Sandy Bay Cemetery
Unnamed Tributary
Lake Michigan
Auxiliary Building
Screenhouse
Intake
Substation/ Switchyard
Nuclear Road
Turbine Building
Sewage Treatment Plant
Containment
Unnamed Tributary
0
0.5
1 Miles
Legend
Plant Structures
Property Boundary
Exclusion Radius (1200 m)
Stream
Water
Kewaunee Power Station
License Renewal Environmental Report
Figure 2.1-3 Site Map

ENCLOSURE 1


N
Shawano
Howard
Green Bay
Luxemburg
Casco
Seymour
Oneida
Ashwaubenon
Allouez
Bellevue Town
Outagamie
Kewaunee
De Pere
East Krok
Kewaunee Power Station
North Appleton
Line R-304
Line F-84
Denmark
Brown
Wrightstown
Line Q-303
Little Chute
Kimberly
Kaukauna
Combined Locks
Maribel
Line Y-51
Mishicot
Kellnersville
Francis Creek
Point Beach Nuclear Plant
Manitowoc
Sherwood
Brillion
Shoto
Calumet
Hilbert
Reedsville
Whitelaw
Two Rivers
Potter
Manitowoc
Lake Winnebago
Stockbridge
Valders
Chilton
Legend
Kewaunee
Point Beach
Primary Highway with Limited Access
Primary Highway
County Boundary
Water
Transmission Line
Substation
0 2.5 5 10 Miles
Kewaunee Power Station
License Renewal Environmental Report
Figure 3.1-3 Transmission System

ENCLOSURE 2

October 8, 2008

Mr. Don L. Klima, Director
Advisory Council on Historic Preservation
Office of Federal Agency Programs
1100 Pennsylvania Ave, NW, Suite 803
Washington, DC 20004

SUBJECT: KEWAUNEE POWER STATION LICENSE RENEWAL APPLICATION REVIEW

Dear Mr. Klima:

The U.S. Nuclear Regulatory Commission (NRC or the staff) is reviewing an application to renew the operating license for Kewaunee Power Station (KPS) which is located on Lake Michigan in Kewaunee County, Wisconsin, and is operated by Dominion Energy Kewaunee, Inc. (DEK). The application for renewal was submitted by DEK in a letter dated August 14, 2008, pursuant to Title 10 of the *Code of Federal Regulations* Part 54 (10 CFR Part 54).

The NRC has established that, as part of the staff's 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," NUREG-1437, will be prepared under the provisions of 10 CFR Part 51, the NRC's regulation that implements the National Environmental Policy Act of 1969. In accordance with 36 CFR 800.8(c), the SEIS will include analyses of potential impacts to historic and cultural resources.

The NRC staff plans to hold two public license renewal and environmental scoping process meetings on October 22, 2008, at the Carlton Town Hall, N1296, Town Hall Road, Kewaunee, Wisconsin 54216. The first meeting will convene at 1:30 p.m. and will continue until 4:30p.m., as necessary. The second meeting will convene at 700 p.m., with a repeat of the overview portions of the first meeting, and will continue until 10:00 p.m., as necessary. You and your staff are invited to attend the public meetings. In addition, during the week of January 12, 2009, the NRC staff plans to conduct a site audit at KPS. Your office will receive a copy of the draft SEIS along with a request for comments. The anticipated publication date for the draft SEIS is August 2009.

D. Klima - 2 -

The KPS license renewal application is available on the internet at www.nrc.gov/reactors/operating/licensing/renewal/applications/kewaunee.html. If you have any questions or require additional information, please contact the License Renewal Project Manager, Ms. Sarah Lopas, at 301-415-1147 or by e-mail at sarah.lopas@nrc.gov.

Sincerely,

/RA/

David L. Pelton, Chief
Projects Branch 1
Division of License Renewal
Office of Nuclear Reactor Regulation

Docket No. 50-305

cc: See next page

October 10, 2008

Mr. Sherman Banker
Wisconsin Historical Society
816 State Street
Madison, Wisconsin 53706-1482

SUBJECT: KEWAUNEE POWER STATION LICENSE RENEWAL APPLICATION REVIEW

Dear Mr. Banker:

The U.S. Nuclear Regulatory Commission (NRC or the staff) is reviewing an application to renew the operating license for Kewaunee Power Station (KPS), which is located on the west-central shore of Lake Michigan in Kewaunee County, Wisconsin, approximately 30 miles east-southeast of Green Bay and eight miles south of the City of Kewaunee. KPS is operated by Dominion Energy Kewaunee, Inc. (DEK). The application for renewal was submitted by DEK in a letter dated August 14, 2008, pursuant to Title 10 of the *Code of Federal Regulations* Part 54 (10 CFR Part 54).

The NRC has established that, as part of the staff's 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", NUREG-1437, will be prepared under the provisions of 10 CFR Part 51, the NRC's regulation that implements the National Environmental Policy Act of 1969 (NEPA). In accordance with 36 CFR 800.8(c), the SEIS will include analyses of potential impacts to historic and cultural resources.

In the context of the National Historic Preservation Act of 1966, as amended, the NRC staff 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 that may be impacted by post-license renewal land-disturbing operations 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 may potentially have an effect on known or proposed historic sites. This determination is made irrespective of ownership or control of the lands of interest.

On October 22, 2008, the NRC will conduct two public license renewal and environmental scoping meetings at the Carlton Town Hall, N1296 Town Hall Road, Kewaunee, WI 54216. 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 staff expects to publish the draft SEIS in August 2009.

S. Banker - 2 -

The KPS license renewal application is available on the internet at www.nrc.gov/reactors/operating/licensing/renewal/applications/kewaunee.html. If you have any questions or require additional information, please contact Ms. Sarah Lopas, License Renewal Project Manager, by phone at 301-415-1147 or by e-mail at sarah.lopas@nrc.gov.

Sincerely,

/RA L. Lund for/

David L. Pelton, Chief
Projects Branch 1
Division of License Renewal
Office of Nuclear Reactor Regulation

Docket No. 50-305

cc: See next page

October 10, 2008

Ms. Kathleen Angel
Federal Consistency and Coastal Hazards Coordinator
Wisconsin Coastal Management Program
P.O. Box 8944
Madison, WI 53708-8944

SUBJECT: KEWAUNEE POWER STATION LICENSE RENEWAL APPLICATION REVIEW

Dear Ms. Angel:

The U.S. Nuclear Regulatory Commission (NRC or the staff) is reviewing an application submitted by Dominion Energy Kewaunee, Inc. (DEK) for the renewal of the operating license for Kewaunee Power Station (KPS), which is located on the west-central shore of Lake Michigan in Kewaunee County, Wisconsin, approximately 30 miles east-southeast of Green Bay and eight miles south of the City of Kewaunee. As part of the review of the license renewal application (LRA), the NRC is preparing a Supplemental Environmental Impact Statement (SEIS) under the provisions of Title 10 of the *Code of Federal Regulations* Part 51 (10 CFR Part 51), the NRC's regulation that implements the National Environmental Policy Act of 1969 (NEPA).

KPS is requesting the renewal of its operating license for a period of 20 years beyond the expiration of the current license term, renewing the license until December 2033. The proposed action would include the use and continued maintenance of existing plant facilities and transmission lines. The KPS site covers approximately 908 acres, of which approximately 60 acres contain structures, facilities, and parking lots associated with KPS. Approximately 450 acres are used for agriculture, and the remainder of the site is a mixture of woods, fields in various stages of succession, small wetlands and watercourses, and open areas. The site also contains approximately two miles of Lake Michigan western shoreline. As such, DEK submitted a Federal Consistency Certification for Wisconsin's Coastal Management Program on August 19, 2008.

The NRC staff plans to hold two identical public meetings covering the license renewal and environmental scoping process on October 22, 2008, at the Carlton Town Hall, N1296 Town Hall Road, Kewaunee, WI 54216. The first meeting will convene at 1:30 p.m., and will continue until 4:30 p.m., as necessary. The second meeting will convene at 7:00 p.m., and will continue until 10:00 p.m., as necessary. You and your staff are invited to attend the public meetings. Your office will receive a copy of the draft SEIS along with a request for comments. The anticipated publication date for the draft SEIS is August 2009.

K. Angel - 2 -

If you have any questions concerning the NRC staff's review of this LRA, please contact Ms. Sarah Lopas, License Renewal Project Manager, at 301-415-1147 or by e-mail at sarah.lopas@nrc.gov.

Sincerely,

/RA L. Lund for/

David L. Pelton, Chief
Projects Branch 1
Division of License Renewal
Office of Nuclear Reactor Regulation

Docket No. 50-305

cc: See next page

October 10, 2008

Mr. Ronald Kazmierczak
Regional Director
Wisconsin Department of Natural Resources
Northeast Region Headquarters
2984 Shawano Avenue
P.O. Box 10448
Green Bay, Wisconsin 54307-0448

SUBJECT: KEWUANEE POWER STATION LICENSE RENEWAL APPLICATION REVIEW

Dear Mr. Kazmierczak:

The U.S. Nuclear Regulatory Commission (NRC or the staff) is reviewing an application submitted by Dominion Energy Kewaunee, Inc. for the renewal of the operating license for Kewaunee Power Station (KPS), which is located on the west-central shore of Lake Michigan in Kewaunee County, Wisconsin, approximately 30 miles east-southeast of Green Bay and eight miles south of the City of Kewaunee. As part of the review of the license renewal application (LRA), the NRC is preparing a Supplemental Environmental Impact Statement (SEIS) under the provisions of Title 10 of the *Code of Federal Regulations* Part 51 (10 CFR Part 51), the NRC's regulation that implements the National Environmental Policy Act of 1969 (NEPA).

KPS is requesting the renewal of its operating license for a period of 20 years beyond the expiration of the current license term, renewing the license until December 2033. The proposed action would include the use and continued maintenance of existing plant facilities and transmission lines. The KPS site covers approximately 908 acres, of which approximately 60 acres contain structures, facilities, and parking lots associated with KPS. Approximately 450 acres are used for agriculture, and the remainder of the site is a mixture of woods, fields in various stages of succession, small wetlands and watercourses, and open areas. The site also contains approximately two miles of Lake Michigan western shoreline. A site map is enclosed with this letter.

The NRC staff plans to hold two identical public meetings covering the license renewal and environmental scoping process on October 22, 2008, at the Carlton Town Hall, N1296 Town Hall Road, Kewaunee, WI 54216. The first meeting will convene at 1:30 p.m., and will continue until 4:30 p.m., as necessary. The second meeting will convene at 7:00 p.m., and will continue until 10:00 p.m., as necessary. In addition, during the week of January 12, 2008, the NRC plans to conduct a site audit. You and your staff are invited to attend both the site audit and the public meetings. Your office will receive a copy of the draft SEIS along with a request for comments. The anticipated publication date for the draft SEIS is August 2009.

R. Kazmierczak - 2 -

The KPS license renewal application is available on the internet at www.nrc.gov/reactors/operating/licensing/renewal/applications/kewaunee.html. If you have any questions concerning the NRC staff's review of this LRA, please contact Ms. Sarah Lopas, License Renewal Project Manager, at 301-415-1147 or by e-mail at sarah.lopas@nrc.gov.

Sincerely,

\RA Louise Lund for

David L. Pelton, Chief
Projects Branch 1
Division of License Renewal
Office of Nuclear Reactor Regulation

Docket No. 50-305

Enclosure:
As stated

cc w/encl: See next page

October 16, 2008

Laurie Boivin, Chairperson
Menominee Indian Tribe of Wisconsin
W2908 Tribal Office Loop
P.O. Box 910
Keshena, WI 54135-0910

SUBJECT: REQUEST FOR SCOPING COMMENTS CONCERNING THE KEWAUNEE POWER STATION LICENSE RENEWAL APPLICATION REVIEW

The U.S. Nuclear Regulatory Commission (NRC or the staff) has recently received an application from Dominion Energy Kewaunee, Inc. (DEK) for the renewal of the operating license for the Kewaunee Power Station (KPS) located in Kewaunee County, WI, approximately 30 miles east-southeast of Green Bay. The NRC is in the initial stages of developing a Supplemental Environmental Impact Statement to the Generic Environmental Impact Statement (GEIS), which will document the impacts associated with the renewal of KPS. We would like your assistance in our review by providing input to the NRC's environmental review scoping process. The NRC's process includes an opportunity for public and inter-governmental participation in the environmental review. We want to ensure that you are aware of our efforts pursuant to Title 10 of the *Code of Federal Regulations* Part 51, Section 51.28(b). In addition, as outlined in 36 CFR 800.8(c), the NRC plans to coordinate compliance with Section 106 of the National Historic Preservation Act of 1966 through the requirements of the National Environmental Policy Act of 1969 (NEPA).

The NRC has sent copies of this letter to the tribal contacts for the following Federally-recognized tribes: Bad River Band of Lake Superior Tribe of Chippewa Indians, Bay Mills Indian Community, Forest County Potawatomi Community of Wisconsin, Grand Traverse Band of Ottawa and Chippewa Indians, Hannahville Indian Community, Ho-Chunk Nation, Huron Potawatomi, Keweenaw Bay Indian Community, Lac Courte Oreilles Band of Lake Superior Chippewa Indians of Wisconsin, Lac du Flambeau Band of Lake Superior Chippewa Indians of Wisconsin, Lac Vieux Desert Band of Lake Superior Chippewa Indians, Little River Band of Ottawa Indians, Little Traverse Bay Bands of Odawa Indians, Menominee Indian Tribe of Wisconsin, Oneida Tribe of Indians of Wisconsin, Pokagon Band of Potawatomi Indians, Red Cliff Band of Lake Superior Chippewa Indians of Wisconsin, St. Croix Chippewa Indians of Wisconsin, Sault Ste. Marie Tribe of Chippewa Indians of Michigan, Sokagon Chippewa Community Mole Lake Band of Lake Superior Chippewa Indians, Stockbridge Munsee Community of Wisconsin, Prairie Band Potawatomi Nation, and the Citizen Potawatomi Nation. This letter was also sent to the Midwest Regional Office of the Bureau of Indian Affairs.

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 license for KPS will expire in December 2013, and DEK is requesting license renewal for an additional 20 years beyond this original expiration date. The proposed action would include the use and continued maintenance of existing plant facilities

- 2 -

and transmission lines. The KPS Site Map and Transmission System Map are enclosed for your information.

The GEIS considered the environmental impacts of renewing nuclear power plant operating licenses for a 20-year period on all currently operating sites. In the GEIS the NRC staff identified 92 environmental issues and developed 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. For the remaining 23 issues, plant-specific analyses will be documented in a supplement to the GEIS.

A supplemental environmental impact statement will be prepared for KPS to document the staff's review of environmental impacts 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 comments that you may have to offer on the scope of the environmental review by December 9, 2008. Written comments should be submitted by mail to the Chief, Rules and Directives Branch, Division of Administrative Services, Mail Stop T-6D59, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001. Electronic comments may be submitted to the NRC by e-mail at Kewaunee.EIS@nrc.gov. At the conclusion of the scoping process, the NRC staff will prepare a summary of the significant issues identified and the conclusions reached, and mail a copy to you.

To accommodate interested members of the public, the NRC will hold two public scoping meetings for the KPS license renewal supplement to the GEIS on October 22, 2008, located at the Carlton Town Hall, N 1296, Town Hall Road, Kewaunee, Wisconsin 54216. 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.

The KPS license renewal application and the GEIS are available on the internet at www.nrc.gov/reactors/operating/licensing/renewal/applications/kewaunee.html. In addition, the Kewaunee Public Library, located at 822 Juneau Street, Kewaunee, Wisconsin, has agreed to make the license renewal application and the GEIS available for public inspection.

The staff expects to publish the draft supplemental environmental impact statement in August 2009. A copy of the document will be sent to you for your review and comment. The NRC will hold another set of public meetings in the site vicinity to solicit comments on the draft supplemental environmental impact statement. After consideration of public comments received, the NRC will prepare a final supplemental environmental impact statement, which is

- 3 -

scheduled to be issued in January 2010. If you need additional information regarding the license renewal review process, please contact Sarah Lopas, License Renewal Project Manager, at 301-415-1147 or by e-mail at sarah.lopas@nrc.gov.

Sincerely,

/RA/

David L. Pelton, Chief
Projects Branch 1
Division of License Renewal
Office of Nuclear Reactor Regulation

Docket No. 50-305

Enclosures:
1. Site Map
2. Transmission System Map

cc w/encls.: See next page

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Green Bay ES Field Office
2661 Scott Tower Drive
New Franken, Wisconsin 54229-9565
Telephone 920/866-1717
FAX 920/866-1710

October 28, 2008

Mr. David Pelton, Branch Chief
Division of License Renewal
Office of Nuclear Reactor Regulation
United States Nuclear Regulatory Commission
Washington, D.C. 20555-0001

re: Request for Species List
License Renewal Application Review
Kewaunee Power Station
Kewaunee County, Wisconsin

Dear Mr. Pelton:

This letter responds to your September 30, 2008 request to the U.S. Fish and Wildlife Service (Service) for a list of federally-listed, proposed and candidate species and critical habitat that may be present in the vicinity of the subject project. The proposed action would renew the operating license for the Kewaunee Power Station (KPS) Nuclear Plant. This action would include the use and maintenance of the existing plant facilities and transmission lines by the applicant Dominion Energy Kewaunee, Inc. (Dominion). The KPS is located on the western shore of Lake Michigan in Kewaunee County, Wisconsin. Our comments follow.

Federally-Listed Species, Candidate Species, and Critical Habitat

A review of the information in our files indicates that one federally-listed species, the Hine's emerald dragonfly (*Somatochlora hineana*), is currently known from Kewaunee County, but is not known from the vicinity of your project area. The preferred habitat of the dragonfly is calcareous streams and associated wetlands overlying dolomite bedrock. One additional species, the piping plover (*Charadrius melodus*), has been documented in adjacent Manitowoc County, and may possibly occur in suitable habitat, consisting of sandy beaches.

While the piping plover is not known to occur on the KPS property, there is designated critical habitat for the species approximately 10 miles south of the plant, within the Point Beach State Forest. Piping plovers nest on wide sandy beaches on the Great Lakes, and prefer sites that have low levels of human disturbance. The habitat present at the project site appears to be possibly suitable for occupation by the piping plover. The Great Lakes piping plover population is currently expanding, and newly formed pairs continue to pioneer new sites and nest in areas where the species has not been previously known to nest. Based upon the secluded nature of the

1

site, and the type of habitat present there, it is possible that plovers may attempt to use the beaches on the KPS property in the future.

We recommend that the applicant conduct annual surveys for the piping plover within suitable habitat on the KPS site during the species breeding season. We recommend at least two surveys be conducted, with one occurring during the latter half of the month of May, and one or more occurring between June 1 and June 15. However, if only one survey is conducted annually, we request that it be conducted no later than June 10. If one or more piping plovers are observed during the survey, the Green Bay Ecological Services Field Office should be contacted immediately to initiate coordination on additional actions.

Migratory Birds

In recent years there have been a number of incidents of diving bird mortality due to entrainment in the water intake structures of the KPS. Since early 2006, there have been at least 46 individuals of 6 different duck species reported killed at this location. The Migratory Bird Treaty Act of 1918 (16 U.S.C. §§703-712), as amended, prohibits the taking, killing, possession, transportation, and importation of migratory birds, their eggs, parts, and nests, except when specifically authorized by the Department of Interior. The Service has an interest in proactively preventing the mortality of migratory birds whenever possible.

Following discussions with the Services' Special Agent located in this office, Dominion has developed an informal self-reporting system whereby they have agreed to inform the Service of such mortality events as they occur. In 2008, Dominion contracted a consultant to examine the issue and analyze possible solutions to the problem. According to the consultant's report, there are currently no technically feasible solutions to this problem which are also economically practical. We appreciate the cooperative relationship that Dominion has developed with this office, and encourage them to continue to explore means to further reduce or eliminate incidental avian mortality at the KPS.

We appreciate the opportunity to respond. Questions pertaining to these comments can be directed to Mr. Joel Trick at 920-866-1737.

Sincerely,

Louise Clemency

Louise Clemency
Field Supervisor

APPENDIX E
CHRONOLOGY OF ENVIRONMENTAL REVIEW

CHRONOLOGY OF ENVIRONMENTAL REVIEW CORRESPONDENCE

This appendix contains a chronological listing of correspondence between the U.S. Nuclear Regulatory Commission (NRC) and external parties as part of its environmental review for Kewaunee Power Station (KPS). All documents, with the exception of those containing proprietary information, are available electronically from the NRC's 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 Agency wide Document Access and Management System (ADAMS), which provides text and image files of NRC's public documents in ADAMS. The ADAMS accession number for each document is included below.

Environmental Review Correspondence

August 12, 2008	Dominion Energy Kewaunee, Inc. (DEK); letter from DEK forwarding the application for renewal of operating license for Kewaunee Power Station, requesting an extension of operating license for an additional 20 years. (ADAMS Accession No. ML082341020)
August 25, 2008	Letter to DEK, "Receipt and Availability of the License Renewal Application for the Kewaunee Power Station." (ADAMS Accession No. ML082120504)
August 29, 2008	Dominion Energy Kewaunee, Inc., "Notice of U.S Nuclear Regulatory Commission (D. Pelton) Receipt and Availability of Application for Renewal of Kewaunee Power Station, Facility Operating License No. DPR-43 for an Additional 20-Year Period" (73 FR 51023), *Federal Register*, August 29, 2008.
September 2, 2008	NRC press release "announcing the availability of the license renewal application for Kewaunee Power Station for public inspection." (ADAMS Accession No. ML082460767)
September 25, 2008	Letter to DEK, "Determination of Acceptability and Sufficiency for Docketing, Proposed Review Schedule, and Opportunity for a Hearing Regarding an Application from Dominion Energy Kewaunee, Inc., for Renewal of the Operating License for the Kewaunee Power Station." (ADAMS Accession No. ML082610303)
September 30, 2008	Letter to Louise Clemency, U.S. Fish and Wildlife Service, "Request for List of State Protected Species within the Area under Evaluation for the Kewaunee Power Station License Renewal Application Review" (ADAMS No. ML082610748)
October 1, 2008	Dominion Energy Kewaunee, Inc.; Kewaunee Power Station, "Notice of Acceptance for Docketing of the Application and Notice of Opportunity for Hearing; Regarding Renewal of Facility Operating

	License No. DPR-43 for an Additional 20-Year Period;" (73 FR 57154), *Federal Register,* October 1, 2008.
October 2, 2008	Letter to DEK, "Notice of Intent to Prepare an Environmental Impact Statement and Conduct Scoping Process for License Renewal for Kewaunee Power Station." (ADAMS Accession No. ML082520774)
October 8, 2008	Notice of public meeting "To discuss the license renewal process and environmental scoping for Kewaunee Power Station, license renewal application review." (ADAMS Accession No. ML082750112)
October 8, 2008	Letter to Don L. Klima, Advisory Council on Historic Preservation, "Kewaunee Power Station License Renewal Application Review." (ADAMS Accession No. ML082610168)
October 9, 2008	Dominion Energy Kewaunee, Inc.; Kewaunee Power Station, "Notice of Intent to Prepare an Environmental Impact Statement and Conduct Scoping Process" (73 FR 59678)," *Federal Register*, October 9, 2008.
October 10, 2008	Letter to Kathleen Angel, Wisconsin Coastal Management Program, "Kewaunee Power Station License Renewal Application Review." (ADAMS Accession No. ML082680027)
October 10, 2008	Letter to Sherman Baker, Wisconsin Historical Society, "Kewaunee Power Station License Renewal Application Review." (ADAMS Accession No. ML082670685)
October 10, 2008	Letter to Ronald Kazmierczak, Wisconsin Department of Natural Resources, "Kewaunee Power Station License Renewal Application Review." (ADAMS Accession No. ML082661119)
October 16, 2008	Press release "announcing the Kewaunee Power Station license renewal scoping meeting." (ADAMS Accession No. ML082900265)
October 16, 2008	Letter to Terrence Virden, Bureau of Indian Affairs, "Request for Scoping Comments Concerning the Kewaunee Power Station License Renewal Application Review." (ADAMS Accession No. ML082800098)
October 16, 2008	Letter to Laurie Boivin, Menominee Indian Tribe of Wisconsin, "Request for Scoping Comments Concerning the Kewaunee Power Station License Renewal Application Review." (ADAMS Accession No. ML082800098)
October 16, 2008	Letter to Steve Ortiz, Prairie Band Potawatomi Nation, "Request for Scoping Comments Concerning the Kewaunee Power Station License Renewal Application Review." (ADAMS Accession No. ML082800098)

October 16, 2008	Letter to Eugene Bigboy, Sr., Bad River Band of Lake Superior Tribe of Chippewa Indians, “Request for Scoping Comments Concerning the Kewaunee Power Station License Renewal Application Review.” (ADAMS Accession No. ML082800098)
October 16, 2008	Letter to Jeffery D. Parker, Bay Mills Indian Community, “Request for Scoping Comments Concerning the Kewaunee Power Station License Renewal Application Review.” (ADAMS Accession No. ML082800098)
October 16, 2008	Letter to John A. Miller, Pokagon Band of Potawatomi Indians, “Request for Scoping Comments Concerning the Kewaunee Power Station License Renewal Application Review.” (ADAMS Accession No. ML082800098)
October 16, 2008	Letter to Rose Gurnoe-Soulier, Red Cliff Band of Lake Superior Chippewa Indians of Wisconsin, “Request for Scoping Comments Concerning the Kewaunee Power Station License Renewal Application Review.” (ADAMS Accession No. ML082800098)
October 16, 2008	Letter to Robert Chicks, Stockbridge Munsee Community of Wisconsin, “Request for Scoping Comments Concerning the Kewaunee Power Station License Renewal Application Review.” (ADAMS Accession No. ML082800098)
October 16, 2008	Darwin McCoy, Sault Ste. Marie Tribe of Chippewa Indians of Michigan, “Request for Scoping Comments Concerning the Kewaunee Power Station License Renewal Application Review.” (ADAMS Accession No. ML082800098)
October 16, 2008	Hazel Hindsley, St. Croix Chippewa Indians of Wisconsin, “Request for Scoping Comments Concerning the Kewaunee Power Station License Renewal Application Review.” (ADAMS Accession No. ML082800098)
October 16, 2008	Richard G. Hill, Oneida Tribe of Indians Wisconsin, “Request for Scoping Comments Concerning the Kewaunee Power Station License Renewal Application Review.” (ADAMS Accession No. ML082800098)
October 16, 2008	Frank Ettawageshik, Little Traverse Bay Bands of Odawa Indians, “Request for Scoping Comments Concerning the Kewaunee Power Station License Renewal Application Review.” (ADAMS Accession No. ML082800098)
October 16, 2008	Larry Romanelli, Little River Band of Ottawa Indians, “Request for Scoping Comments Concerning the Kewaunee Power Station License Renewal Application Review.” (ADAMS Accession No. ML082800098)

October 16, 2008	James Williams, Jr., Lac Vieux Desert Band of Lake Superior Chippewa Indians, "Request for Scoping Comments Concerning the Kewaunee Power Station License Renewal Application Review." (ADAMS Accession No. ML082800098)
October 16, 2008	Louis Taylor, Lac Courte Oreilles Band of Lake Superior Chippewa Indians of Wisconsin, "Request for Scoping Comments Concerning the Kewaunee Power Station License Renewal Application Review." (ADAMS Accession No. ML082800098)
October 16, 2008	Victoria A. Doud, Lac du Flambeau Band of Lake Superior Chippewa Indians of Wisconsin, "Request for Scoping Comments Concerning the Kewaunee Power Station License Renewal Application Review." (ADAMS Accession No. ML082800098)
October 16, 2008	Phillip Shopodock, Forest County Potawatomi Community of Wisconsin, "Request for Scoping Comments Concerning the Kewaunee Power Station License Renewal Application Review." (ADAMS Accession No. ML082800098)
October 16, 2008	Robert Kewaygoshkum, Grand Traverse Band of Ottawa and Chippewa Indians, "Request for Scoping Comments Concerning the Kewaunee Power Station License Renewal Application Review." (ADAMS Accession No. ML082800098)
October 16, 2008	Kenneth Meshigaud, Hannahville Indian Community, "Request for Scoping Comments Concerning the Kewaunee Power Station License Renewal Application Review." (ADAMS Accession No. ML082800098)
October 16, 2008	Wilfred Cleveland, Ho-Chuck Nation, "Request for Scoping Comments Concerning the Kewaunee Power Station License Renewal Application Review." (ADAMS Accession No. ML082800098)
October 16, 2008	Laura Spurr, Huron Potawatomi, Inc., "Request for Scoping Comments Concerning the Kewaunee Power Station License Renewal Application Review." (ADAMS Accession No. ML082800098)
October 16, 2008	Susan J. LaFernier, Keweenaw Bay Indian Community, "Request for Scoping Comments Concerning the Kewaunee Power Station License Renewal Application Review." (ADAMS Accession No. ML082800098)
October 16, 2008	Arlyn Ackley, Sokagon Chippewa Community, Mole Lake Band of Lake Superior Chippewa Indians, "Request for Scoping Comments Concerning the Kewaunee Power Station License Renewal Application Review." (ADAMS Accession No. ML082800098)

October 16, 2008	John Barret, Citizen Potawatomi Nation, “Request for Scoping Comments Concerning the Kewaunee Power Station License Renewal Application Review.” (ADAMS Accession No. ML082800098)
October 27, 2008	Letter to DEK, “Request for Additional Information Regarding the Review of the License Renewal Application for Kewaunee Power Station.” (ADAMS Accession No. ML082560558)
October 28, 2008	Letter from Louise Clemency, U.S. Fish and Wildlife Service, “Re: Request for Species List License Renewal Application Review Kewaunee Power Station Kewaunee County, Wisconsin.” (ADAMS Accession No. ML083390643)
November 17, 2008	Summary of Public License Renewal Overview and Environmental Scoping Meetings Related to the Review of the Kewaunee Power Station License Renewal Application. (ADAMS Accession No. ML083090452)
November 25, 2008	Letter from DEK, “Dominion Energy Kewaunee, Inc. Kewaunee Power Station Response to Request for Additional Information License Renewal Application.” (ADAMS Accession No. ML083520612)
December 3, 2008	Letter to DEK, “Project Manager Change for the License Renewal Review for Kewaunee Power Station.” (ADAMS Accession No. ML083370231)
December 9, 2008	Letter to DEK, “Revision of Schedule for the Conduct of the Review of the Kewaunee Power Station License Renewal Application.” (ADAMS Accession No. ML083370245)
January 8, 2009	“Request for Additional Information Regarding Severe Accident Mitigation Alternatives for Kewaunee Power Station.” (ADAMS Accession No. ML083250719)
February 3, 2009	Summary of Conference Call with Dominion Energy Kewaunee, Inc., to Discuss the Severe Accident Mitigation Alternatives Requests for Additional Information for Kewaunee Power Station. (ADAMS Accession No. ML090290287)
March 9, 2009	Letter from DEK, “Dominion Energy Kewaunee, Inc. Kewaunee Power Station Response to Request for Additional Information Regarding Severe Accident Mitigation Alternatives for Kewaunee Power Station License Renewal Application.” (ADAMS Accession No. ML0906900458)
April 6, 2009	Letter to DEK, “Issuance of Environmental Scoping Summary Report Associated with the Staff’s Review of the Application by Dominion

	Energy Kewaunee, Inc., for Renewal of the Operating License for Kewaunee Power Station." (ADAMS Accession No. ML090770880)
April 11, 2009	Letter to DEK, "Environmental Site Audit Regarding Kewaunee Power Station License Renewal Application." (ADAMS Accession No. ML090750720)
April 20, 2009	"Reissuing of the Environmental Scoping Summary Report Associated with the Staff's Review of the Application by Dominion Energy Kewaunee, Inc., for Renewal of the Operating License for Kewaunee Power Station (ADAMS Accession No. ML091100093).
June 1, 2009	Letter from DEK, "Dominion Energy Kewaunee, Inc. Kewaunee Power Station Response to Follow-Up Questions Regarding the Severe Accident Mitigation Alternatives for Kewaunee Power Station." (ADAMS Accession No. ML091600037)
July 6, 2009	Letter from DEK, "Response to Request to Docket Information Related to the Environmental Site Audit for Kewaunee Power Station." (ADAMS Accession No. ML0919705124)
July 8, 2009	Summary of Conference Calls With Dominion Energy Kewaunee, Inc., to Discuss Response to Follow-Up Question Regarding Severe Accident Mitigation Alternatives Request for Additional Information For Kewaunee Power Station. (ADAMS Accession No. ML091820565)
July 8, 2009	Letter to DEK, "Environmental Project Manager Change for the License Renewal of Kewaunee Power Station." (ADAMS Accession No. ML091880344)
July 10, 2009	Letter to DEK, "Request for Additional Information Regarding the Environmental Review of the License Renewal Application for Kewaunee Power Station." (ADAMS Accession No. ML091890017)

APPENDIX F
U.S. NUCLEAR REGULATORY COMMISSION STAFF EVALUATION OF SEVERE ACCIDENT MITIGATION ALTERNATIVES FOR KEWAUNEE POWER STATION IN SUPPORT OF LICENSE RENEWAL APPLICATION REVIEW

U.S. NUCLEAR REGULATORY COMMISSION STAFF EVALUATION OF SEVERE ACCIDENT MITIGATION ALTERNATIVES FOR KEWAUNEE POWER STATION IN SUPPORT OF LICENSE RENEWAL APPLICATION REVIEW

F.1 Introduction

Dominion Energy Kewaunee, Inc. (DEK) submitted an assessment of severe accident mitigation alternatives (SAMAs) for Kewaunee Power Station (KPS) as part of the environmental report (ER) (DEK, 2008a). This assessment was based on the most recent KPS probabilistic risk assessment (PRA) available at that time, a plant-specific offsite consequence analysis performed using the MELCOR Accident Consequence Code System 2 (MACCS2) computer code, and insights from the KPS individual plant examination (IPE) (WPSC, 1992) and individual plant examination of external events (IPEEE) (WPSC, 1994a). In identifying and evaluating potential SAMAs, DEK considered SAMAs that addressed the major contributors to core damage frequency (CDF) and large early release frequency (LERF) at KPS, as well as SAMA candidates for other operating plants, which have submitted license renewal applications. DEK identified 189 potential SAMA candidates. This list was reduced to 64 SAMAs by eliminating SAMAs that are not applicable at KPS due to design differences, have been effectively implemented at KPS, have estimated costs that would exceed the dollar value associated with completely eliminating all severe accident risk at KPS, or have a very low benefit because they are associated with a non-risk-significant system. DEK assessed the costs and benefits associated with each of the potential SAMAs and concluded in the ER that several of the candidate SAMAs evaluated are potentially cost-beneficial.

Based on a review of the SAMA assessment, the U.S. Nuclear Regulatory Commission (NRC) issued a request for additional information (RAI) to DEK by letter dated January 8, 2009 (NRC, 2009a). Key questions concerned: additional details regarding the plant-specific PRA model and changes to the model since the IPE; identification of candidate SAMAs from the available plant-specific fire and seismic risk analyses; additional information regarding the Level 2 PRA analysis and Level 3 PRA inputs; the screening of specific candidate SAMAs; and further information on the cost-benefit analyses of several specific candidate SAMAs and low-cost alternatives. DEK submitted additional information by letter dated March 9, 2009 (DEK, 2009a). In response to the RAIs, DEK provided: information regarding PRA models and recent changes; additional justification for the treatment of external events; additional information on the Level 2 and 3 PRA analysis and inputs; and additional information regarding selection, screening and cost-benefit analysis of several specific SAMAs. DEK responded to six follow-up questions from the NRC staff (NRC, 2009b) by letters dated June 1, 2009 (DEK, 2009b), and July 28, 2009 (DEK, 2009c). DEK's responses addressed the NRC staff's concerns and resulted in the identification of additional potentially cost-beneficial SAMAs.

An assessment of SAMAs for KPS is presented below.

F.2. Estimate of Risk for Kewaunee Power Station

DEK's estimates of offsite risk at KPS are summarized in Section F.2.1. The summary is followed by the NRC staff's review of DEK's risk estimates in Section F.2.2.

F.2.1. Kewaunee's Risk Estimates

Two distinct analyses are combined to form the basis for the risk estimates used in the SAMA analysis: (1) the KPS Level 1 and 2 PRA model, which is an updated version of the IPE (WPSC, 1992), 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 KPS Level 1 and 2 PRA model available at the time of the ER, referred to as version K101AASAMA. The scope of the KPS PRA does not include external events.

The baseline CDF for the purpose of the SAMA evaluation is approximately 7.7 x 10-5 per year as determined from the sum of the minimal cutsets. When determined from the sum of the event tree sequences, the CDF is 8.1 x 10-5 per year. The latter value was used in the SAMA analysis. The CDF is based on the risk assessment for internally-initiated events, which includes internal flooding. DEK did not include the contribution from external events within the KPS risk estimates; however, it did account for the potential risk reduction benefits associated with external events by doubling the estimated benefits for internal events. This is discussed further in Sections F.2.2 and F.6.2.

The breakdown of CDF by initiating event is provided in Table F.2-1. This information was summarized from that provided in Table F-1 of the ER and in response to an RAI (DEK, 2009a). As shown in this table, events initiated by internal flooding are the dominant contributors to CDF, contributing a total of 4.5 x 10-5 per year or 58 percent of the total internal events CDF. Although not separately reported, station blackout (SBO) sequences contribute roughly 3.3 x 10-6 per year (4.3 percent of the total internal events CDF), while anticipated transient without scram (ATWS) sequences contribute less than 1 percent to the total internal events CDF.

The Level 2 KPS PRA model is based on the IPE model, with updates in 2004 and May 2007. The Level 1/Level 2 interface utilizes plant damage states (PDS) determined from “bridge trees”. These bridge trees extend the Level 1 analysis to include systems relevant to the Level 2 analysis. Each PDS is then evaluated through the Level 2 containment event tree (CET) (ER Figure F-1). The CET probabilistically evaluates the progression of the damaged core with respect to release to the environment. The CET end states then are examined for considerations of timing and magnitude of release and assigned to release categories using a release category diagram (ER Figure F-2).

The result of the Level 2 model is a set of 14 release categories, also referred to as source term categories (STCs), with their respective frequency and release characteristics. The release categories and their characteristics are provided in Table F-6 and F-10 of the ER. The categories were defined based on the timing, duration, and magnitude of the release and whether the containment remains intact, fails, or is bypassed. The frequency of each release category was obtained by summing the frequency of the individual CET end states assigned to each release category. The release characteristics for the 14 release categories were based on analyses using the Modular Accident Analysis Program (MAAP) computer code.

Table F.2-1. Kewaunee Power Station Core Damage Frequency

Initiating Event	CDF1 (Per Year)	% Contribution to CDF
Internal Floods	4.5 x 10-5	58
Transient with Main Feedwater Available	6.5 x 10-6	8
Loss of Component Cooling Water	6.0 x 10-6	8
Steam Generator Tube Rupture (SGTR)	4.7 x 10-6	6
Loss of Offsite Power	3.9 x 10-6	5
Stuck Open Pressurizer PORV	2.0 x 10-6	3
Loss of Service Water	1.9 x 10-6	3
Loss of Main Feedwater	1.6 x 10-6	2
Small LOCA	1.2 x 10-6	2
Vessel Failure	9.5 x 10-7	1
Loss of Instrument Air	8.0 x 10-7	1
All Others	2.5 x 10-6	3
Total CDF (internal events)	**7.7 x 10-5**	**100**

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 these analyses include plant-specific and site-specific input values for core radionuclide inventory, source term and release characteristics, site meteorological data, projected population distribution (within an 80-kilometer (50-mile) radius) for the year 2033, emergency response evacuation modeling, and economic data. The magnitude of the onsite impacts (in terms of clean-up and decontamination costs and occupational dose) is based on information provided in NEI 05-01 (NEI, 2005), which in turn is based on NUREG/BR-0184 (NRC, 1997a).

In the ER, DEK estimated the dose to the population within 50 miles (80 km) of the KPS site to be approximately 0.302 person-sievert (Sv) (30.2 person-rem) per year. The breakdown of the total population dose by containment release mode is summarized in the following table:

Table F.2-2. Containment bypass events (such as transients with an induced SGTR, or SGTR-initiated accidents with a stuck open safety relief valve on the ruptured steam generator) and late containment failures without containment spray dominate the population dose risk at Kewaunee Power Station.

Containment Release Mode	Population Dose (Person-Rem Per Year)	% Contribution
Late Containment Failure without containment sprays	8.6	29
ISLOCA with scrubbing	0.2	<1
ISLOCA without scrubbing	0.9	3
SGTR with failure of secondary side isolation	19.5	64
SGTR with successful secondary side isolation	0.9	3
Other	0.1	1
Total	**30.2**	**100**

One person-rem = 0.01 person-Sv

F.2.2. Review of Dominion Energy Kewaunee, Inc.'s Risk Estimates

DEK's determination of offsite risk at KPS is based on the following three major elements of analysis:

- the Level 1 and Level 2 risk models that form the bases for the 1992 IPE submittal (WPSC, 1992) and the external events analyses of the 1994 IPEEE submittal (WPSC, 1994a),
- the major modifications to the IPE model that have been incorporated in the K101AASAMA PRA model, and
- the MACCS2 analyses performed to translate fission product source terms and release frequencies from the Level 2 PRA model into offsite consequence measures.

Each of these analyses was reviewed to determine the acceptability of DEK's risk estimates for the SAMA analysis, as summarized below.

The NRC staff's review of the KPS IPE is described in an NRC report dated January 15, 1997 (NRC, 1997b). Based on a review of the IPE submittal and responses to RAIs, the NRC staff concluded that the IPE submittal met the intent of Generic Letter (GL) 88-20; that is, the licensee's IPE process is capable of identifying the most likely severe accidents and severe accident vulnerabilities. While the NRC Staff Evaluation Report (SER) and the attached Technical Evaluation Report (TER) did not specifically highlight any weaknesses in the IPE, in a subsequent submittal relative to risk-informed in-service inspection (NMC, 2005), the licensee indicated that six weaknesses were identified in the IPE review. In response to an RAI, DEK addressed each weakness and confirmed that they are not applicable to the model used for the SAMA analysis (DEK, 2009a).

The IPE identified nine severe accident vulnerabilities associated with core damage and six improvements to address the first five of these vulnerabilities (WPSC, 1994a). Improvements to address the remaining four vulnerabilities were being given further consideration at the time of the IPE submittal. In a subsequent IPE submittal, all but one of the original six improvements were stated to have been implemented. The one improvement not implemented was to change the normal position of two safety injection motor operated valves from open to closed, thereby reducing the ISLOCA frequency. While this was included in the IPE, it was subsequently found that the CDF contribution of failing to open was higher than the CDF reduction from having the valves closed. Accordingly, implementation of this change was not considered appropriate. The status of the remaining four vulnerabilities was also given (WPSC, 1994b). SAMAs in the current evaluation address these remaining four vulnerabilities. No vulnerabilities or improvements associated with containment performance were identified (WPSC, 1992).

The CDF value from the 1996 KPS revised IPE (1.1 x 10-4 per year) is at the high end of the range of the CDF values reported in the IPEs for Westinghouse two-loop plants. Figure 11.6 of NUREG-1560 (NRC, 1997c) shows that the IPE-based total internal events CDF for two-loop Westinghouse plants ranges from 5 x 10-5 per year to 1.2 x 10-4 per year (NRC, 1997c). It is recognized that other plants have updated the values for CDF subsequent to the IPE submittals to reflect modeling and hardware changes. The internal events CDF result for KPS used for the SAMA analysis is somewhat higher than that for other plants of similar vintage and characteristics due to the relatively high internal flooding contribution to CDF, as described below.

There have been nine revisions to the PRA model between the 1992 IPE submittal and the model used for the SAMA analysis. A description of changes made from one model to another is provided in Section F.2 of the ER and is summarized in Table F.2-3. The CDF and LERF values have varied widely over these revisions.

In response to an RAI concerning the major reasons for these changes, DEK indicated that the principal reason for the changes was due to internal flood modeling (DEK, 2009a). According to DEK, the flood model in the 8/2003 PRA was not substantially different from that in the IPE, and resulted in a flood CDF of 3.6 x 10-7 per year. The 12/2004 PRA incorporated what was considered to be a conservative model that bounded actual flooding conditions until a best estimate model could be developed. This model had a flooding CDF contribution of 6.8 x 10-4 per year with the majority of the frequency due to (1) rupture of the condenser expansion joint, with flood water propagating to the safeguards alley via floor drains and under doors, and (2) break of safety injection piping from the refueling water storage tank, with flood water propagating to the safeguards alley through a failed door. In 2005, design changes were made to mitigate these flooding contributors. Credit for these design changes, as well as planned internal flood modifications, was included in the K101AASAMA model and reduced the internal flood CDF to 4.5 x 10-5 per year.

Table F.2-3. Kewaunee Power Station Probabilistic Risk Assessment Historical Summary

Version	Description/changes from previous model	CDF (per year)	LERF (per year)
IPE	**11.0 ORIGINAL IPE**	6.6 x 10-5	NC
Revised IPE 6/1996	Revised in response to RAIs, including new Human Reliability Analysis	1.1 x 10-4	NC
1/1997	- Credited operator to refill RWST - Modeled alternate cooling for air compressors	3.9 x 10-5	2.2 x 10-6
4/1998	Removed asymmetric modeling	3.6 x 10-5	1.9 x 10-6
12/2001	- Incorporated plant failure and initiating event data - Included consideration of replacement SGs - Converted from GRAFTER code to WinNUPRA code - Reviewed in 6/2002 WOG Group peer review	4.1 x 10-5	4.8 x 10-6
8/2003	- Reevaluated important human error probabilities - Updated Level 2 success criteria for power uprate - Updated medium LOCA and ISLOCA models - Incorporated WOG RCP seal LOCA model - Revised steam line break analysis to include pressurized thermal shock - Added quantitative shutdown model - Resolved numerous peer review comments	3.0 x 10-5	5.3 x 10-6
12/2004	- Revised internal flooding model - Added need to stop safety injection following steam line break - Added dependence of letdown on component cooling water - Added power recovery and 480 VAC bus cross-ties - Updated success criteria for power uprate	7.2 x 10-4	5.0 x 10-6
K101A 6/2006	- Incorporated new internal flooding model which included plant changes to address flooding concerns - Incorporated revised diesel-generator reliability data - Incorporated reactor coolant system cooldown and depressurization following RCP seal LOCA to avoid core damage	2.7 x 10-4	5.7 x 10-6
K101AA 12/2006	- Incorporated flood barriers to protect RHR pumps - Incorporated operator actions to address flooding of battery room, auxiliary feedwater (AFW) room, and switchgear room ventilation - Incorporated procedure changes addressing service water isolation and removed other isolation conservatisms	1.3 x 10-4	7.0 x 10-6
K101AASAMA 5/2007	One time only model for SAMA. Updates were carried through to future revisions as specified - Revised service water model for internal flooding sequences - Incorporated credit for planned internal flooding design changes (described below) - Restructured Level 1 event trees to support revised Level 2 model	7.7 x 10-5 (8.1 x 10-5)	9.5 x 10-6 (9.9 x 10-6)

Version	Description/changes from previous model	CDF (per year)	LERF (per year)
K101AB 5/2007	Update to K101AA - Revised service water model for internal flooding sequences Note: No internal flooding modifications included	1.1 x 10-4	5.7 x 10-6
K107A 8/2007	Subjected to independent review 1/2008 - Updated basic event database - Updated internal flooding model to remove conservatisms - Restructured Level 1 event trees to support revised Level 2 model Note: No internal flooding modifications included	7.6 x 10-5	9.8 x 10-6
K107Aa 7/2008	Updated model to “as installed” configuration of internal flooding modifications included in K101AASAMA model.	4.8 x 10-5	6.4 x 10-6
K107AaILRT 7/15/2008	Re-evaluated significant operator actions	4.2 x 10-5 (4.3 x 10-5)	4.9 x 10-6 (4.9 x 10-6)

NC - Not Calculated

Values in parentheses are sum of sequence frequencies

The planned internal flood modifications were discussed with the NRC on November 30, 2006 (DEK, 2006). At the time of the SAMA analysis, three of the four planned modifications had been implemented, and the fourth modification, involving relocating two electrical safety-related supply circuit breakers (breakers 15206 and 16206), had not yet been completed. In response to an RAI, DEK indicated that relocation of breaker 16206 is currently planned for the next available opportunity, but relocation of breaker 15206, which is stated to have a much lower benefit, is no longer planned (DEK, 2009a). However, another design change, involving rerouting a wire for a Turbine Building basement fan coil unit, was completed in 2008 but not included in the K101AASAMA model. DEK indicated that credit for rerouting this wire would more than offset the impact of raising the breakers (DEK, 2009a).

Subsequent to the SAMA analysis, DEK submitted an unrelated risk-informed license amendment request regarding containment integrated leak rate testing (DEK, 2008b) that provided information on a more recent version of the PRA (i.e., the K107Aa PRA model of July 2008). The July 2008 PRA update has a significantly lower CDF (4.8 x 10-5 per year) than that for the SAMA model. In response to an RAI, DEK provided information on PRA model changes subsequent to the K101AASAMA PRA (DEK, 2009a). A description of these changes is included in Table F.2-3. The majority of the CDF reduction from the SAMA model to the K107Aa model is attributed to the database update and the incorporation of credit for rerouting a wire connecting the supply breaker for the turbine building basement fan coil unit B and auxiliary relays (DEK, 2009a). Other changes in the model, principally incorporating several specific ventilation design features and requirements, had a smaller impact on CDF. It is also noted that the current model does not include credit for raising of either breaker 15206 or 16206. The impact of this new PRA version on the results of the SAMA evaluation is discussed in Section 3.2 below.

The NRC staff considered the peer reviews performed for the KPS PRA and the potential impact of the review findings on the SAMA evaluation. In the ER, DEK described the June 2002 peer review by the (former) Westinghouse Owner’s Group (WOG) of the 12/2001 PRA model.

The peer review identified five Level A and 49 Level B Facts & Observations (F&Os) (DEK, 2008a). DEK stated in the ER that all Level A F&Os (important and necessary to address before the next regular PRA update) and all but two Level B F&Os (important and necessary to address but disposition may be deferred until the next PRA update) have been dispositioned, and that those items requiring model and/or documentation changes have been addressed in the PRA used for the SAMA analysis (K101AASAMA). One unresolved F&O pertains to not documenting the basis for not including room cooling as a required support system. In the SAMA model, room cooling is required unless a calculation shows it is not needed. The second unresolved F&O pertains to loss of room cooling as a separate initiating event. In response to an RAI, DEK discusses loss of room-cooling events and points out that the equipment needed during power operation is in different plant locations from that needed to respond to a reactor trip or accident. Consequently, the same room- cooling failures would not be expected to impact both functions. DEK concluded that loss of room cooling need not be treated as an initiator. In the SAMA model, room cooling is considered as a support function and this has led to the identification of a number of room cooling related SAMAs. The NRC staff considers this modeling approach sufficient for the purposes of the SAMA analysis.

In the aforementioned integrated leak rate testing submittal (DEK, 2008b), DEK described a review of the July 2008 revised KPS PRA (K107Aa) against Regulatory Guide (RG) 1.200, Revision 1, and the supporting requirements (SRs) of the ASME PRA Standard (ASME, 2003). In response to an RAI, DEK provided additional information on this review and the impact of its findings on the SAMA analysis (DEK, 2009a). DEK summarized the unmet SRs, described how the unmet SRs were reviewed to determine if they would have an impact on the risk insights of the SAMA analysis, and concluded that resolution of the unmet SRs is not expected to alter the findings of the SAMA analysis.

In the ER and in response to an RAI, DEK described the PRA update process in use at KPS. The model is updated at least every 3 years to maintain it consistent with the as-built, as-operated plant, to incorporate improved thermal-hydraulic results, and to incorporate PRA improvements. The entire process of logging and tracking potential model changes, making the model changes, documenting the changes, independent review of the changes and management approval of the updated model and its documentation are governed by DEK procedures.

Given that the KPS internal events PRA model has been peer reviewed and the peer review findings were all addressed, and that DEK has satisfactorily addressed NRC staff questions regarding the PRA, the NRC staff concludes that the internal events Level 1 PRA model is of sufficient quality to support the SAMA evaluation.

As indicated above, the KPS PRA does not include external events. In the absence of such an analysis, DEK used the KPS IPEEE to identify the highest risk accident sequences and the potential means of reducing the risk posed by those sequences (DEK 2009a, 2009b). This is discussed below and in Section F.3.2.

The KPS IPEEE was submitted in June 1994 (WPSC, 1994a), in response to Supplement 4 of Generic Letter 88-20 (NRC, 1991). This submittal included a seismic PRA, a fire PRA, and a screening analysis for other external events. While no fundamental weaknesses or vulnerabilities to severe accident risk in regard to the external events were identified, several opportunities for seismic risk reduction were identified from the seismic IPEEE/USI A-46 reviews, walkdowns, and relay chatter evaluations, and implemented as discussed below. In a letter dated October 5, 1999, the NRC 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 (NRC, 1999).

The seismic PRA included in the KPS IPEEE consisted of a Level 1 seismic PRA with a qualitative and quantitative evaluation of containment structures and containment safeguard systems. The seismic PRA approach employed was a composite of seismic PRA and seismic margins assessment (SMA) methods. Plant seismic walkdowns and screening were conducted using the SMA procedures and guidance (EPRI, 1991). For the components screened out using high confidence in low probability of failure (HCLPF) requirements for the 0.30g peak ground acceleration Review Level Earthquake (RLE), "surrogate elements" were included in the PRA model. Inclusion of these surrogate elements is necessary to incorporate in the seismic risk estimates the failure of relatively robust elements at higher ground accelerations. While the NRC review of the seismic PRA concluded that the use of "surrogate elements" resulted in an identification and ranking of dominant sequences that was not meaningful, the overall conclusion was that the resulting CDF of 1.1 x 10-5 per year was likely to be realistic or conservative, and that there are, with reasonable confidence, no significant vulnerabilities. The seismic outliers and the "bad actor" relays identified in the IPEEE were all resolved by modifications so that they would not contribute to seismic risk, and therefore were not included in the model (DEK, 2008a; NRC, 1998). The containment performance analysis included a review and walkdown of the containment structures and components (penetrations, hatches, isolation valves, freestanding steel shell, and attached piping and conduit). All met the screening criteria and were therefore evaluated using the surrogate element approach, leading to a single containment structural failure sequence. Fragilities for containment safeguard systems (spray, air-cooling, and isolation) were determined based on walkdown results. Models for failures of these systems were then input into a simplified Level 2 analysis based on the IPE model. Subsequent to the IPEEE, changes made to the seismic PRA, including credit for seismically-rugged air accumulators and more realistic human error probabilities, led to a slight reduction in seismic CDF to 1.04 x 10-5 per year.

To provide additional insight into the appropriate seismic CDF to use for the SAMA evaluation, the NRC staff developed an independent estimate of the seismic CDF for KPS using the simplified-hybrid approximation method described in a paper by Robert P. Kennedy, entitled "Overview of Methods for Seismic PRA and Margin Analysis Including Recent Innovations" (Kennedy, 1999) and using both updated 2008 seismic hazard curve data from the U.S. Geologic Survey (USGS, 2008) and LLNL seismic hazard curve data (NRC, 1994). The NRC staff's independent calculations indicate the seismic CDF for KPS to be in the range of 6 x 10-6 per year to 1 x 10-5 per year depending on seismic hazard curve and plant fragility assumptions. Based on these estimates of the seismic CDF, the NRC staff concludes that the seismic CDF given in the ER is appropriate for use in the SAMA assessment.

The KPS IPEEE fire analysis employed a combination of fire PRA methodology with the Electric Power Research Institute's fire-induced vulnerability evaluation (FIVE) methodology. Fire zones were initially screened out if a fire did not cause an initiating event or did not involve mitigating equipment modeled in the PRA. Quantitative screening was then performed using fire frequencies based on the FIVE methodology and the assumption that fire destroyed everything in the zone. The sequence was then quantified using the PRA internal events model. If the CDF was greater than 1 x 10-6 per year the zone was subjected to more detailed analysis. The potential impact on containment performance and isolation was evaluated following the core damage evaluation.

The fire model was revised in response to an RAI on potential weaknesses that were noted in the staff's evaluation of the IPEEE fire analysis. This revision included adding the control room and cable spreading room to the fire zones evaluated, revising the human error probabilities (HEPs), and updating the initiating event frequencies and severity factors (DEK, 2008a; WPSC 1995, 1998). The total fire CDF from the revised IPEEE analysis was estimated to be 1.8 x 10-4 per year.

In general, the fire PRA model has not been updated since the completion of the IPEEE review. However, when HEPs and plant failure data were updated for the internal events model, these updates were carried into the fire model. In addition, the fire propagation modeling for the auxiliary feedwater (AFW) pump B room, a dominant fire area, was updated, resulting in a fire CDF of about 1.4 x 10-4 per year. The important fire areas and their contributions to the fire CDF are listed in Table F.2-4.

In the ER, DEK identifies a number of conservatisms in the fire analysis. These are:

- Initiating-event frequencies are based on old data that does not reflect current housekeeping practices.
- Fire-coping strategies credited only one train and did not rely on offsite power.
- If a cable tray is damaged, all cables in the tray are assumed to be damaged.
- Fire propagation analysis is highly conservative.
- Except for AFW Pump Room B, the most severe fire was assumed to occur with a frequency equal to the total fire initiating event frequency for the room.

In response to an RAI, DEK indicated the fire zones to which each of the conservatisms was applicable. Most of the conservatisms are applicable to all fire zones and all are applicable to the dominant fire zones (CDF greater than 1 x 10-6 per year).

DEK further states in the ER that changes to plant procedures made subsequent to the completion of the IPEEE would reduce the fire CDF by at least a factor of five from the IPEEE. In response to an RAI, DEK provided a reassessment of the top 100 cutsets from the fire risk analysis in which these fire procedures were credited, i.e., OP-KW-AOP-FP-001, "Abnormal Operating Procedure—Fire", and OP-KW-AOP-FP-002, "Fire in Alternate Zone." The reassessment supports a reduction in CDF of slightly more than a factor of 5. DEK concluded that the fire CDF would be 3.6 x 10-5 per year, based on applying the factor of 5 reduction to the IPEEE fire CDF of 1.8 x 10-4 per year. However, the staff notes that the assessment that led to this factor of 5 reduction used the updated fire PRA model with a CDF of about 1.4 x 10-4 per year as the baseline. Thus, the adjusted fire CDF should be 2.8 x 10-5 per year. DEK agrees that this is the correct value to use and that the value used in SAMA analysis is conservative. The fire CDF for the dominant fire zones after making this adjustment are given in Table F.2-4 (DEK, 2009b).

Table F.2-4. Important Fire Areas and Their Contribution to Fire Core Damage Frequency

Event ID	Description	CDF (Per Year)	
		Post-IPEEE	SAMA Analysis
IE-FIR14	Fire in Diesel Generator Room A	4.2 x 10-5	4.9 x 10-6
IE-FIR5	Fire in Relay Room	3.3 x 10-5	5.6 x 10-6
IE-FIR8	Fire Near Buses 51 and 52	2.4 x 10-5	2.9 x 10-6
IE-FIR4	Fire in Diesel Generator Room B	1.8 x 10-5	1.8 x 10-6
IE-FIR6	Auxiliary Feedwater Pump A Oil fire	1.2 x 10-5	1.3 x 10-6
IE-FIR10	Fire in Bus 5 Switches in ECCA	5.5 x 10-6	5.5 x 10-6
IE-FIR11	Fire in Bus 6 Switches in ECCA	5.2 x 10-6	5.2 x 10-6
Total (All Fire Zones)		1.4 x 10-4	2.8 x 10-5

Considering the above conservatisms and procedure assessment and the response to the staff RAIs, the staff concludes that the fire CDF of 3.6 x 10-5 per year is reasonable for the SAMA analysis.

The IPEEE analysis of high winds, floods, and other (HFO) external events followed the screening and evaluation approaches described in Supplement 4 of Generic Letter 88-20 (NRC, 1991) and did not identify any significant sequences or vulnerabilities (WPSC, 1994a). Based on this result, the licensee concluded that these other external hazards would be negligible contributors to overall core damage and did not consider any plant specific SAMAs for these events.

The NRC SER on the IPEEE (NRC, 1999) identified an open item pertaining to the protection of the vents on the underground diesel oil storage tanks against tornado-generated missiles. In response to an RAI, DEK indicated that these vents had been lowered so as to be less vulnerable to tornado missiles, thereby meeting the IPEEE requirements. A future modification is, however, planned to further minimize the tornado risk.

Based on the aforementioned results, the external events CDF is approximately 60 percent of the internal events CDF from the K101AASAMA PRA (based on a fire CDF of 3.6 x 10-5 per year, a seismic CDF of 1 x 10-5 per year, a negligible HFO contribution, and an internal events CDF of 8.1 x 10-5 per year). Accordingly, the total CDF from internal and external events would be approximately 1.6 times the internal events CDF from the K101AASAMA PRA. In the SAMA analysis submitted in the ER, DEK doubled the benefit that was derived from the internal events model to account for the combined contribution from internal and external events. The NRC staff agrees with the licensee’s overall conclusion concerning the impact of external events, and concludes that the licensee’s use of a multiplier of 2 to account for external events is reasonable for the purposes of the SAMA evaluation.

The NRC staff reviewed the general process used by DEK to translate the results of the Level 1 PRA into containment releases, as well as the results of the Level 2 analysis, as described in the ER and in response to an NRC staff RAI (DEK, 2009a). The current Level 2 KPS PRA is based on the IPE model with updates in 2004 and 2007, the latter using the results from the K101AASAMA Level 1 PRA. The 2004 update incorporated a design change that ensured that water on the containment floor would spill into the reactor sump after reaching a level of 29 inches, thereby providing a flooded reactor cavity that could reduce the impact of core-concrete interactions in a severe accident. In addition, the 2004 update incorporated the results of reanalysis of accident sequences using a later version of the MAAP code and reflected a 6 percent power uprate at KPS. The 2007 update included consideration of induced SGTR sequences, separation of SGTR sequences into those that had a large early release and those that did not, and resolution of comments from the WOG peer certification.

Each plant damage state is analyzed through the Level 2 CET to evaluate the phenomenological progression of the sequence. The CET end states are then assigned to one of 14 release categories based on characteristics that determine the timing and magnitude of fission product release using a release category diagram (Figure F-2 of the ER). The frequency of each release category was obtained by summing the frequency of the individual accident progression CET endpoints into the release category.

Source term release characteristics were developed for each release category based on results of plant-specific calculations using the MAAP computer program, Version 4.0.5. The release categories and their frequencies and release characteristics are presented in Table F-6 of the ER. The MAAP case selected to represent each release category was the sequence with the highest frequency that bounded the release fractions for the release category. In response to an RAI, DEK stated that when the Level 2 sequences were reanalyzed in 2007, the previously analyzed sequences for each release category were reviewed to ensure that they still reflected the expected accident progression for the associated release category, and if not, new cases were run (DEK, 2009a). DEK indicated that in most cases the previously selected sequence still represented the new source term category. The exception was release category 4 for which a flood scenario was selected for the revised analysis since floods are the dominant contributor.

The NRC staff's review of the Level 2 IPE concluded that it appeared to have considered the most important severe accident phenomena and it identified no significant problems or errors (NRC, 1997b). Based on the NRC staff's review of the Level 2 methodology and in particular the changes made since the IPE, and the fact that the Level 2 model was reviewed as part of the WOG peer review and a subsequent self-assessment, the NRC staff concludes that the Level 2 PRA provides an acceptable basis for evaluating the benefits associated with various SAMAs.

As indicated in the ER, the reactor core radionuclide inventory used in the consequence analysis was determined from the results of an end-of-cycle ORIGEN2 code calculation. The results for a power level of 1772 MWt (the uprated power level) were increased by 0.6 percent for potential measurement error. In response to an RAI, the licensee indicated that KPS does not have any current plans that would cause fuel burnup/management to change during the renewal period.

The NRC staff reviewed the process used by DEK to extend the containment performance (Level 2) portion of the PRA to an assessment of offsite consequences (essentially a Level 3 PRA). This included consideration of the source terms used to characterize fission product releases for the applicable source term categories and the major input assumptions used in the offsite consequence analyses. The MACCS2 code was utilized to estimate offsite consequences. Plant-specific input to the code includes the source terms for each source term category and the reactor core radionuclide inventory (both discussed above), site-specific meteorological data, projected population distribution within an 80-kilometer (50-mi) radius for the year 2033, emergency evacuation modeling, and economic data. This information is provided in Attachment F of the ER.

All releases were modeled as occurring at the top of the containment approximately 180 feet above grade, with a thermal content the same as ambient (i.e., a non-buoyant plume). The impact of the shield building that surrounds the containment on initial plume size and release elevation was neglected. DEK assessed the impact of alternatively assuming a ground level release and a higher (buoyant) plume. The results of these sensitivity studies showed that a ground level release produces about a 6 percent reduction in population dose and offsite economic cost, while a conservatively large thermal content (buoyant plume) produces about a 4 to 5 percent increase in population dose and economic cost. DEK also reported that an increase or decrease in initial plume size due to building wake size has no impact on population dose and a small (1 percent) change in offsite cost. In response to an RAI concerning the validity of release parameters for the dominant SGTR sequence, which has a release elevation somewhat lower than that assumed, but with a buoyant plume, DEK stated that the base case assumption of perpetual rain fall in the 40 to 50 mile segment surrounding the site introduces a 30 to 40 percent conservatism that more than offsets any increase from selection of alternative release parameters (DEK, 2009a). Based on the information provided, the NRC staff concludes that the release parameters utilized are acceptable for the purposes of the SAMA evaluation.

DEK used site-specific meteorological data for the 2002 calendar year as input to the MACCS2 code. The development of the meteorological data is discussed in Section F.3.5 of the ER and in response to an RAI (DEK, 2009a). The wind and atmospheric stability data were collected from the onsite meteorological tower. Precipitation data was from Sturgeon Bay, Wisconsin, approximately 40 miles north of KPS, which is the closest weather station collecting hourly precipitation data. Seasonal morning and afternoon mixing heights were determined for each year from National Weather Service (NWS) measurements at Green Bay, Wisconsin. Data from 2003 and 2004 were also considered, but the 2002 data was chosen because results of a MACCS2 sensitivity case comparing the use of the data indicated that the 2002 data produced more conservative results. In response to an RAI, DEK described the sources of data used to fill in gaps due to missing and invalid data (DEK, 2009a). The principal source was onsite measurements at other elevations, followed by data from the Point Beach site (approximately 4 miles to the South), followed by nearest NWS locations. The NRC staff notes that previous SAMA analysis results have shown little sensitivity to year-to-year differences in meteorological data and concludes that the approach taken for collecting and applying the meteorological data in the SAMA analysis is reasonable.

The population distribution the licensee used as input to the MACCS2 analysis was estimated for the year 2033. This estimate was based on the U.S. Census Bureau population data for 2000, as provided by the SECPOP 2000 program (NRC, 2003), transient population estimates used in the updated evacuation time estimate study for KPS (TOMCOD, 2005), and county-by-county growth rate estimates for the years 2000 to 2030 (State of Wisconsin, 2003). As described by DEK in response to an RAI, both geometric and exponential annual county growth rates were calculated for the 2030-2033 population growth (DEK, 2009a). The exponential rates were found to result in a larger 2033 population and were applied to the populations in each of the 160 population zones (10 distance rings and 16 directions). Individual county rates were applied to the fraction of area in each zone in each county. Transient population was extrapolated in the same manner. The NRC staff considers the 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 10 miles (16 km) from the plant. It was assumed that 95 percent of the population would evacuate. 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 time used in the SAMA analysis was based on a projection for the year 2033. The evacuees were assumed to begin evacuating 80 minutes after a General Emergency has been declared and to evacuate at an average radial speed of approximately 2.6 miles per hour (1.16 meters per second). The evacuation speed is based on that for adverse weather conditions from the 2000 evacuation study extrapolated to 2033 by the ratio of the year 2000 population to the year 2033 population within the emergency planning zone (TOMCOD, 2005). The ER reports the results of several sensitivity analyses in which the evacuation modeling assumptions were varied. These analyses show that variations in the modeling assumptions had little or no impact on the results. Reducing the evacuation speed to half the base value, increasing it to the year 2000 value or decreasing the evacuation effectiveness to 50 percent had less than a 0.5 percent impact on population dose or offsite costs. Changing the time of declaration of a general emergency to the time when the core gets uncovered had no measurable impact on population dose and reduced offsite costs by 1 percent. The NRC staff concludes that the evacuation assumptions and analysis are reasonable and acceptable for the purposes of the SAMA evaluation.

Much of the site-specific economic data was provided from SECPOP2000 (NRC, 2003) by specifying the data for each of the counties surrounding the plant to a distance of 50 miles (80 km). This included the fraction of land devoted to farming, annual farm sales, the fraction of farm sales resulting from dairy production, and the value of non-farm land. SECPOP2000 utilizes economic data from the 1997 Census of Agriculture (USDA, 1998). Area-wide farm wealth was determined from 2002 National Census of Agriculture (USDA, 2002) county statistics for farmland, buildings and machinery, with only the fraction of each county within 50 miles of KPS considered. Non-farm wealth was similarly calculated from 2003 Wisconsin tax assessments but was found to be less than that from SECPOP2000, so the latter value was used.

In addition, generic economic data that applies to the region as a whole was obtained from the MACCS2 sample problem input. This included parameters describing the cost of evacuating and relocating people, land decontamination, and property condemnation. An escalation factor of 1.85 was applied to these parameters to account for cost escalation from 1986 (the year the input was first specified) to 2007.

As described in the ER, the three recently discovered problems in SECPOP2000 have all been accounted for in preparing the input for KPS. These problems involved: (1) an inconsistency in the format in which several economic parameters were output from the SECPOP2000 code and input to the MACCS2 code, (2) an error that resulted in use of agricultural/economic data for the wrong counties in the SECPOP2000 calculations, and (3) an error that resulted in the economic data for some counties being handled incorrectly.

The NRC staff concludes that the methodology used by DEK to estimate the offsite consequences for KPS provides an acceptable basis from which to proceed with an assessment of risk reduction potential for candidate SAMAs. Accordingly, the NRC staff based its assessment of offsite risk on the CDF and offsite doses reported by DEK.

F.3. Potential Plant Improvements

This section discussed the process for identifying potential plant improvements, an evaluation of that process, and the improvements evaluated in detail by DEK.

F.3.1. Process for Identifying Potential Plant Improvements

DEK's process for identifying potential plant improvements (SAMAs) consisted of the following elements:

- Review of the most significant basic events from the plant-specific PRA,
- Review of potential plant improvements identified in the KPS IPE and IPEEE,
- Review of Phase 2 SAMAs from recent license renewal applications for six other U.S. nuclear sites, and
- Review of generic SAMAs as documented in NEI 05-01 (NEI, 2005).

Additionally, in response to RAIs, DEK's process for identifying potential plant improvements was expanded to include:

- Review of dominant fire and seismic risk contributors from the IPEEE analysis for improvements that could potentially reduce the associated fire risk, and
- Review of the results of importance analysis of the K107Aa PRA (completed after the original SAMA assessment) for any additional potential improvements.

Based on this process, an initial set of 189 SAMA candidates, referred to as Phase 1 SAMAs, was identified (ER Table F-17). In Phase 1 of the evaluation, DEK 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 KPS due to design differences (21 screened out),
- The SAMA has been effectively implemented at KPS (45 screened out),
- The SAMA has estimated costs that would exceed the dollar value associated with completely eliminating all severe accident risk at KPS (28 screened out), or
- The SAMA would be of very low benefit because it is associated with a non-risk-significant system, and a change would have negligible impact on the risk profile (31 screened out).

Based on this screening, a total of 125 SAMAs were eliminated leaving 64 SAMAs for further evaluation. The remaining SAMAs, referred to as Phase 2 SAMAs, are listed in Table F-19 of the ER. Several of the SAMAs retained for further evaluation were considered to be similar in terms of their benefits. As noted in Table F-17 of the ER, these SAMAs were combined and analyzed together in the Phase 2 evaluations.

In Phase 2, a detailed evaluation was performed for the remaining SAMA candidates (46 evaluations after combining similar SAMAs), as discussed in Sections F.4 and F.6 below. To account for the potential impact of external events, the estimated benefits based on internal events were multiplied by a factor of 2, as previously discussed.

The review of the dominant fire and seismic contributors to risk did not identify any additional SAMAs. The review of the K107Aa PRA importance analysis identified one additional SAMA, involving implementation of temporary screenhouse ventilation. These reviews are discussed further in Section F.3.2

F.3.2. Review of Dominion Energy Kewaunee, Inc.'s Process

DEK's efforts to identify potential SAMAs focused primarily on areas associated with internal initiating events, but also included explicit consideration of potential SAMAs for fire and seismic events. The initial list of SAMAs generally addressed the accident sequences considered to be important to CDF from functional, initiating event, and risk reduction worth perspectives at KPS, and included selected SAMAs from prior SAMA analyses for other plants.

DEK provided a tabular listing of the PRA basic events sorted according to their Fussell-Vesely (F-V) importance with respect to CDF (DEK, 2008a). SAMAs impacting these basic events would have the greatest potential for reducing risk. DEK used an F-V cutoff of 0.005, which corresponds to about a 0.5 percent change in CDF given 100 percent reliability of the SAMA. This equates to a benefit of approximately $25,000. All 149 basic events in the listing were reviewed to identify potential SAMAs. Based on this review, 16 SAMAs were identified and included in the Phase 1 list of Table F-17. The remaining basic events were found to be events that had no physical meaning (such as complement events or constants), were covered by generic SAMAs already listed, or were due to conservative assumptions and could be eliminated by more detailed modeling. DEK also provided and reviewed the LERF-related F-V events down to an F-V value of 0.005. DEK correlated these basic events with the SAMAs already identified and did not find any additional SAMAs.

In addition to basic event importance review, DEK reviewed the top 200 core damage cutsets to identify any basic events not included in the importance analysis that might suggest additional SAMAs. The resulting list contained 47 basic events (excluding events that had no physical meaning) and is provided in Table F-18 of the ER. Two additional SAMAs were identified in this review.

DEK considered the potential plant improvements described in the IPE and IPEEE in the identification of plant-specific candidate SAMAs for internal and external events, as summarized below.

The KPS IPE (WPSC, 1992) identified nine severe accident vulnerabilities and/or improvements associated with core damage. Six of these have either been implemented or assessed as not appropriate due to downside risk considerations (WPSC, 1994b). The Phase 1 SAMA list includes the remaining improvements identified in the IPE. No vulnerabilities or improvements associated with poor containment performance were identified in the IPE nor are there any identified in the IPEEE. While the IPEEE did not identify any vulnerabilities, as discussed above, a number of equipment outliers were identified during the walkdowns, all of which have been resolved.

The NRC staff questioned DEK about the disposition of a number of the basic events listed in the importance analyses, including consequential loss of offsite power and requested consideration of alternative SAMAs (NRC, 2009a). In response, DEK discussed why the consequential loss of offsite power event is important at KPS and the impact that potentially cost-beneficial SAMAs would have on this importance. Conservatisms in the modeling of the impact of this event were also discussed. Based on this information, the NRC staff concludes that no additional SAMAs would be effective in reducing the risk related to this event. DEK also discussed the benefit of additional refueling water storage tank (RWST) low-level alarms or an automatic RWST refilling system. DEK pointed out that the benefit of multiple low-level alarms is already included in the model and additional alarms would have a negligible impact on risk. A cost-benefit analysis for an automatic refill system, performed in a manner similar to the evaluation of other SAMAs, was provided, which showed that such a system would not be cost-beneficial.

The NRC staff requested clarification and further information regarding the screening of a number of the Phase 1 SAMAs (NRC, 2009a). In response, DEK: provided additional information regarding those SAMA that were screened out because they had already been implemented, cited additional data indicating that trip circuitry failure is not important to diesel generator failures, and clarified why additional transfer and isolation switches would not have any benefit. DEK clarified that while the central cooling water (CCW) system can be cross tied, there is presently no provision to cross tie the fire water system to the CCW system. A cost-benefit analysis for adding a cross tie was provided that showed that such a modification would not be cost-beneficial.

The NRC staff noted that KPS does not presently have a diesel-driven fire pump. In response to an RAI, DEK discussed the current fire pump design and the potential benefits and cost implications of adding a diesel-driven fire pump. While there is some opportunity for risk reduction by adding a diesel-driven pump, the benefits were qualitatively assessed by DEK to be small; whereas, the cost of a new pump, probably requiring a new building, was assessed as being more than any potential benefits. The NRC staff considers this conclusion reasonable given the available information on fire risk.

DEK also clarified that while SAMA 151, “Increase training and operating experience feedback to improve operator response,” is stated to need further evaluation in ER Table F-17, it was not specifically evaluated since individual operator actions identified in the importance analysis review (ER Table F-3) and the cutset review (ER Table F-18) were evaluated separately.

As indicated above, a number of Phase 1 SAMAs were combined for the Phase 2 evaluation. In response to an RAI concerning combining SAMAs 170 and 171 (involving safeguards alley cooling) with SAMAs 81, 82 and others (involving diesel building and switchgear room cooling), DEK provided a description of the various rooms and areas referred to as the “safeguards alley” (DEK, 2009a). The safeguards alley consists of a series of interconnected rooms housing both motor drive auxiliary feedwater pumps, the turbine driven auxiliary feedwater pump, both divisions of 480 VAC switchgear, and both divisions of diesel generator/4160 VAC buses. DEK stated that because of the proximity and interconnections between these rooms, the benefits of providing high-temperature alarms and temporary ventilation can most effectively be evaluated by considering all rooms of the safeguards alley together.

As requested in an RAI, DEK reviewed the results of importance analyses of the K107Aa completed after the original SAMA analysis to determine if any additional SAMAs would have been identified based on a review of the updated PRA. One of the modifications made in the PRA model involved adding screenhouse ventilation as a support system for the service water system. The K107Aa-based importance analysis showed that failures in screenhouse ventilation were important. In response, DEK indicated that a SAMA involving implementing temporary screenhouse ventilation and installing additional temperature detectors will be considered further (DEK, 2009a).

The NRC staff questioned DEK about lower cost alternatives to some of the SAMAs evaluated (NRC 2009a, 2009b), including:

- Automating the cross-tie of the existing condensate storage tank (CST) to other water sources rather than installing a new CST,
- Modifying procedures to direct primary system cooldown to further reduce the probability of RCP seal failures,
- Modifying procedures and equipment for using a portable diesel-driven or AC-powered pump to provide feedwater to the steam generators with suction from the intake canal,
- Developing a procedure to cross-connect the chemical and volume control system (CVCS) holdup tanks to the volume control tank (VCT) through the CVCS holdup transfer pump, and
- Procuring and developing a procedure for using a gagging device to close a stuck-open steam generator safety valve on a faulted steam generator before core damage occurs.

In response to the RAIs, DEK addressed the lower cost alternatives and gave specific reasons why they would not impact the results of the SAMA evaluation, including the fact that some of these items are covered by an existing procedure or are addressed by other SAMAs (DEK 2009a, 2009b, 2009c). This is discussed further in Section F.6.2.

Based on this information, the NRC staff concludes that the set of SAMAs evaluated in the ER, together with those identified in response to NRC staff RAIs, addresses the major contributors to internal event CDF.

Although the KPS IPEEE did not identify any vulnerabilities for external events, at the request of the NRC staff, DEK reviewed the results of the IPEEE fire and seismic risk analysis to determine if any KPS-specific external event SAMAs could be identified. This review is summarized below.

The top cutsets resulting from the IPEEE fire PRA were reviewed to identify potential SAMAs that might reduce the KPS fire risk. The fire risk cutsets include failures due to fire itself combined with non-fire related failures. DEK reviewed the non-fire related failures and determined that those in the dominant fire contributors were already addressed by multiple SAMAs identified in the internal events review (DEK, 2009a). To address the fire-induced failures, DEK estimated the total benefit that might result from entirely eliminating the fire risk from each fire risk contributor. This was done for the 7 percent discount rate base case as well as the 3 percent discount rate and the 95 percentile uncertainty sensitivity study cases. Six fire risk contributors were found to have a benefit that exceeded the $100,000 value used to estimate the minimum cost of a modification. DEK reviewed the fire induced failures for each of these six fire risk contributors and concluded that no cost-beneficial improvements in fire detection or mitigation were reasonably available (DEK, 2009b). At the request of the NRC staff, DEK also considered the impact on identification of SAMAs of several weaknesses in the fire PRA identified in the NRC review of the IPEEE submittal (NRC, 1999). Based on consideration of each weakness, DEK concluded that no new SAMAs would be identified as a result of correcting these weaknesses (DEK, 2009a). The NRC staff concludes that the opportunity for fire-related SAMAs has been adequately explored and that it is unlikely that there are additional potentially cost-beneficial, fire-related SAMA candidates.

Based on the IPEEE seismic analysis, six sequences dominate the seismic risk at KPS. Three of these sequences involve major structural failures. DEK estimated that the cost of strengthening structures would exceed any potential benefit associated with reducing seismic risk. One dominant sequence involved failure of the operator to switch AFW pump suction from the CST to the service water system. A sensitivity study performed for the IPEEE showed that reducing the operator error resulted in only a 2 percent reduction in seismic CDF. DEK also noted that internal event SAMA items address improvements to long-term AFW availability, hence no new SAMAs are indicated for this sequence. The two other dominant sequences have a CDF of 1 x 10-6 per year or less and involve the emergency AC and DC power systems. All components in the AC power system have median seismic capacities of 1.86g PGA or more while the components of the DC power system have median seismic capacities of 1.10g PGA or more. Considering these relatively high seismic capacities, the low frequency of the seismic sequences that would challenge these systems, and the expected cost of strengthening the components, DEK identified no new SAMA items for these sequences (DEK, 2009a). At the request of the NRC staff, DEK also considered the impact on identification of SAMAs of the weaknesses in the seismic PRA identified in the NRC review of the IPEEE submittal (NRC, 1999). Based on a discussion of each weakness, DEK concluded that no new SAMAs would be identified as a result of correcting these weaknesses (DEK, 2009a).

The NRC 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 NRC 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 NRC staff concludes that DEK used a systematic and comprehensive process for identifying potential plant improvements for KPS, and that the set of SAMAs evaluated in the ER, together with those evaluated in response to NRC staff inquiries, is reasonably comprehensive and therefore acceptable. This search included reviewing insights from the plant-specific risk studies and reviewing plant improvements considered in previous SAMA analyses. While explicit treatment of external events in the SAMA identification process was limited, it is recognized that the absence of external event vulnerabilities reasonably justifies examining primarily the internal events risk results for this purpose.

F.4. Risk Reduction Potential of Plant Improvements

DEK evaluated the risk-reduction potential of the 64 remaining SAMAs that were applicable to KPS (46 SAMA evaluations after combining similar SAMAs). The SAMA evaluations were performed using generally conservative assumptions. On balance, such calculations overestimate the benefit and are conservative.

For most of the SAMAs, DEK used model re-quantification to determine the potential benefits. The CDF, population dose and offsite economic cost reductions were estimated using the 2007 version of the KPS PRA model (K101AASAMA). The changes made to the model to quantify the impact of the SAMAs are detailed in Section F.6 of Attachment F to the ER. Table F.5-1 lists the assumptions considered to estimate the risk reduction for each of the evaluated 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. The estimated benefits reported in Table F.5-1 reflect the combined benefit in both internal and external events. The determination of the benefits for the various SAMAs is further discussed in Section F.6.

The NRC staff questioned the assumptions used in evaluating the benefits or risk reduction estimates of certain SAMAs provided in the ER (NRC, 2009a). For example, in the ER DEK reported a negative benefit for SAMA 19, provide backup cooling to emergency diesel generators. In response to an RAI, DEK indicated the evaluation of SAMA 19 resulted in an increase in risk because of certain assumptions relative to operator response to the sequence after the modification was made. DEK provided an alternative assessment, incorporating procedure changes as well as hardware changes, which indicated a positive benefit. For SAMA 150, improved maintenance procedures, the NRC staff questioned the applicability of the benefit determined by setting the maintenance unavailability to zero. In response, DEK stated that because no specific procedure improvement was identified by this generic SAMA, the maintenance unavailability for all of the Maintenance Rule (a)(1) equipment was used as a surrogate. DEK stated that this bounds the impact of improving the reliability of individual equipment items. Further, compliance with the Maintenance Rule will require reliability improvement actions be taken for any items failing to meet Maintenance Rule goals. DEK therefore concluded that no action for this SAMA is cost beneficial (DEK, 2009a).

The NRC staff has reviewed DEK'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 NRC staff based its estimates of averted risk for the various SAMAs on DEK's risk reduction estimates.

F.5. Cost Impacts of Candidate Plant Improvements

DEK estimated the costs of implementing the candidate SAMAs through the application of engineering judgment, the use of other licensees' estimates for similar improvements and the use of KPS actual experience 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 contingency costs associated with unforeseen implementation obstacles (DEK, 2008a).

For a simple procedure change, DEK assumed a minimum cost of $50K for preparation, review, approval, training, and implementation. Complex procedure changes or changes involving emergency operating procedures were assumed to cost more. For a simple design change, DEK assumed a minimum cost of $100K for completing and assembling the design change package, performing limited calculations, and minor drawing revisions. Complex design changes were assumed to cost considerably more (DEK, 2008a). The cost estimates for each SAMA are detailed in Section F.6 of the ER.

For a number of SAMAs (SAMAs 19, 26, 55, 56, 58, 59, 71, 81, 111, 112, 124, 125, 150, 178, 179, 180, and 182) the estimated benefit for the 3 percent discount rate case and/or the 95th percentile uncertainty case was found to exceed the initial implementation cost estimate. The implementation costs for these SAMAs were further assessed to more realistically account for additional cost considerations. This is described in ER Sections F.7.1 and F.7.5, and in responses to NRC staff RAIs (DEK 2009a, 2009b).

The NRC staff reviewed the bases for the licensee's cost estimates (presented in Section F.6 of Attachment F to the ER). For certain improvements, the NRC staff also compared the cost estimates 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 NRC staff reviewed the costs and found them to be reasonable and generally consistent with estimates provided in support of other plants' analyses.

The NRC staff concludes that the cost estimates provided by DEK are sufficient and appropriate for use in the SAMA evaluation.

Table F.5-1. Severe Accident Mitigation Alternative Cost/Benefit Screening Analysis for Kewaunee Power Station[(a)]

Case ID - Title	Potential SAMAs evaluated by case	Modeling Assumptions	% Risk Reduction[(b)]		Total Benefit ($)		Cost ($)
			CDF	Population Dose	Baseline (Internal + External)	Baseline With Uncertainty	
SAMA 1 Improved Availability and Reliability of DC Power	1, 3, 5, 6, 74	AC power to safety related battery chargers completely available.	<0.1	<0.1	1.0K	1.9K	50K
SAMA 19 Provide Backup Cooling to emergency diesel generators (EDGs)	19, 20	No service water required for EDGs.	See Note (c)	See Note (c)	(-)23K	(-)41K	50K
		0.1 probability of EDG cooling failure	1.9	1.9	81K	150K	100K(e)
SAMA 21 Develop Procedures to Repair 4kVAC Breakers	21	Failure probability of breakers supplying safety related buses 5 and 6 set to zero.	0.2	0.9	8.6K	16K	50K
SAMA 26 Provide Additional Diesel-Powered Safety Injection Pump	26	Reactor coolant pump (RCP) seals and safety injection pumps would not fail.	41	27	1.7M	3.0M	2M (e)
SAMA 31 Provide for Manual Alignment to emergency core cooling system (ECCS) Recirculation	31	Electric power is not required for the valves needed to switch to ECCS recirculation.	<0.1	0	360	650	50K

Case ID - Title	Potential SAMAs evaluated by case	Modeling Assumptions	% Risk Reduction[b]		Total Benefit ($)		Cost ($)
			CDF	Population Dose	Baseline (Internal + External)	Baseline With Uncertainty	
SAMA 32 Provide Automatic Alignment to ECCS Recirculation	32	HEPs associated with ECCS recirculation set to zero.	1.6	0.3	51K	92K	100K
SAMA 46 Add a Service Water Pump	46	Failure probability of service water pumps set to zero.	18	15	820K	1.5M	2.7M
SAMA 50 Enhance Loss of Cooling Water Procedures	50, 162, 163	Failure probability of the basic event that represents failure of operator action to initiate reactor coolant system (RCS) cool down in response to a loss of seal cooling set to 1.0E-04.	0.37	0.3	15K	28K	50K
SAMA 55 Install Independent RCP Seal Injection System With Dedicated Diesel	55	Failure probability of charging to RCP seals set to zero.	33	19	1.3M	2.3M	2M (e)
SAMA 56 Install Independent RCP Seal Injection System Without Dedicated Diesel	56	Failure probability of charging to RCP seals for all accident scenarios except station blackout set to zero.	29	14	1.0M	1.8M	1.5M (e)
SAMA 58 Install Improved RCP Seals	58	Failure probability of charging to RCP seals set to zero.	33	19	1.3M	2.3M	1.4M (e)

Case ID - Title	Potential SAMAs evaluated by case	Modeling Assumptions	% Risk Reduction[b]		Total Benefit ($)		Cost ($)
			CDF	Population Dose	Baseline (Internal + External)	Baseline With Uncertainty	
SAMA 59 Install an Additional CCW Pump	59	Failure probability of CCW pumps set to zero.	25	14	980K	1.8M	1.4M (e)
SAMA 66 Install a New Feedwater Source [Proceduralize use of existing sources][d]	66	Failure probability for the hardware associated with water sources to the feedwater systems set to zero.	6.7	8.5	380K	690K	50K
SAMA 71 Install A New Condensate Storage Tank	71	Failure probability of events associated with providing a cross-tie of the CSTs to other sources set to zero.	19	18	1.0M	1.8M	1.7M (e)
SAMA 76 Change Failure Position of Condenser Makeup Valve	76, 184	Remove any power dependencies from valve MU-3A.	<0.1	<0.1	4.4K	7.9K	100K
SAMA 80 Add Redundant Ventilation Systems [Stage temporary equipment and provide procedures and power source connections][d]	80	Remove any ventilation system dependencies for equipment located in the auxiliary building from the fault tree models.	12	6.0	510K	910K	250K
SAMA 81 Diesel Room Cooling Improvements[f]	81, 160, 166, 167, 170, 171	Diesel room ventilation was always successful.	4.6	5.1	240K	430K	400K (e)

Case ID - Title	Potential SAMAs evaluated by case	Modeling Assumptions	% Risk Reduction[b]		Total Benefit ($)		Cost ($)
			CDF	Population Dose	Baseline (Internal + External)	Baseline With Uncertainty	
SAMA 82 Switchgear Room Ventilation Response [Stage backup fans in switchgear rooms, add switchgear room high temperature alarm, stage temporary fans and ducts along with power cords for safeguards alley room cooling, provide high temperature alarms for safeguards alley][d]	82, 83, 170, 171	Add an operator action to implement actions for temporary ventilation following any loss of switchgear room ventilation.	8.8	9.4	440K	800K	400K
SAMA 86 Proceduralize Backup Power to Air Compressors	86	Power to air compressors F and G does not fail.	0.2	0.2	11K	19K	50K
SAMA 87 Replace Air Compressors With Self-Cooled Units	87	Remove the service water and plant equipment water dependency of air compressors from the system fault trees.	0.7	0.4	26K	46K	100K
SAMA 111 Improve Prevention and Detection of interfacing systems loss-of-coolant accident (ISLOCA)	111, 113	ISLOCA frequency set to zero.	1.1	3.8	130K	240K	190K (e)

Case ID - Title	Potential SAMAs evaluated by case	Modeling Assumptions	% Risk Reduction(b)		Total Benefit ($)		Cost ($)
			CDF	Population Dose	Baseline (Internal + External)	Baseline With Uncertainty	
SAMA 112 Enhance Containment Isolation Valve Indication	112	ISLOCA frequency set to zero and containment isolation set to success.	1.1	3.4	130K	240K	150K (e)
SAMA 114 Install Self-Actuating Containment Isolation Valves	114	Containment isolation set to success in the Level 2 PRA models.	0	<0.1	1.3K	2.3K	100K
SAMA 118 Improve Training on ISLOCA	118	Failure probability of all human action events associated with ISLOCAs set to 1.0E-04.	<0.1	0.1	4.7K	8.6K	50K
SAMA 122 Improve RCS Depressurization Capability	122	Hardware associated with primary depressurization does not fail.	0.1	<0.1	4.7K	8.4K	100K
SAMA 124 Improve Detection of SGTR	124	Probability of operator failure to detect and diagnose a SGTR is 1.0E-04.	0.1	4.2	130K	240K	150K (e)
SAMA 125 Prevent Release of SGTR From Steam Generators	125, 129	Level 2 PRA model changed so that SGTR events do not lead to containment bypass.	<0.1	64	1.8M	3.2M	2.7M (e)
SAMA 126 Install Closed-Loop Steam Generator Cooling System	126	Hardware associated with cool down and depressurization would not fail following a SGTR.	3.6	2.8	170K	300K	2.7M

Case ID - Title	Potential SAMAs evaluated by case	Modeling Assumptions	% Risk Reduction[b]		Total Benefit ($)		Cost ($)
			CDF	Population Dose	Baseline (Internal + External)	Baseline With Uncertainty	
SAMA 131 Install Additional Primary System Relief Capacity to Mitigate ATWS	131	Initiating event equation for ATWS events set to zero.	3.3	3.5	170K	310K	700K
SAMA 150 Improve Maintenance Procedures	150	Maintenance unavailability for Maintenance Rule (a)(1) equipment set to zero.	1.4	0.6	56K	100K	100K (e)
SAMA 168 Add Capability to Isolate Service Water Without Power	168	Eliminate from the fault tree models the requirement for power to close service water valves SW-10A and SW-10B.	1.2	<0.1	33K	59K	100K
SAMA 169 Provide Flood Protection for MCC-52E, -62E, and -62H	169	Eliminate flood-induced failure of the three MCCs from the fault tree models.	12	4.3	420K	750K	284K
SAMA 172 Provide Additional Alarm for Extremely Low CST Level	172	Failure probability for the associated basic event set to 1.0E-04.	14	13	750K	1.4M	250K
SAMA 173 Protect Auxiliary Building Mezzanine Cooling Units From Spray	173	Remove flood-induced failures of the auxiliary building mezzanine cooling units from the fault tree models.	3.6	2.9	170K	310K	150K
SAMA 174 Protect Boric Acid Transfer Pumps From Spray	174	Remove flood-induced failures of the boric acid transfer pumps from the fault tree models.	3.3	2.5	160K	280K	150K

Case ID - Title	Potential SAMAs evaluated by case	Modeling Assumptions	% Risk Reduction(b)		Total Benefit ($)		Cost ($)
			CDF	Population Dose	Baseline (Internal + External)	Baseline With Uncertainty	
SAMA 175 Protect A-Train CCW Pump From Spray	175	Remove flood-induced failures of the A-train CCW pump from the fault tree models.	4.0	2.9	185K	330K	150K
SAMA 176 Install Larger Sump Pumps In Safeguards Alley	176	Eliminate submergence-induced failures of equipment from the fault tree models.	8.7	6.7	360K	660K	269K
SAMA 177 Install Watertight Barrier Between 480 VAC Switchgear Rooms	177	Remove flood propagation-induced failures of equipment in safeguards alley from the fault tree models for events that initiate on the opposite side of the wall.	9.7	8.7	440K	790K	162K
SAMA 178 Install Flood Detection In Battery Rooms	178	Probability of the basic event that represents operator failure to isolate battery room floods set to zero.	2.0	2.5	110K	200K	150K (e)
SAMA 179 Add Diverse AFW Flow Indication	179	Probability of the AFW flow miscalibration errors set to zero.	3.2	2.6	160K	280K	200K (e)
SAMA 180 Remove AFW Low Lube Oil Pressure Start Interlock	180	Remove the auxiliary lube oil pump failure logic from the fault tree models.	2.5	2.7	130K	240K	150K (e)
SAMA 181 Install Break Away Mechanisms on EDG Room Doors	181	Remove flood-induced failures from the main, reserve, and tertiary auxiliary transformers.	2.7	4.6	180K	330K	100K

Case ID - Title	Potential SAMAs evaluated by case	Modeling Assumptions	% Risk Reduction[b]		Total Benefit ($)		Cost ($)
			CDF	Population Dose	Baseline (Internal + External)	Baseline With Uncertainty	
SAMA 182 Install Flood Relief Path In Screenhouse	182	Remove flood propagation-induced equipment failures from accident sequences that begin with a screenhouse flood.	1.4	1.5	72K	130K	100K (e)
SAMA 183 Install Flood Detection in Control Room heating, ventilation, and air conditioning (HVAC) Room	183	Remove flood propagation-induced equipment failures from accident sequences that begin with a control room HVAC room flood.	<0.1	0.4	17K	30K	100K
SAMA 188 Install Larger Capacity Sump Pumps In Turbine Building	188	HEP associated with isolating turbine building floods and assuming that small flooding events in safeguards alley cannot propagate set to 1.0E-04.	2.8	2.2	120K	210K	269K
SAMA 189 Install Diverse SI Flow Indication	189	Eliminate miscalibration errors from the SI fault tree.	0.4	0.5	23K	45K	100K

[a]SAMAs in bold are potentially cost-beneficial.

[b]Percent risk reduction determined from base case and uncertainty values provided in ER Sections F.6 and F.7.5.

[c]CDF and Population Dose increased for this SAMA due to modeling assumptions. Results of an alternate evaluation provided below based on DEK RAI response (DEK, 2009a).

[d]Description in brackets is more appropriate for understanding the SAMA evaluation.

[e]Costs and/or benefits of these SAMAs were further assessed. Based on further assessment, implementation costs were determined to be higher than the estimated benefits, even for the 95th percentile uncertainty case (ER Section F.7.5, DEK, 2008a, and responses to RAI 6a, 7.b and 7.c in DEK, 2009a and 2009b).

[f]SAMA 81 found to be cost-beneficial if implemented simultaneously with other SAMAs (ER Section 7.7, DEK, 2008a).

F.6. Cost-Benefit Comparison

DEK's cost-benefit analysis and the NRC staff's review are described in the following sections.

F.6.1. Dominion Energy Kewaunee, Inc.'s Evaluation

The methodology used by DEK was based on NEI 05-01, *Severe Accident Mitigation Alternatives (SAMA) Analysis Guidance Document* (NEI, 2005), which in turn is based on NRC's guidance for performing cost-benefit analysis, i.e., NUREG/BR-0184, *Regulatory Analysis Technical Evaluation Handbook* (NRC, 1997a). NEI 05-01 was endorsed by the NRC for use in license renewal applications (NRC, 2007). The guidance involves determining the net value for each SAMA according to the following formula:

Net Value = (APE + AOC + AOE + AOSC) - 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. DEK's derivation of each of the associated costs is summarized below.

NUREG/BR-0058 has recently been revised to reflect the agency's policy on discount rates. Revision 4 of NUREG/BR-0058 states that two sets of estimates should be developed, one at 3 percent and one at 7 percent (NRC, 2004). DEK provided a base set of results using the 7 percent discount rate and a sensitivity study using the 3 percent discount rate (DEK, 2008a).

<u>Averted Public Exposure (APE) Costs</u>

The APE costs were calculated using the following formula:

APE = Annual reduction in public exposure (units of person-rem per year)

x monetary equivalent of unit dose ($2000 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,1997a), the monetary value of the public health risk after discounting does not represent the expected reduction in public health risk caused by 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 caused by 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, which assumes elimination of all severe accidents caused by internal events, DEK calculated an APE of approximately $650,000 for the 20-year license renewal period.

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

This term represents the sum of the frequency-weighted offsite economic costs for each release category, as obtained for the Level 3 risk analysis. For the purposes of initial screening, which assumes elimination of all severe accidents caused by internal events, DEK calculated an annual offsite economic cost of about $49,700 based on the Level 3 risk analysis. This results in a discounted value of approximately $535,000 for the 20-year license renewal period.

Averted Occupational Exposure (AOE) Costs

The AOE costs were calculated using the following formula:

AOE = Annual CDF reduction

x occupational exposure per core damage event

x monetary equivalent of unit dose

x present value conversion factor

DEK derived the values for AOE from information provided in Section 5.7.3 of the regulatory analysis handbook (NRC, 1997a). Best estimate values provided for immediate occupational dose (3,300 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 elimination of all severe accidents caused by internal events, DEK calculated an AOE of approximately $30,800 for the 20-year license renewal period.

Averted Onsite Costs

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. DEK derived the values for AOSC based on information provided in Section 5.7.6 of NUREG/BR-0184, the regulatory analysis handbook (NRC, 1997a).

DEK divided this cost element into two parts—the onsite cleanup and decontamination cost, also commonly referred to as averted cleanup and decontamination costs (ACC), and the replacement power cost (RPC).

ACCs were calculated using the following formula:

ACC = Annual CDF reduction

x present value of cleanup costs per core damage event

x present value conversion factor

The total cost of cleanup and decontamination subsequent to the severe accident is estimated in NUREG/BR-0184 to be \$1.5 x 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 elimination of all severe accidents caused by internal events, DEK calculated an ACC of approximately \$939,000 for the 20-year license renewal period.

Long-term RPCs were calculated using the following formula:

RPC = Annual CDF reduction

x present value of replacement power for a single event

x factor to account for remaining service years for which replacement power is required

x reactor power scaling factor

DEK based its calculations on the rated KPS net electric output of 556 megawatt-electric (MWe) and scaled down from the 910 MWe reference plant in NUREG/BR-0184 (NRC, 1997a). Therefore, DEK applied a power scaling factor of 556/910 to determine the replacement power costs. For the purposes of initial screening, which assumes elimination of all severe accidents caused by internal events, DEK calculated an RPC of approximately \$390,000, and an AOSC of approximately \$1.3M for the 20-year license renewal period.

Using the above equations, DEK estimated the total present dollar value equivalent associated with completely eliminating severe accidents caused by internal events at KPS to be about \$2.54M. Use of a multiplier of two to account for external events increases the value to \$5.09M and represents the dollar value associated with completely eliminating all internal and external event severe accident risk at KPS, also referred to as the Modified Maximum Averted Cost Risk (MMACR).

<u>DEK's Results</u>

If the implementation costs for a candidate SAMA exceeded the calculated benefit, the SAMA was considered not to be cost-beneficial. In the baseline analysis contained in the ER, (using a 7 percent discount rate), DEK identified 14 potentially cost-beneficial SAMAs. The potentially cost-beneficial SAMAs are:

- SAMA 66 – Install a New Feedwater Source (The evaluated SAMA actually involved proceduralizing use of existing water sources)

- SAMA 80 – Add Redundant Ventilation Systems (The evaluated SAMA actually involved staging temporary equipment and providing procedures and power source connections)
- SAMA 82, 83, 170, 171 – Switchgear Room Ventilation Response (The evaluated SAMA actually involved staging backup fans in switchgear rooms, adding switchgear room high-temperature alarm, staging temporary fans and ducts along with power cords for safeguards alley room cooling, and providing high-temperature alarms for the safeguards alley)
- SAMA 169 – Provide Flood Protection for MCC-52E, -62E, and -62H
- SAMA 172 – Provide Additional Alarm for Extremely Low CST Level
- SAMA 173 – Protect Auxiliary Building Mezzanine Cooling Units from Spray
- SAMA 174 – Protect Boric Acid Transfer Pumps from Spray
- SAMA 175 – Protect A-Train CCW Pump from Spray
- SAMA 176 – Install Larger Sump Pumps In Safeguards Alley
- SAMA 177 – Install Watertight Barrier between 480 VAC Switchgear Rooms
- SAMA 181 – Install Break Away Mechanisms on EDG Room Doors

DEK performed additional analyses to evaluate the impact of parameter choices and uncertainties on the results of the SAMA assessment (DEK, 2008a).

Based on an analysis using 3 percent, as recommended in NUREG/BR-0058 (NRC, 2004), DEK determined that four of the Phase 1 SAMAs screened out due to excessive implementation cost (SAMAs 2, 104, 116 and 119) and would have been retained for further analysis. Thirteen of the Phase 2 SAMAs, which had a negative net value at a 7 percent discount rate (SAMAs 19, 26, 55, 56, 58, 59, 111, 112, 124, 178, 179, 180, and 182) would have a potentially positive net value at a 3 percent discount rate. In Section F.7.1 of the ER (and in RAI 6.a responses for SAMA 19), DEK discussed each of these SAMAs and concluded that in each case the cost of implementation would be higher than that utilized in the original cost-benefit analyses and would exceed the benefit using the 3 percent discount rate (DEK 2008a, 2009a, 2009b).

If the benefits are increased by a factor of 1.8 to account for uncertainties, four Phase 1 SAMAs (the same four SAMAs mentioned above) would have been retained for further analysis, and 17 Phase 2 SAMAs (the 13 SAMAs mentioned above plus SAMAs 71, 81, 125, and 150) would become potentially cost-beneficial. In Section F.7.5 of the ER (and in RAI responses for SAMAs 19 and 58), DEK discusses each of these items noting: costs that were not included in the base case assessment, the optimistic nature of some of the estimates and, in some cases, the conservative nature of the benefit calculation. Based on this, DEK concludes that no additional SAMAs would be cost beneficial even at the 95 percentile risk values.

DEK also considered the impact of simultaneous implementation of several of the SAMAs from both a benefit and a cost standpoint. DEK concluded that while the simultaneous implementation of several SAMAs would not increase the total benefit beyond that for each SAMA individually, the implementation cost could be reduced. Based on the evaluation of similar SAMAs involving improvements in room cooling and ventilation, DEK concluded that the following three additional SAMAs involving diesel room cooling improvements would be cost beneficial:

- SAMA 81 – Add a diesel building high temperature alarm or redundant louver and thermostat
- SAMA 166 – Open Doors for Alternate DG Room Cooling
- SAMA 167 – Proceduralize Actions to Open EDG Room Doors on Loss of HVAC and Implement Portable Fans

As discussed above, DEK's review of the results of importance analysis of the K107Aa PRA, prepared subsequent to the SAMA evaluation documented in the ER, indicated one new contributor to risk that could be impacted by a candidate SAMA. DEK concluded that a new SAMA addressing this contributor—loss of screenhouse ventilation—could be cost effectively combined with similar SAMAs 81, 82, 83, 160, 166, 167, 170, and 171.

- Implementation of temporary screenhouse ventilation, including installing additional temperature detectors

DEK committed to further review these SAMAs for implementation as part of DEK's ongoing performance improvement program (DEK 2008a, 2009a).

The potentially cost-beneficial SAMAs and DEK's plans for further evaluation of these SAMAs are discussed in more detail in Section F.6.2.

F.6.2. Review of Dominion Energy Kewaunee, Inc.'s Cost-Benefit Evaluation

The cost-benefit analysis performed by DEK was based primarily on NEI 05-01, *Severe Accident Mitigation Alternatives (SAMA) Analysis Guidance Document* (NEI, 2006), which in turn is based on NRC's guidance for performing cost-benefit analysis, i.e., NUREG/BR-0184, *Regulatory Analysis Technical Evaluation Handbook* (NRC, 1997a). NEI 05-01 was endorsed by the NRC for use in license renewal applications (NRC, 2007). The NRC staff's review indicated that the cost-benefit analysis was implemented in accordance with these guidance documents.

NUREG/BR-0058 has recently been revised to reflect the agency's policy on discount rates. Revision 4 of NUREG/BR-0058 states that two sets of estimates should be developed, one at 3 percent and one at 7 percent (NRC, 2004). DEK provided a base set of results using the 7 percent discount rate and a sensitivity study using the 3 percent discount rate (DEK, 2008a).

SAMAs identified primarily on the basis of the internal events analysis could provide benefits in certain external events, in addition to their benefits in internal events. To account for the additional benefits in external events, DEK multiplied the internal event benefits by a factor of 2. The NRC staff notes that the KPS external events CDF is approximately 60 percent of the internal events CDF from the K101AASAMA PRA (based on a fire CDF of 3.6×10^{-5} per year, a seismic CDF of 1×10^{-5} per year, a negligible HFO contribution, and an internal events CDF of 8.1×10^{-5} per year). Accordingly, the total CDF from internal and external events would be approximately 1.6 times the internal events CDF from the K101AASAMA PRA. Thus, the use a multiplier of 2 is conservative. The NRC staff concludes that the factor of 2 multiplier for external events is reasonable for purposes of the SAMA evaluation.

DEK considered the impact that possible increases in benefits from analysis uncertainties would have on the results of the SAMA assessment. In the ER, DEK presents the results of an uncertainty analysis of the internal events CDF for KPS, which indicates that the 95th percentile value is a factor of 1.8 greater than the mean CDF for KPS. DEK assessed the impact on the SAMA screening, if the estimated benefits were further increased by this uncertainty factor (in addition to the multiplier of 2 for external events).

DEK performed additional sensitivity analyses, including use of a 3 percent discount rate, use of a longer plant life and use of different evacuation assumptions, and considered the impact of unresolved peer review findings and recent plant modifications on the results of the SAMA analysis. These analyses did not identify additional potentially cost-beneficial SAMAs beyond those already identified through the uncertainty analysis.

The NRC staff noted in an RAI that a number of important basic events involved failure of the operator to refill the RWST and requested that DEK consider an automatic refilling system as a potential SAMA (NRC, 2009a). In response, DEK provided a cost benefit analysis, based on a 7 percent discount rate, which showed that this modification would not be cost beneficial (DEK, 2009a). In a request for clarification of the RAI response (NRC, 2009b), the NRC staff pointed out that based on DEK's analysis, the automatic refilling system would be cost-beneficial at a 3 percent discount rate or when considering uncertainties in CDF. In response to the request for clarification, DEK agreed that using the original cost estimate of $850,000 for an automatic refilling system, the enhancement would be cost beneficial for these sensitivity cases. However, they indicated that this cost estimate was a conservatively low screening estimate. DEK provided an updated cost estimate of approximately $1.5 million, based on a more refined analysis similar to that for a CST refill system (discussed later). Since this is more than the benefit using a 3 percent discount rate ($972,000) or when accounting for uncertainty ($1.1 million), DEK concluded that this enhancement would not be cost-beneficial (DEK, 2009b).

A similar situation was observed for SAMA 19. As noted previously, DEK's evaluation of SAMA 19, provide backup cooling to emergency diesel generators, resulted in an increase in CDF. In response to an RAI, DEK provided a cost benefit analysis that indicated that the SAMA was not cost beneficial. The analysis in this initial response was performed for a 7 percent discount rate. In a request for clarification of the RAI response (NRC, 2009b), the NRC staff pointed out that based on DEK's analysis, the SAMA would be cost-beneficial at a 3 percent discount rate or when considering uncertainties in CDF. In response to the request for clarification, DEK agreed that using the original cost estimate of $100,000, this SAMA would be cost beneficial for these sensitivity cases. However, they indicated that this cost estimate was a conservatively low screening estimate. DEK provided an updated cost estimate of at least $150,000, which accounted for additional hardware costs associated with the modification. Since this is more than the benefit using a 3 percent discount rate ($125,000) or when accounting for uncertainty ($146,000), DEK concluded that this enhancement would not be cost beneficial (DEK, 2009b).

The NRC staff noted that for certain SAMAs considered in the ER, there may be alternatives that could achieve much of the risk reduction at a lower cost. The NRC staff asked the licensee to evaluate several lower cost alternatives to the SAMAs considered in the ER, including

SAMAs that had been found to be potentially cost-beneficial at other PWR plants. These alternatives were: (1) automating the cross-tie of the existing CST to other water sources rather than installing a new CST, (2) modifying procedures to direct primary system cool-down to further reduce the probability of RCP seal failures, (3) modifying procedures and equipment for using a portable diesel-driven or AC-powered pump to provide feedwater to the steam generators with suction from the intake canal, (4) developing a procedure to cross-connect the CVCS holdup tanks to the VCT through the CVCS holdup transfer pump, and (5) procuring and developing a procedure for using a gagging device to close a stuck-open steam generator safety valve on a faulted steam generator before core damage occurs. The latter had been found potentially cost-beneficial in two previous SAMA evaluations (Entergy, 2008; FENOC, 2007) and might be cost beneficial at KPS as a SGTR where failure to isolate contributes 64 percent of the population dose at KPS (See Table F.2-2). DEK provided a further evaluation of these alternatives, as summarized below:

- Automate the CST Cross-Tie. The cost benefit of automating the CST cross-tie was evaluated by setting the operator failure to perform the cross-tie to zero. This produced an 18 percent reduction in CDF and a 17 percent reduction in person-rem, yielding a benefit of $912,000 (based on a 7 percent discount rate, and including the factor of 2 multiplier for external events). The cost of this enhancement was estimated to be approximately $1.5 million. Based on this assessment, the enhancement would not be cost beneficial. In a request for clarification of RAI responses, DEK addressed the impact of assuming a 3 percent discount rate or accounting for uncertainty. A revised analysis using a 3 percent discount rate and the K101AASAMA PRA model yielded a total benefit of about $1.4 million, which is less than the cost of the enhancement. To address the impact of uncertainty, DEK recalculated the base case and SAMA assessment case using the more recent K107AaILRT PRA model. Use of this PRA model and a more realistic (less conservative) assumption concerning the SAMA benefits (both operator failure and electrical bus failure required to fail the CST cross-tie rather than setting operator error to zero) resulted in only an 8 percent reduction in CDF and a $333,000 benefit. Based on this alternative evaluation, DEK concluded that this enhancement would not be cost-beneficial even for the 95th percentile uncertainty case (DEK Electric Kewaunee, 2009b).

- Modify Procedures to Reduce RCP Seal Failures. Modifying procedures to direct primary system cooldown was evaluated in SAMAs 50, 162 and 163 and found by DEK to not be cost beneficial.

- Modify Procedures to Use a Portable Pump to Provide Feedwater to Steam Generators. DEK described the procedures followed and actions taken by the operators following a reactor trip. These include determining status of AFW flow, attempting to restore AFW flow, if not available, or restoring main feedwater. If this is not possible, procedures include depressurizing the steam generators to establish condensate flow or initiating feed and bleed cooling. The time available and steps necessary to establish flow to a steam generator from a portable pump were also described. Based on the required actions and time available, DEK concluded that, unless significant plant impairments exist, it would be best for the operators to focus on restoration of cooling using permanently installed equipment. Modifying procedures to use a portable pump for steam generator makeup would provide a negligible risk reduction and would not be cost-beneficial.

- Modify Procedures to Provide Makeup to the Volume Control Tank. DEK discussed the potential use of the CVCS holdup tanks to provide makeup to the VCT and thereby provide a continued source of water for injection to the RCP seals and the RCS. DEK noted that makeup to the VCT is normally from the letdown flow. If this is interrupted, then flow is provided automatically from the RWST. If this fails, RCP seal integrity will be maintained as long as component cooling water to the seals continues. If this is lost, seals will fail if injection is not restored within 13 minutes. DEK indicated that provision of flow from the CVCS holdup tanks to the VCT in 13 minutes is not considered practical. While flow from the CVCS after a seal loss of coolant accident (LOCA) would provide RCS makeup, it would not remove decay heat nor prevent core damage. Based on the above, DEK concluded that this proposed enhancement would not offer significant risk reduction benefits and would not be cost-beneficial.

- Provide a Gagging Device to Close a Stuck-Open Steam Generator Safety Valve. DEK discussed and evaluated the conditions under which a gagging device could be used to close a stuck-open steam generator safety valve, and the resulting benefit associated with it. As outlined in the DEK response, two circumstances contribute to the release of radioactivity following an SGTR event with a stuck-open safety valve. The first is an induced-SGTR, which occurs after core damage when hot gases and high RCS pressure cause a steam generator tube to fail, with subsequent safety valve opening and failure to re-close. The second circumstance is a spontaneous SGTR, in which a tube rupture is the initiating event and high pressure from the reactor coolant system causes the steam generator pressure to rise. If the operators fail to cool down and depressurize soon enough in this latter event, the secondary water level would increase along with pressure causing a safety valve to open and pass liquid. There would then be a significant chance that, when the pressure is reduced, the safety valve would fail to re-close.

For the induced-SGTR events (which account for approximately 80 percent of the total SGTR-related release frequency), the radiation levels in the vicinity of the valve is expected to be too high to permit operators to install and utilize the gagging device. Thus, the gagging device would not provide benefits in induced-SGTR events. With regard to SGTR-initiated events, the gagging device would only provide benefits for a limited subset of events, specifically, events in which the operators follow the emergency operating procedures (EOPs), but fail to cool down and depressurize in time to prevent overfilling the steam generator. (If operators were not following the EOPs, then secondary pressure would keep rising and the gagging device could not be used.) Given that operators follow the EOPs but fail to prevent overfilling the steam generator, the EOPs direct the operators to continue to cool down and depressurize the RCS to cold shutdown conditions and to establish heat removal using the residual heat removal (RHR) system. If this is successful, core damage is prevented. If a gagging device is used to re-close the stuck open safety valve, achieving cold shutdown and use of the RHR is not needed as heat can be removed via the intact (or faulted) steam generator without loss of reactor coolant inventory. Thus, the risk associated with failure to achieve cold shutdown and use RHR would be eliminated by the gagging device.

To determine the benefit associated with the use of a gagging device, DEK revised the SAMA base case model to eliminate the operator execution error and the hardware failures associated with establishing RHR cooling following a SGTR with stuck-open safety valve. The result was a 0.4 percent reduction in CDF (from 8.089×10^{-5} per year to 8.060×10^{-5} per year) and a 1.1 percent reduction in offsite person-rem per year (from 30.19 person-rem per year to 29.86 person-rem per year). The total averted cost is about $19,000 at a 7 percent discount rate, and $35,000 accounting for uncertainty. Based on an estimated cost of procuring a gagging device and preparing procedures for its use of $50,000, DEK concluded that this potential enhancement would not be cost-beneficial (DEK, 2009c). The NRC staff notes that this benefit estimate does not include doubling to account for external events, but that this is considered appropriate because SGTR events would not generally occur as a direct result of an external event and this SAMA would not have any associated benefit for these events.

The NRC staff concurs with DEK's conclusions regarding these alternative SAMAs because the NRC staff finds the additional information provided by DEK for the aforementioned alternative SAMAs to be technically sound.

In the discussion of the conclusions of the cost-benefit analysis, DEK identified the individual SAMAs that address improving the availability of HVAC. The SAMAs identified were those found to be cost-beneficial in the baseline analysis (SAMAs 80, 82, 83, 170, and 171), plus those found to be cost-beneficial due to synergies, if the SAMAs were implemented concurrently (SAMAs 81, 160, 166 and 167). In response to an RAI, DEK noted that the latter four SAMAs would be included within the set of SAMAs that they intend to review further for possible implementation as part of DEK's ongoing performance improvement program (DEK, 2009a). In a request for clarification, the NRC staff noted that SAMA 160, Insulate EDG Exhaust Ducts, was not included in the evaluation of simultaneous implementation in Section 7.7 of the ER. In response, DEK agreed that SAMA 160 should not have been included as a SAMA to be considered further, since it does not have any implementation synergisms with the HVAC SAMAs and there would be no noticeable risk reduction if implemented alone. DEK, however, indicated SAMA 160 will be considered further when risk reduction strategies are evaluated in the future (DEK, 2009b).

The NRC staff concludes that, with the exception of the potentially cost-beneficial SAMAs discussed above, the costs of the SAMAs evaluated would be higher than the associated benefits.

F.7. Conclusions

DEK compiled a list of 189 SAMAs based on a review of the most significant basic events from the current (at the time of the ER preparation) plant-specific PRA, insights from the plant-specific IPE and IPEEE, Phase 2 SAMAs from license renewal applications for other plants, and review of other industry documentation. An initial screening removed SAMA candidates that (1) are not applicable at KPS due to design differences, (2) have been effectively implemented at KPS, (3) have estimated costs that would exceed the dollar value associated with completely eliminating all severe accident risk at KPS, or (4) have a very low benefit because they are associated with a non-risk-significant system. Based on this screening, 125 SAMAs were eliminated, leaving 64 candidate SAMAs for evaluation.

For the remaining 64 SAMA candidates, a more detailed evaluation was performed as shown in Table F.5-1. The cost-benefit analyses in the ER showed that 14 SAMA candidates were potentially cost-beneficial in the baseline analysis (SAMAs 66, 80, 82, 83, 169, 170, 171, 172, 173, 174, 175, 176, 177, and 181). DEK performed additional analyses to evaluate the impact of parameter choices and uncertainties on the results of the SAMA assessment. As a result, no additional SAMAs were identified as potentially cost-beneficial. In response to an NRC request, DEK reviewed the most recent KPS PRA, prepared subsequent to the SAMA evaluation documented in the ER, and identified one additional potentially cost-beneficial enhancement involving implementing temporary screenhouse ventilation and installing additional temperature detectors. DEK also considered the cost savings associated with simultaneous SAMA implementation and concluded that three additional SAMAs (SAMAs 81, 166 and 167) would be potentially cost-beneficial if implemented together with SAMAs 82, 83, 160, 170, and 171 (all but SAMA 160 were found to be potentially cost-beneficial in the baseline analysis). Although not cost-beneficial, SAMA 160 will also be considered during the evaluation of risk reduction strategies. DEK has indicated that all these potentially cost-beneficial SAMAs will be considered for implementation at KPS as part of the ongoing performance improvement program.

The NRC staff reviewed the DEK analysis and concludes that the methods used and the implementation of those methods were sound. The treatment of SAMA benefits and costs support the general conclusion that the SAMA evaluations performed by DEK are reasonable and sufficient for the license renewal submittal. Although the treatment of SAMAs for external events was somewhat limited, the likelihood of there being cost-beneficial enhancements in this area was minimized by improvements that have been realized as a result of the IPEEE process, and inclusion of a multiplier to account for external events.

The NRC staff concurs with DEK's identification of areas in which risk can be further reduced in a cost-beneficial manner through the implementation of the identified, potentially cost-beneficial SAMAs. Given the potential for cost-beneficial risk reduction, the NRC staff agrees that further evaluation of these SAMAs by DEK 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 Title 10 of the *Code of Federal Regulations*, Part 54.

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11. ABSTRACT *(200 words or less)*

This draft supplemental environmental impact statement (SEIS) has been prepared in response to an application submitted by Dominion Energy Kewaunee, Inc. (DEK) to renew the operating license for Kewaunee Power Station (KPS) for an additional 20 years. This draft SEIS includes the preliminary analysis that evaluates the environmental impacts of the proposed action and alternatives to the proposed action. It also includes the NRC's recommendation regarding the proposed action.

The NRC's preliminary recommendation is that the adverse environmental impacts of license renewal for KPS are not so great that preserving the option of license renewal for energy-planning decision makers would be unreasonable. The recommendation is based on (1) the analysis and findings in the GEIS; (2) information submitted in DEK's Environmental Report; (3) consultation with other Federal, State, and local agencies; (4) a review of other pertinent studies and reports; and (5) a consideration of public comments received during the scoping process.

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