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

NUREG-1437
Supplement 52
Volume 1

Generic Environmental Impact Statement for License Renewal of Nuclear Plants

Supplement 52

Regarding Davis-Besse Nuclear Power Station

Final Report

Chapters 1 to 12

Office of Nuclear Reactor Regulation

AVAILABILITY OF REFERENCE MATERIALS IN NRC PUBLICATIONS

NRC Reference Material

As of November 1999, you may electronically access NUREG-series publications and other NRC records at NRC's Public Electronic Reading Room at http://www.nrc.gov/reading-rm.html. Publicly released records include, to name a few, NUREG-series publications; *Federal Register* notices; applicant, licensee, and vendor documents and correspondence; NRC correspondence and internal memoranda; bulletins and information notices; inspection and investigative reports; licensee event reports; and Commission papers and their attachments.

NRC publications in the NUREG series, NRC regulations, and Title 10, "Energy," in the *Code of Federal Regulations* may also be purchased from one of these two sources.

1. The Superintendent of Documents
   U.S. Government Printing Office
   Mail Stop SSOP
   Washington, DC 20402–0001
   Internet: bookstore.gpo.gov
   Telephone: 202-512-1800
   Fax: 202-512-2250
2. The National Technical Information Service
   Springfield, VA 22161–0002
   www.ntis.gov
   1–800–553–6847 or, locally, 703–605–6000

A single copy of each NRC draft report for comment is available free, to the extent of supply, upon written request as follows:
Address: U.S. Nuclear Regulatory Commission
Office of Administration
Publications Branch
Washington, DC 20555-0001
E-mail: DISTRIBUTION.RESOURCE@NRC.GOV
Facsimile: 301–415–2289

Some publications in the NUREG series that are posted at NRC's Web site address http://www.nrc.gov/reading-rm/doc-collections/nuregs are updated periodically and may differ from the last printed version. Although references to material found on a Web site bear the date the material was accessed, the material available on the date cited may subsequently be removed from the site.

Non-NRC Reference Material

Documents available from public and special technical libraries include all open literature items, such as books, journal articles, transactions, *Federal Register* notices, Federal and State legislation, and congressional reports. Such documents as theses, dissertations, foreign reports and translations, and non-NRC conference proceedings may be purchased from their sponsoring organization.

Copies of industry codes and standards used in a substantive manner in the NRC regulatory process are maintained at—
The NRC Technical Library
Two White Flint North
11545 Rockville Pike
Rockville, MD 20852–2738

These standards are available in the library for reference use by the public. Codes and standards are usually copyrighted and may be purchased from the originating organization or, if they are American National Standards, from—
American National Standards Institute
11 West 42nd Street
New York, NY 10036–8002
www.ansi.org
212–642–4900

Legally binding regulatory requirements are stated only in laws; NRC regulations; licenses, including technical specifications; or orders, not in NUREG-series publications. The views expressed in contractor-prepared publications in this series are not necessarily those of the NRC.

The NUREG series comprises (1) technical and administrative reports and books prepared by the staff (NUREG–XXXX) or agency contractors (NUREG/CR–XXXX), (2) proceedings of conferences (NUREG/CP–XXXX), (3) reports resulting from international agreements (NUREG/IA–XXXX), (4) brochures (NUREG/BR–XXXX), and (5) compilations of legal decisions and orders of the Commission and Atomic and Safety Licensing Boards and of Directors' decisions under Section 2.206 of NRC's regulations (NUREG–0750).

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

NUREG-1437
Supplement 52
Volume 1

Generic Environmental Impact Statement for License Renewal of Nuclear Plants

Supplement 52

Regarding Davis-Besse Nuclear Power Station

Final Report

Chapters 1 to 12

Manuscript Completed: March 2015
Date Published: April 2015

Office of Nuclear Reactor Regulation

COVER SHEET

Responsible Agency: U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation. There are no cooperating agencies involved in the preparation of this document.

Title: Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Supplement 52, Regarding Davis-Besse Nuclear Power Station, Unit 1, Final Report, (NUREG-1437).

Davis-Besse Nuclear Power Station, Unit 1, is located in Carroll Township, Ottawa County, Ohio.

For additional information or copies of this document contact:

Division of License Renewal
U.S. Nuclear Regulatory Commission
Office of Nuclear Reactor Regulation
Mail Stop O-11F1
11555 Rockville Pike
Rockville, Maryland 20852
Phone: 1-800-368-5642, extension 8517
Email: elaine.keegan@nrc.gov

ABSTRACT

This supplemental environmental impact statement (SEIS) has been prepared in response to an application submitted by FirstEnergy Nuclear Operating Company (FENOC) to renew the operating license for Davis-Besse Nuclear Power Station, Unit No. 1, (Davis-Besse) for an additional 20 years.

This SEIS includes the analysis that evaluates the environmental impacts of the proposed action and alternatives to the proposed action. Alternatives considered include replacement power from a new, natural-gas-fired combined-cycle (NGCC) power plant; combination alternative of NGCC, solar, wind, and compressed air energy storage; a coal-fired power plant; and not renewing the license (the no-action alternative).

The U.S. Nuclear Regulatory Commission's (NRC's) recommendation is that the adverse environmental impacts of license renewal for Davis-Besse are not great enough to deny the option of license renewal for energy-planning decisionmakers. This recommendation is based on the following:

- analysis and findings in the generic environmental impact statement,
- the Environmental Report submitted by FENOC,
- consultation with Federal, state, Tribal, and local agencies,
- NRC staff's own independent review,
- NRC staff's consideration of public comments received during the scoping process, and
- NRC staff's consideration of public comments received during the draft SEIS comment period.

TABLE OF CONTENTS

FIGURES

TABLES

EXECUTIVE SUMMARY

BACKGROUND

By letter dated August 27, 2010, FirstEnergy Nuclear Operating Company (FENOC) submitted an application to the U.S. Nuclear Regulatory Commission (NRC) to issue a renewed operating license for Davis-Besse Nuclear Power Station, Unit No. 1, (Davis-Besse), for an additional 20-year period.

Pursuant to Title 10, Part 51.20(b)(2) of the *Code of Federal Regulations* (10 CFR 51.20(b)(2)), the renewal of a 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 NRC shall prepare an EIS, which is a supplement to the NRC's NUREG-1437, "Generic Environmental Impact Statement (GEIS) for License Renewal of Nuclear Plants."

The GEIS was originally published in 1996, and amended in 1999. Subsequently, on June 20, 2013, the NRC published a final rule (78 FR 37282) revising 10 CFR Part 51, "Environmental protection regulations for domestic licensing and related regulatory functions." The final rule updates the potential environmental impacts associated with the renewal of an operating license for a nuclear power reactor for an additional 20 years. A revised GEIS, which updates the 1996 GEIS, provides the technical basis for the final rule. The revised GEIS specifically supports the revised list of National Environmental Policy Act (NEPA) issues and associated environmental impact findings for license renewal contained in Table B–1 in Appendix B to Subpart A of the revised 10 CFR Part 51. The 2013 rule revised the previous rule to consolidate similar Category 1 and 2 issues, change some Category 2 issues into Category 1 issues, consolidate some of those issues with existing Category 1 issues, and adds new Category 1 and 2 issues.

The final rule became effective July 22, 2013, after publication in the Federal Register. Compliance by license renewal applicants is not required until June 20, 2014, (i.e., license renewal applications submitted later than 1 year after publication must be compliant with the new rule). Nevertheless, under NEPA, the NRC must now consider and analyze, in its license renewal Supplemental Environmental Impact Statement (SEIS), the potential significant impacts described by the final rule's new Category 2 issues, and to the extent there is any new and significant information, the potential significant impacts described by the final rule's new Category 1 issues.

In addition, on September 19, 2014, the NRC published a revised rule at 10 CFR 51.23 (Continued Storage Rule) and associated generic environmental impact statement for continued storage of spent nuclear fuel. The NRC staff has also separately addressed in this SEIS, under the uranium fuel cycle, the impacts from the Continued Storage Rule.

Upon acceptance of FENOC's application, the NRC staff began the environmental review process described in 10 CFR Part 51 by publishing a Notice of Intent, in the Federal Register, to prepare a supplemental environmental impact statement (SEIS) and conduct scoping. In preparation of this SEIS for Davis-Besse, the NRC staff performed the following:

- conducted public scoping meetings on November 4, 2010, in Port Clinton, Ohio;
- conducted a site audit at the plant in March 8–10, 2011;
- reviewed FENOC's Environmental Report (ER) and compared it to the GEIS;

- consulted with Federal, state, and local agencies;
- conducted a review of the issues following the guidance set forth in NUREG-1555, "Standard Review Plans for Environmental Reviews for Nuclear Power Plants, Supplement 1: Operating License Renewal";
- considered public comments received during the scoping process;
- issued the draft SEIS for comment;
- conducted public meetings to receive comments on the draft SEIS on March 25, 2014; and
- considered the public comments received during the draft SEIS comment period.

PROPOSED ACTION

FENOC initiated the proposed Federal action—issuing a renewed power reactor operating license—by submitting an application for the license renewal of Davis-Besse, for which the existing license (NPF-003) will expire on April 22, 2017. The NRC's Federal action is the decision whether or not to renew the license for an additional 20 years (April 22, 2037).

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 the current nuclear power plant operating license to meet future system generating needs. Such needs may be determined by other energy-planning decisionmakers, such as state, utility, and, where authorized, Federal (other than NRC). This definition of purpose and need reflects the NRC's recognition that, unless there are findings in the safety review required by the Atomic Energy Act (AEA) or findings in the National Environmental Policy Act (NEPA) environmental analysis that would lead the NRC to reject a license renewal application (LRA), the NRC does not have a role in the energy-planning decisions of whether a particular nuclear power plant should continue to operate.

If the renewed license is issued, the appropriate energy-planning decisionmakers, along with FENOC, will ultimately decide if the plant will continue to operate based on factors such as the need for power. 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—April 22, 2017.

ENVIRONMENTAL IMPACTS OF LICENSE RENEWAL

The SEIS evaluates the potential environmental impacts of the proposed action. The environmental impacts from the proposed action are designated as SMALL, MODERATE, or LARGE. As set forth in the GEIS, Category 1 issues are those that meet all of the following criteria:

- The environmental impacts associated with the issue are 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.
- 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.
- Mitigation of adverse impacts associated with the issue is 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.

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

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

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

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

FENOC submitted its ER under NRC's 1996 rule governing license renewal environmental reviews (61 FR 28467, June 5, 1996, as amended), as codified in NRC's environmental protection regulation, 10 CFR 51. The 1996 GEIS and Addendum 1 to the GEIS provided the technical basis for the list of NEPA issues and associated environmental impact findings for license renewal contained in Table B–1 in Appendix B to 40 Subpart A of 10 CFR Part 51. For Davis-Besse, the NRC staff initiated its environmental review in accordance with the 1996 rule and GEIS and documented its findings in Chapter 4 of this SEIS.

Under NEPA, the NRC must now consider and analyze in this SEIS the potential significant impacts described by the 2013 rule's new Category 2 issues, and to the extent there is any new and significant information, the potential significant impacts described by the 2013 rule's new Category 1 issues.

The new Category 1 issues include geology and soils, exposure of terrestrial organisms to radionuclides, exposure of aquatic organisms to radionuclides, human health impact from chemicals, and physical occupational hazards. Radionuclides released to groundwater, effects on terrestrial resources (non-cooling system impacts), minority and low-income populations (i.e., environmental justice), and cumulative impacts were added as new Category 2 issues. These issues are described in Chapter 4 of this SEIS.

The NRC staff did not identify any new issues applicable to Davis-Besse that have a significant environmental impact. The NRC staff, therefore, relies upon the conclusions of the 1996 and 2013 GEIS for all Category 1 issues applicable to Davis-Besse.

Table ES–1 summarizes the Category 2 issues applicable to Davis-Besse, as well as the NRC staff's findings related to those issues. If the NRC staff determined that there were no Category 2 issues applicable for a particular resource area, the findings of the GEIS, as documented in Appendix B to Subpart A of 10 CFR Part 51, stand. Hereafter in this SEIS, general references to the GEIS, without stipulation, are inclusive of the 1996 GEIS. Information and findings specific to the June 2013, final rule and GEIS, are identified as such.

Table ES–1. Summary of NRC Conclusions Relating to Site-Specific Impact of License Renewal

Resource Area	Relevant Category 2 Issues	Impacts
Land use	NONE	SMALL
Air quality	NONE	SMALL
Geology and soils	NONE[a]	SMALL
Surface water resources	NONE	SMALL
Groundwater resources	Radionuclides released to groundwater [a]	SMALL
Aquatic resources	NONE	SMALL
Terrestrial resources	Effects on terrestrial resources (non-cooling system impacts) [a]	SMALL
Protected species	Threatened or endangered species	No effect/ may affect, but is not likely to adversely affect [b]
Human health	Electromagnetic fields-acute effects (electric shock)	SMALL
Socioeconomics	Housing Impacts Public services (public utilities) Offsite land use Public services (public transportation) Historic and archaeological resources	SMALL SMALL SMALL SMALL SMALL to MODERATE
Cumulative Impacts	Surface water resources [a]	SMALL to MODERATE
	Aquatic resources [a]	LARGE
	Terrestrial resources [a]	MODERATE
	Human health-microbiological organisms [a]	MODERATE
	All other evaluated resources [a]	SMALL

[a] These issues are new Category 2 issues identified in the 2013 GEIS and Rule (78 FR 37282). U.S. Nuclear Regulatory Commission. "Revisions to Environmental Review for Renewal of Nuclear Power Plant Operating Licenses." June 2013.

[b] For Federally protected species, the 2013 GEIS and rule state that, in complying with the Endangered Species Act (ESA), the NRC will report the effects of continued operations and refurbishment in terms of its ESA findings, which varies by species for Davis-Besse.

Source: Table B–1 in Appendix B, Subpart A, to 10 CFR Part 51 (NRC 1996, 61 FR 28467), unless otherwise specified

With respect to environmental justice, the NRC staff determined that there would be no disproportionately high and adverse impacts to these populations from the continued operation of Davis-Besse during the license renewal period. Additionally, the NRC staff determined that 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 water, local food, fish, and wildlife.

SEVERE ACCIDENT MITIGATION ALTERNATIVES

Since FENOC had not previously considered alternatives to reduce the likelihood or potential consequences of a variety of highly uncommon, but potentially serious, accidents at Davis-Besse, NRC regulation 10 CFR 51.53(c)(3)(ii)(L) requires that FENOC evaluate severe accident mitigation alternatives (SAMAs) in the course of the 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.

The NRC staff reviewed the ER's evaluation of potential SAMAs. Based on the staff's review, the NRC staff concluded 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

The NRC staff considered the environmental impacts associated with alternatives to license renewal. These alternatives include other methods of power generation and not renewing the Davis-Besse operating license (the no-action alternative). Replacement power options considered were as follows:

- natural-gas-fired combined-cycle (NGCC),
- combination alternative (wind, solar, NGCC, and compressed air energy storage), and
- coal-fired power.

The NRC staff initially considered a number of additional alternatives for analysis as alternatives to license renewal of Davis-Besse; however, these were later dismissed due to technical, resource availability, or commercial limitations that currently exist and that the NRC staff believes are likely to continue to exist when the existing Davis-Besse license expires in 2017. The no-action alternative by the NRC staff, and the effects it would have, were also considered.

Where possible, the NRC staff evaluated potential environmental impacts for these alternatives located both at the Davis-Besse site and at some other unspecified alternate location. Alternatives considered but dismissed were as follows:

- wind power,
- wind power with compressed air energy storage,
- solar power,
- solar power with compressed air energy storage,
- wood waste,
- conventional hydroelectric power,
- ocean wave and current energy,

- geothermal power,
- municipal solid waste (MSW),
- biofuels,
- oil-fired power,
- fuel cells,
- energy conservation and energy efficiency, and
- purchased power.

The NRC staff evaluated each alternative using the same impact areas that were used in evaluating impacts from license renewal.

RECOMMENDATION

The NRC's recommendation is that the adverse environmental impacts of license renewal for Davis-Besse are not so great that preserving the option of license renewal for energy-planning decisionmakers would be unreasonable. This recommendation is based on the following:

- analysis and findings in the GEIS;
- ER submitted by FENOC;
- consultation with Federal, State, and local agencies;
- NRC staff's own independent review;
- consideration of public comments received during the scoping process; and
- consideration of public comments received during the draft SEIS comment period.

ABBREVIATIONS AND ACRONYMS

µCi/g	microcurie(s) per gram
AADT	annual average daily traffic
AEC	Atomic Energy Commission
ALARA	as low as is reasonably achievable
AQCR	Air Quality Control Region
BSBO	Black Swamp Bird Observatory
Btu	British thermal unit(s)
C	Celsius
CAA	Clean Air Act, as amended through 1990
CDF	core damage frequency
CEQ	Council on Environmental Quality
CET	containment event tree
CFR	*Code of Federal Regulations*
cfs	cubic foot/feet per second
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent(s)
CWA	Clean Water Act
CWS	circulating water system
DAPC	Division of Air Pollution Control
Davis-Besse	Davis-Besse Nuclear Power Station
DAW	dry active waste
DSM	demand-side management
EFH	essential fish habitat
EIA	Energy Information Administration
EPCRA	Emergency Planning and Community Right-to-Know Act of 1986
EPRI	Electric Power Research Institute
ER	Environmental Report
ERM	Environmental Resources Management
ESA	Endangered Species Act
F	Fahrenheit
FBC	fluidized-bed-combustion
FE	FirstEnergy Corporation

FENGenCo	FirstEnergy Nuclear Generation Corp.
FENOC	FirstEnergy Nuclear Operating Company
FERC	Federal Energy Regulatory Commission
FES	final environmental statement
fps	foot/feet per second
ft^3	cubic foot/feet
FWS	U.S. Fish and Wildlife Service
gal	gallon(s)
GEIS	generic environmental impact statement
GHG	greenhouse gas
GLWQA	Great Lakes Water Quality Agreement
gpd	gallon(s) per day
gpm	gallon(s) per minute
GWP	global warming potential
IGCC	integrated gasification combined cycle
IJC	International Joint Commission
IPA	integrated plant assessment
ISFSI	independent spent fuel storage installation
kV	kilovolt(s)
kWh	kilowatt-hour(s)
LaMP	lakewide management plan
LAMP	Lakewide Management Plan
lb	pound(s)
lb/MMBtu	pound(s) per million British thermal units
LOS	level(s) of service
LLRWSF	low-level radioactive waste storage facility
m^3	cubic meter(s)
mA	milliampere(s)
MAAP	Modular Accident Analysis Program
MACCS2	MELCOR Accident Consequence Code System
MBTA	Migratory Bird Treaty Act
MDC	minimum detection concentration
mg/l	milligram(s) per liter
mgd	million gallons per day
MM	million

MMBtu	million British thermal units
MSW	municipal solid waste
MW	megawatt(s)
MWd/MTU	megawatt-day(s) per metric ton uranium
MWe	megawatt(s)-electric
MWh	megawatt-hour(s)
MWt	megawatt(s)-thermal
NAAQS	national ambient air quality standards
NCDC	National Climatic Data Center
NEI	Nuclear Energy Institute
NEPA	National Environmental Policy Act
NESC	National Electrical Safety Code
NGCC	natural gas-fired combined cycle
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NO_x	nitrogen oxide(s)
NO_2	nitrogen dioxide
NPDES	national pollutant discharge elimination system
NRC	Nuclear Regulatory Commission
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NRR	Office of Nuclear Reactor Regulation
O_3	ozone
OAC	Ohio Administrative Code
OCMP	Ohio Coastal Management Program
ODCM	offsite dose calculation manual
ODNR	Ohio Department of Natural Resources
OEPA	Ohio Environmental Protection Agency
OHPO	Ohio Historic Preservation Office
ONWR	Ottawa National Wildlife Refuge
OPSB	Ohio Power Siting Board
Pb	lead
PCBs	polychlorinated biphenyls
PCDD	polychlorinated dibenzo-p-dioxin
PCDF	polychlorinated dibenzofuran

pCi/L	picocurie(s) per liter
PDS	plant damage state
PEIS	programmatic environment impact statement
PM	particulate matter
PM_{10}	particulates with diameters less than 10 microns
$PM_{2.5}$	particulates with diameters less than 2.5 microns
ppb	part(s) per billion
ppm	part(s) per million
ppt	part(s) per thousand
PRA	probabilistic risk assessment
PSD	prevention of significant deterioration
psig	pound(s) per square inch, gauge
PWR	pressurized water reactor
RC	release category
RCRA	Resource Conservation and Recovery Act of 1976, as amended
RCS	reactor coolant system
REC	renewable energy credits
rms	root mean square
ROW	right of way
RPS	renewable portfolio standards
SAMA	severe accident mitigation alternative
scf	standard cubic foot/feet
SEIS	supplemental environmental impact statement
SHPO	State Historic Preservation Officer
SO_2	sulfur dioxide
SO_x	sulfur oxide(s)
S.U.	standard unit(s)
SWS	service water system
TRC	total residual chlorine
TRO	total residual oxidant
USACE	U.S. Army Corps of Engineers
USAR	updated safety analysis report
USCB	U.S. Census Bureau
USDOD	U.S. Department of Defense
USDOE	U.S. Department of Energy

USEPA	U.S. Environmental Protection Agency
USGCRP	U.S. Global Change Research Program
USGS	U.S. Geological Survey
USOSHA	U.S. Occupational Safety and Health Administration
wt%	percent by weight
yr	year

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 renewed nuclear power plant operating license requires the preparation of an environmental impact statement (EIS).

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

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 based on whether 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

FirstEnergy Nuclear Operating Company (FENOC) initiated the proposed Federal action by submitting an application for license renewal of the Davis-Besse Nuclear Power Station, Unit No. 1 (Davis-Besse) for which the existing license, NPF-3, expires April 22, 2017 (FENOC 2010a). NRC's Federal action is the decision whether to renew the license for an additional 20 years. In accordance with 10 CFR 2.109, if a licensee of a nuclear power plant files an application to renew an operating license at least 5 years before the expiration date of that license, the existing license will not be deemed to have expired until the safety and environmental reviews are completed and the NRC has made the final decision to either deny the application or issue a renewed operating license for the 20 additional 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, as such needs may be determined by other energy-planning decisionmakers. This definition of purpose and need reflects the Commission's recognition that, unless there are findings in the safety review required by the Atomic Energy Act or findings in the NEPA environmental analysis that would lead the NRC to reject a license renewal application (LRA), 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 FENOC 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.

1.3 Major Environmental Review Milestones

FENOC submitted an Environmental Report (ER) (FENOC 2010a) as part of its LRA (FENOC 2010) in August 2010. After reviewing the LRA and ER for sufficiency, the NRC staff

published a *Federal Register* Notice of Acceptability and Opportunity for Hearing (75 FR 65528) on October 25, 2010. Then, on October 28, 2010, NRC published another notice in the *Federal Register* (75 FR 66399) on the intent to conduct scoping, thereby beginning the 60-day scoping period.

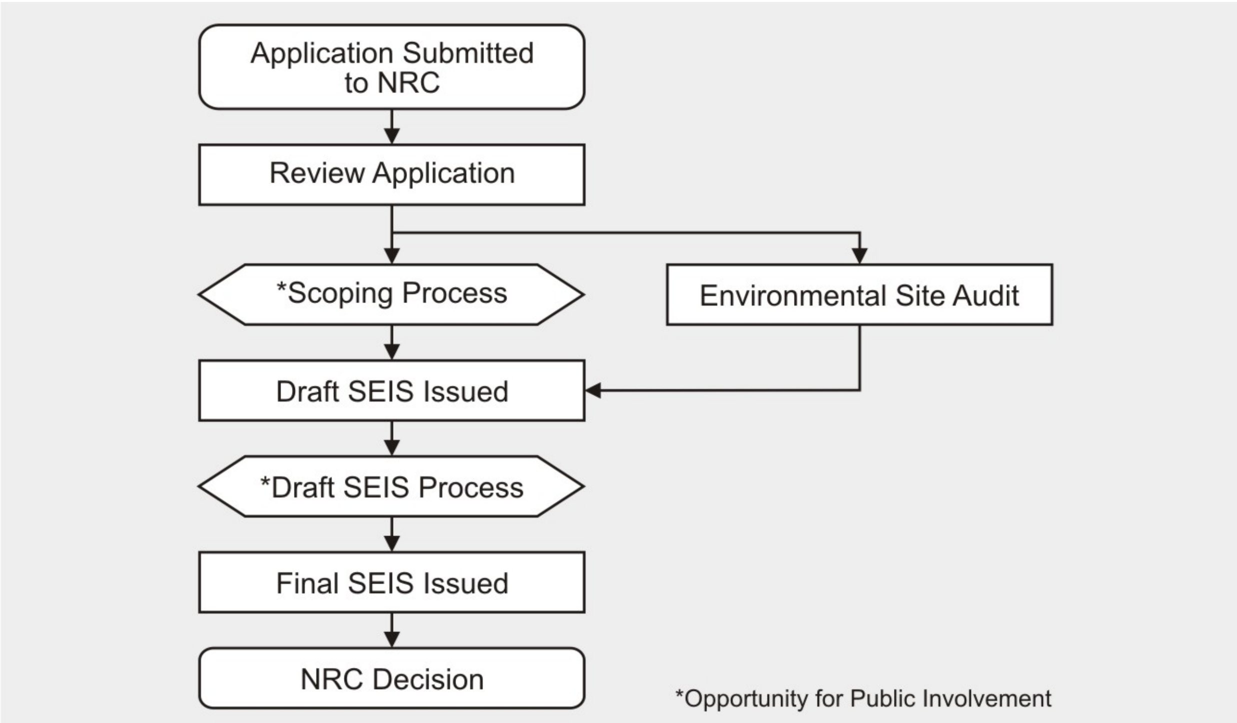
Two public scoping meetings were held on November 4, 2010, in Port Clinton, OH. The comments received during the scoping process are presented in their entirety in the "Environmental Impact Statement Scoping Process, Summary Report, Davis-Besse Nuclear Power Station, Oak Harbor, OH," published in October 2013 (NRC 2013a). The comments considered being within the scope of the environmental license renewal review and the NRC responses are presented in Appendix A of this supplemental environmental impact statement (SEIS).

To independently verify information provided in the ER, NRC staff conducted a site audit at Davis-Besse in March 2011. During the site audit, staff met with plant personnel, reviewed specific documentation, toured the facility, and met with interested Federal, State, and local agencies. A summary of that site audit and the attendees is contained in the "Summary of Site Audit Related to the Review of the License Renewal Application for Davis-Besse Nuclear Power Station, Unit 1," published June 2, 2011 (NRC 2011a).

Upon completion of the scoping period and site audit, the NRC staff compiled its findings in a draft SEIS (Figure 1–1). The draft SEIS was available for public comment for 45 days. During this time, the NRC staff hosted two public meetings on March 25, 2014, in Port Clinton, Ohio, to collect comments from members of the public. Members of the public also submitted written comments. Based on the information gathered, the NRC staff amended the SEIS, as necessary, and then published the final SEIS. The NRC has established a license renewal process that can be completed in a reasonable period of time with clear requirements to assure safe plant operation for up to an additional 20 years of plant life. The safety review, which documents its finding in a safety evaluation report (SER), is conducted concurrently with the environmental review. The findings in the SEIS and the SER are both factors in the Commission's decision to either grant or deny the issuance of a new license.

Figure 1–1. Environmental Review Process

The process provides opportunities for public involvement.



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 review process. *The Generic Environmental Impact Statement for License Renewal of Nuclear Power Plants (GEIS)*, NUREG-1437, (NRC 1996, 1999) 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. The NRC staff analyzed in detail and resolved those environmental issues that could be resolved generically in the GEIS. The GEIS was originally issued in 1996, and Addendum 1 to the GEIS was issued in 1999.

The GEIS established 92 separate issues for NRC staff to independently verify. Of these issues, the staff determined that 69 are generic to all plants (Category 1), and 21 issues do not lend themselves to generic consideration (Category 2). Two other issues remained uncategorized; environmental justice and chronic effects of electromagnetic fields must be evaluated on a site-specific basis. A list of all 92 issues is contained in Appendix B of this SEIS.

On June 20, 2013, the NRC published a final rule (78 FR 37282) revising its environmental protection regulation, Title 10 of the Code of Federal Regulations (10 CFR) Part 51, "Environmental protection regulations for domestic licensing and related regulatory functions." Specifically, the final rule updated the potential environmental impacts associated with the renewal of an operating license for a nuclear power reactor for an additional 20 years. A revised GEIS (NRC 2013b), which updates the 1996 GEIS, provides the technical basis for the final rule. The revised GEIS specifically supports the revised list of NEPA issues and associated environmental impact findings for license renewal contained in Table B–1 in Appendix B to Subpart A of the revised 10 CFR Part 51. The revised GEIS and final rule reflect

lessons learned and knowledge gained during previous license renewal environmental reviews. In addition, public comments received on the draft revised GEIS and rule and during previous license renewal environmental reviews were reexamined to validate existing environmental issues and identify new ones.

The final rule identifies 78 environmental impact issues, of which 17 will require plant-specific analysis. The final rule consolidates similar Category 1 and 2 issues, changes some Category 2 issues into Category 1 issues, and consolidates some of those issues with existing Category 1 issues. The final rule also adds new Category 1 and 2 issues. The new Category 1 issues include geology and soils, exposure of terrestrial organisms to radionuclides, exposure of aquatic organisms to radionuclides, human health impact from chemicals, and physical occupational hazards. Radionuclides released to groundwater, and cumulative impacts were added as new Category 2 issues. Minority and low-income populations (i.e., environmental justice) was recharacterized as a Category 2 issue. “Refurbishment impacts” was expanded in scope and renamed “effects on terrestrial resources (non-cooling system impacts)” and remains a Category 2 issue.

The final rule became effective July 22, 2013, after publication in the *Federal Register*. Compliance by license renewal applicants is not required until 1 year from the date of publication (i.e., license renewal environmental reports submitted later than 1 year after publication must be compliant with the new rule). Nevertheless, under NEPA, the NRC must now consider and analyze, in its license renewal SEISs, the potential significant impacts described by the final rule’s new Category 2 issues and, to the extent there is any new and significant information, the potential significant impacts described by the final rule’s new Category 1 issues.

In addition, on August 26, 2014, the Commission approved a revised rule at 10 CFR 51.23 (Continued Storage Rule) and associated Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel (NUREG-2157, NRC 2014). Subsequently, on September 19, 2014, the NRC published the revised rule (79 FR 56238) in the *Federal Register,* along with NUREG-2157 (79 FR 56263). The NRC staff has addressed the impacts from the Continued Storage Rule in Chapter 6, The Uranium Fuel Cycle, of this SEIS. For each potential environmental issue, the GEIS does the following:

- describes the activity that affects the environment,
- identifies the population or resource that is affected,
- assesses the nature and magnitude of the impact on the affected population or resource,
- characterizes the significance of the effect for both beneficial and adverse effects,
- determines whether the results of the analysis apply to all plants, and
- 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.

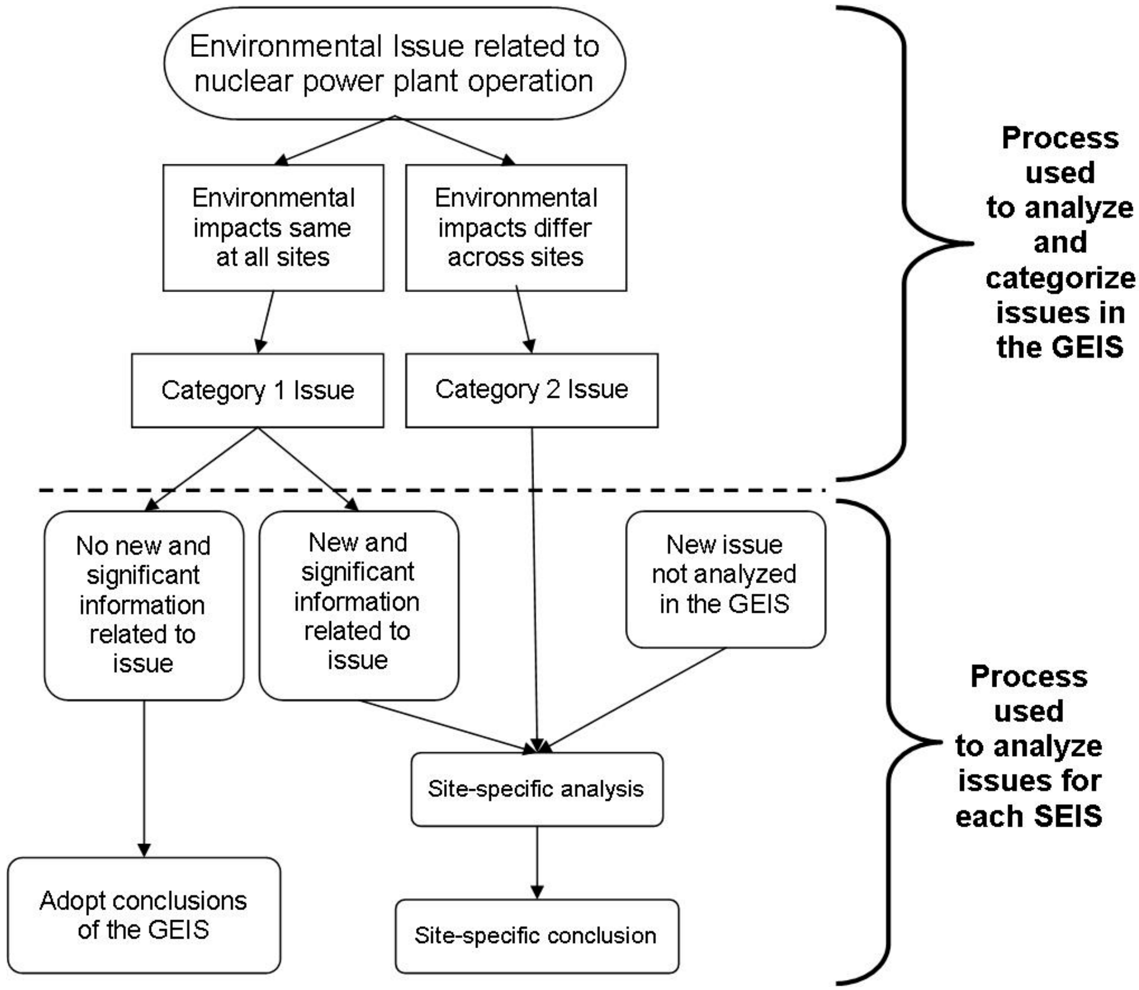
The GEIS includes a determination of whether the analysis of the environmental issue could be applied to all plants and whether additional mitigation measures would be warranted (NRC 1996, 1999). Issues are assigned a Category 1 or a Category 2 designation. As set forth in the GEIS, Category 1 issues are those that meet the following criteria.

- 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.
- 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).
- 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 SEIS 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; 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

Initially, 92 issues were 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 Davis-Besse, alternatives to license renewal, and possible mitigation measures for minimizing adverse environmental impacts. Chapter 8 contains analysis and comparison of the potential environmental impacts from alternatives. Chapter 9 presents the 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 includes consideration of comments received during the public scoping period and on the draft SEIS.

In the preparation of this SEIS for Davis-Besse, the NRC staff did the following:

- reviewed the information provided in the FENOC 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 during the draft SEIS comment period.

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

> **New and significant information** must be both new and bear on the proposed action or its impacts, presenting a seriously different picture of the impacts from those envisioned in the GEIS (i.e., impacts of greater severity than impacts considered in the GEIS, considering their intensity and context).

FENOC submitted its ER under NRC's 1996 rule governing license renewal environmental reviews (61 FR 28467, June 5, 1996, as amended), as codified in NRC's environmental protection regulation, 10 CFR 51. The 1996 GEIS (NRC 1996) and Addendum 1 to the GEIS (NRC 1999) provided the technical basis for the list of NEPA issues and associated environmental impact findings for license renewal contained in Table B–1 in Appendix B to Subpart A of 10 CFR Part 51. For Davis-Besse, the NRC staff initiated its environmental review in accordance with the 1996 rule and GEIS (NRC 1996, 1999) and documented its findings in Chapter 4 of this SEIS.

As described in Section 1.4, the NRC published a final rule (78 FR 37282, June 20, 2013) revising 10 CFR 51 including the list of NEPA issues and findings in Table B–1 of 10 CFR 51. Under NEPA, the NRC must now consider and analyze in this SEIS the potential significant impacts described by the final rule's new Category 2 issues, and to the extent there is any new and significant information, the potential significant impacts described by the final rule's new Category 1 issues. The new Category 1 issues include geology and soils, exposure of terrestrial organisms to radionuclides, exposure of aquatic organisms to radionuclides, human health impact from chemicals, and physical occupational hazards. Radionuclides released to groundwater, effects on terrestrial resources (non-cooling system impacts), minority and low-income populations (i.e., environmental justice), and cumulative impacts were added as new Category 2 issues. These new issues are also analyzed in Chapter 4 of this SEIS. As also described in Section 1.4, the NRC published a revised rule at 10 CFR 51.23 that generically determined the impacts associated with the continued storage of spent nuclear fuel beyond the licensed life for reactor operations. Hereafter in this SEIS, general references to the "GEIS" without stipulation are inclusive of the 1996 GEIS, and 1999 Addendum (NRC 1996, 1999). Information and findings specific to the June 2013 final rule (78 FR 37282) or the June 2013 GEIS (NRC 2013b) or both are appropriately referenced as such.

1.6 Cooperating Agencies

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

1.7 Consultations

The Endangered Species Act of 1973, as amended (ESA 1973); the Magnuson–Stevens Fisheries Management Act of 1996, as amended (MSFMA 1996); and the National Historic Preservation Act of 1966 (NHPA 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.

Listed below are the agencies and groups with whom the NRC consulted.

- Advisory Council on Historic Preservation,
- Ohio Historic Preservation Office,
- U.S. Fish and Wildlife Service,
- National Oceanic and Atmospheric Administration, National Marine Fisheries Service,
- Ohio Department of Natural Resources,
- Delaware Nation,
- Forest County Potawatomi Community,
- Hannahville Indian Community Council,
- Miami Tribe of Oklahoma,
- Shawnee Tribe,
- Wyandotte Nation,
- Peoria Tribe of Indians of Oklahoma, and
- Ottawa Tribe of Oklahoma.

1.8 Correspondence

During the course of the environmental review, the NRC staff contacted Federal, State, regional, local, and Tribal agencies listed in Section 1.7. Appendix E contains a chronological list of all the documents sent and received during the environmental review

A list of persons who received a copy of the draft SEIS is provided in Chapter 12.

1.9 Status of Compliance

FENOC 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 the Appendix H of the GEIS. Appendix C of this SEIS includes a list of the permits and licenses issued by Federal, State, and local authorities for activities at Davis-Besse.

1.10 References

10 CFR Part 51. *Code of Federal Regulations*, Title 10, *Energy*, Part 51, "Environmental protection regulations for domestic licensing and related regulatory functions."

61 FR 28467. U.S. Nuclear Regulatory Commission. "Environmental Review for Renewal of Nuclear Power Plant Operating Licenses." *Federal Register* 61 (109): 28467-28497. June 5, 1996.

75 FR 65528. U.S. Nuclear Regulatory Commission. "Notice of Acceptance for Docketing of the Application, Notice for Opportunity for Hearing for Facility Operating License No. NPF-003 for an Additional 20-year Period: FirstEnergy Nuclear Operating Company, Davis-Besse Nuclear Power Station, Unit 1" *Federal Register*. Volume 75(130): 65528-65531. October 25, 2010.

75 FR 66399. U.S. Nuclear Regulatory Commission. "FirstEnergy Nuclear Operating Company; Notice of Intent to Prepare an Environmental Impact Statement and Conduct the Scoping Process for Davis-Besse Nuclear Power Station, Unit 1," *Federal Register.* Volume 75(208): 66399-66401. October 28, 2010.

78 FR 37282. U.S. Nuclear Regulatory Commission. "Revisions to Environmental Review for Renewal of Nuclear Power Plant Operating Licenses." *Federal Register* 78(119):37282–37324. June 20, 2013.

79 FR 56238. U.S. Nuclear Regulatory Commission. "Continued Storage of Spent Nuclear Fuel." *Federal Register* 79(182): 56238–56263. September 19, 2014.

79 FR 56263. U.S. Nuclear Regulatory Commission. "Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel." *Federal Register* 79(182):56263–56264. September 19, 2014.

Atomic Energy Act, 42 U.S.C. §2011 (1954).

Endangered Species Act, 16 U.S.C. §1531, et seq. (1973).

[FENOC] FirstEnergy Nuclear Operating Company (FENOC), "Davis-Besse Nuclear Power Station License Renewal Application," Toledo, OH, August 2010, Agencywide Documents Access and Management System (ADAMS) Accession Nos. ML102450572.

Magnuson–Stevens Fishery Conservation and Management Act, 16 U.S.C. §1855, et seq. (as amended by the Sustainable Fisheries Act of 1996).

National Environmental Policy Act, 42 U.S.C. §4321, et seq. (1969).

National Historic Preservation Act, 16 U.S.C. §470, et seq.

[NRC] U.S. Nuclear Regulatory Commission. 1996. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*. Washington, DC: NRC. NUREG-1437. May 1996. ADAMS Accession Nos. ML040690705 and ML040690738.

[NRC] U.S. Nuclear Regulatory Commission. 1999. Section 6.3—Transportation, Table 9.1, Summary of findings on NEPA issues for license renewal of nuclear power plants. In: *Generic Environmental Impact Statement for License Renewal of Nuclear Plants.* Washington, DC: NRC. NUREG-1437, Volume 1, Addendum 1. August 1999. ADAMS Accession No. ML04069720.

[NRC] U.S. Nuclear Regulatory Commission. 2011. *Summary of Site Audit Related to the Review of the License Renewal Application for Davis-Besse Nuclear Power Station*, NRC. June 3, 2011, ADAMS Accession No. ML110820276.

[NRC] U.S. Nuclear Regulatory Commission. 2013a. *Environmental Impact Statement Scoping Process, Summary Report, Davis-Besse Nuclear Power Station, Oak Harbor, OH*. Rockville, MD: NRC. October 2013, ADAMS Accession No. ML11168A197.

[NRC] U.S. Nuclear Regulatory Commission. 2013b. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*. Washington, DC: Office of Nuclear Reactor Regulation. NUREG-1437, Revision 1, Volumes 1, 2, and 3. June 2013. ADAMS Accession Nos. ML13106A241, ML13106A242, and ML13106A244.

[NRC] U.S. Nuclear Regulatory Commission. 2014. *Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel*. Washington, DC: NRC, Office of Nuclear Material Safety and Safeguards. NUREG–2157, Volumes 1 and 2. Published September 2014. ADAMS Accession Nos. ML14196A105 and ML14196A107.

2.0 AFFECTED ENVIRONMENT

Davis-Besse Nuclear Power Station, Unit No. 1, (Davis-Besse) is located 25 mi (40 km) east of Toledo, OH. It is situated on the southwest coastline of Lake Erie. The 954-acre (ac) (386-hectare (ha)) site is located in Carroll Township, Ottawa County, just north of the Toussaint River with approximately 7,500 ft (2,300 m) of Lake Erie frontage. Approximately 733 ac (297 ha) are marshland that is leased to the U.S. Government as a national wildlife refuge. Figure 2–1 and Figure 2–2 present the 50-mi (80- km) and 6-mi (10-km) vicinity maps, respectively (FENOC 2010c).

For purposes of the evaluation in this report, the “affected environment” is the environment that currently exists at and around Davis-Besse. Because existing conditions are at least partially the result of past construction and operation at the plant, the impacts of these 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

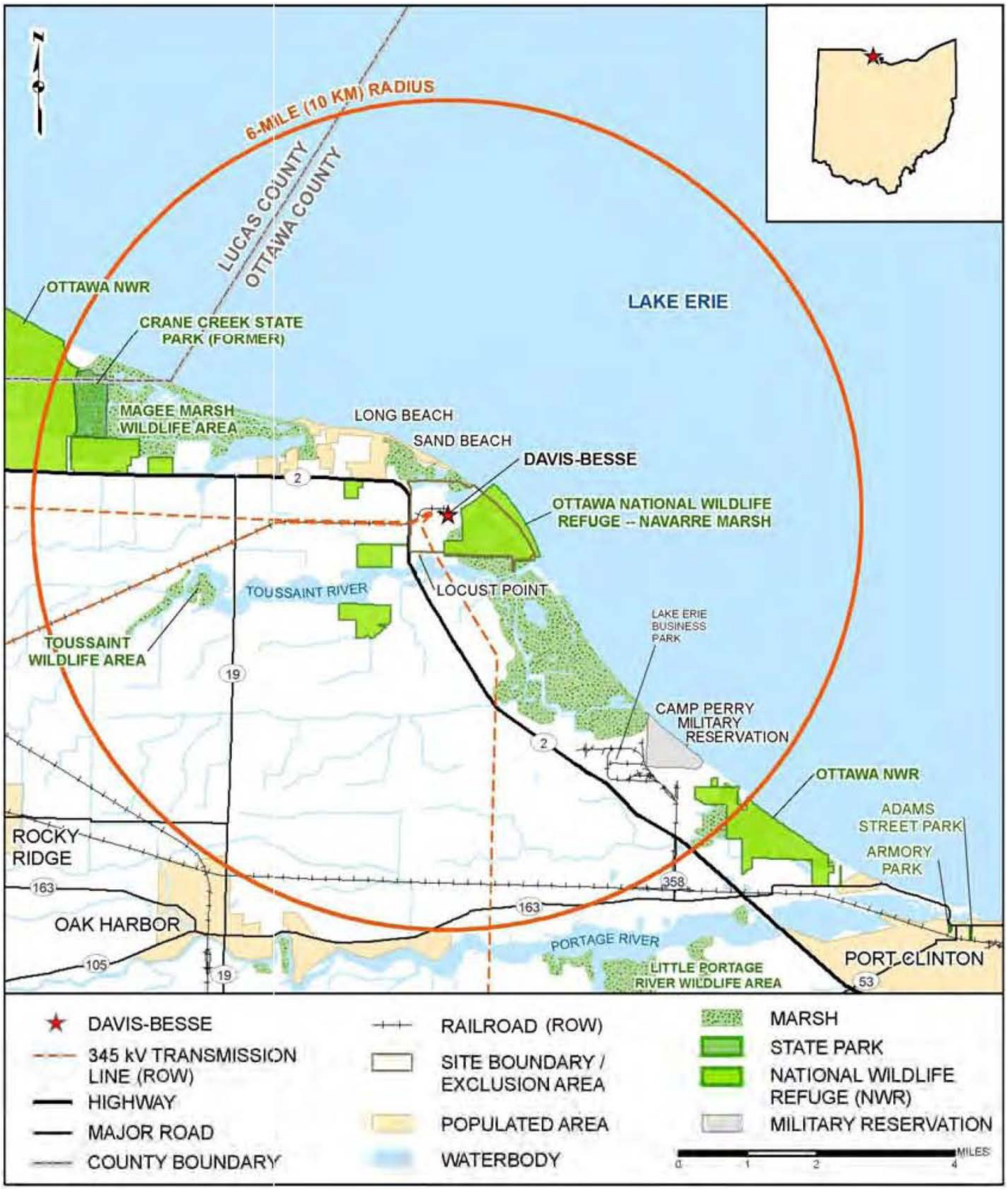
This assessment of the affected environment begins with a description of Davis-Besse, which is the source of potential environmental effects. Davis-Besse is a single-unit pressurized water reactor (PWR) plant that uses closed-cycle cooling (using cooling towers to recirculate up to 95 percent of the cooling water). The plant is licensed for an electrical output of 2,817 megawatts-thermal (MWt) and 908 megawatts-electric (MWe).

The most visible structures on the Davis-Besse site include the cooling tower, switchyard, forebay and intake canal, and the plant structures. Figure 2–3 shows the site layout referencing these features. The plant structures include structures such as the containment building, turbine building, and auxiliary building. A more detailed layout of these structures can be seen on Figure 2–4. On this figure, additional structure locations such as the meteorological tower can also be located. Davis-Besse’s used (or spent) fuel is stored in a pool inside the plant until it is cooled and transferred to dry storage containers located onsite called the independent spent fuel storage installation (ISFSI). Spent fuel will be stored there until the Federal Government removes it to be reprocessed or stored at a Government facility.

Figure 2–1. Location of Davis-Besse, 50 mi (80 km) Region

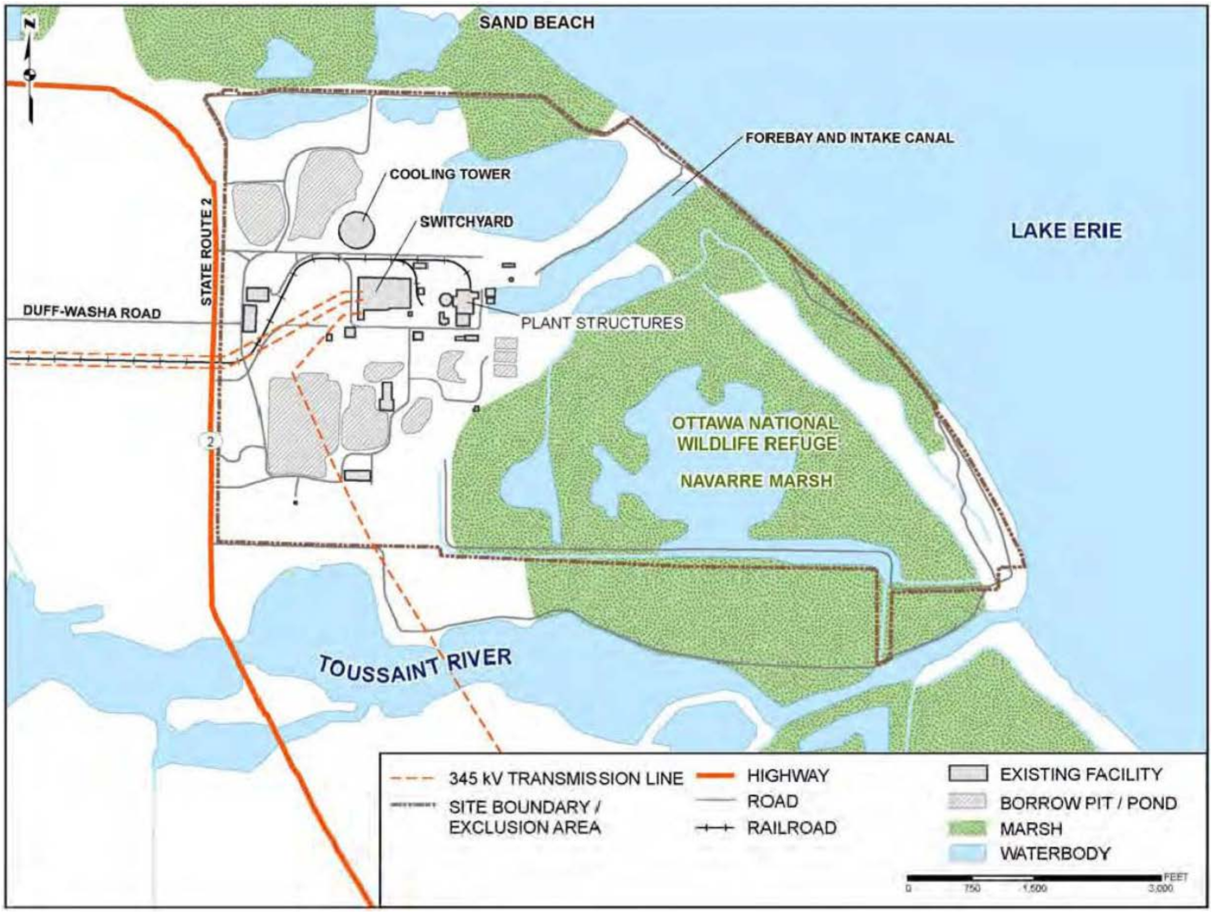
Source: FENOC 2010c

Figure 2–2. Location of Davis-Besse, 6 mi (10 km) Region



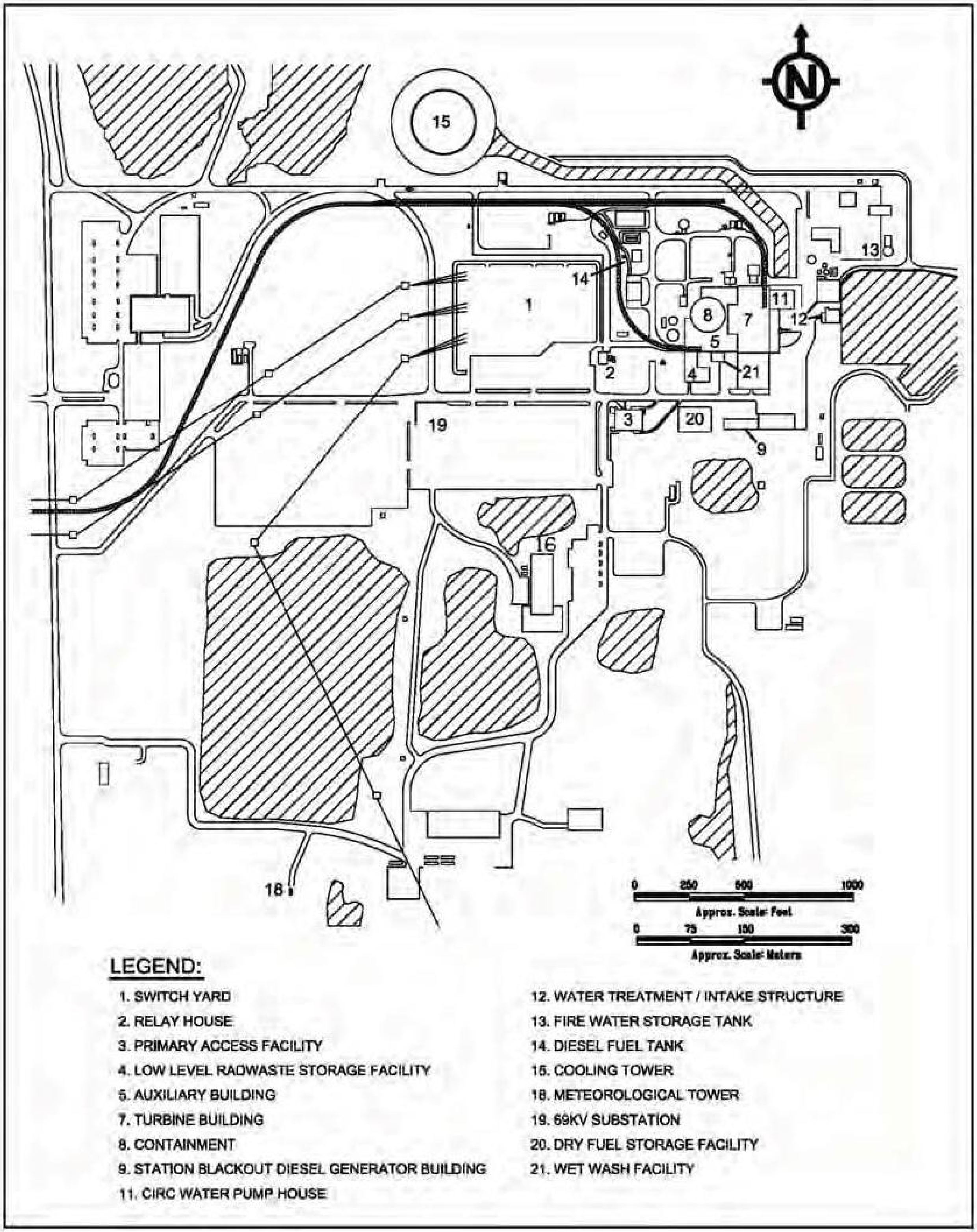
Source: FENOC 2010c

Figure 2–3. Davis-Besse Site Boundary and Facility Layout



Source: FENOC 2010c

Figure 2–4. Davis-Besse Site Boundary and Facility Layout



Source: FENOC 2010c

2.1.1 Reactor and Containment Systems

Davis-Besse is single unit nuclear power plant that began commercial operation on April 22, 1977. Davis-Besse is equipped with a Babcock and Wilcox-designed PWR. Davis-Besse includes a nuclear steam supply system supplied by Babcock and Wilcox Company and a turbine generator designed and manufactured by General Electric Company.

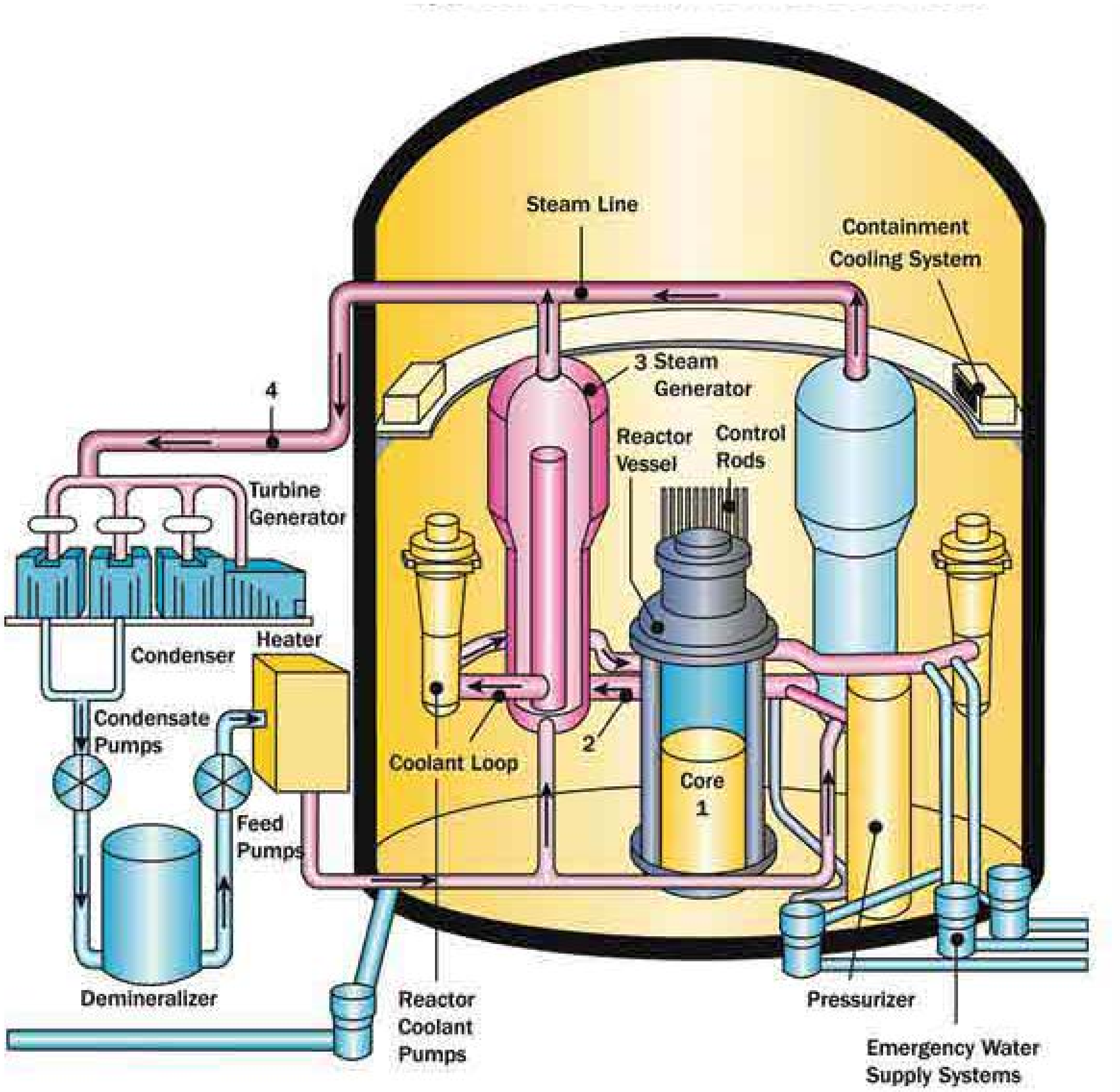
Davis-Besse was initially licensed to operate at a maximum steady-state core power level of 2,772 MWt. In 2008, amendments of the operating license and technical specifications allowed an increase in the rated thermal power of 1.63 percent. The reactor has a current electrical output of 2,817 MWt and 908 MWe gross. An additional 17 MWt is contributed to the cycle by the reactor coolant pumps, resulting in a net electrical output of about 925 MWe (FENOC 2010c).

Davis-Besse's fuel for the reactor core consists of slightly enriched (less than 5 percent by weight) uranium dioxide pellets sealed in Zircaloy-4 or M5 tubes. The complete core has 177 fuel assemblies arranged in a square lattice to approximate a cylinder.

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 contains 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.

Figure 2–5 presents a typical PWR.

Figure 2–5. Typical Pressurized-Water Reactor



The containment system for the station uses a free-standing containment vessel surrounded by a reinforced concrete shield building. The shield building is a reinforced concrete structure of right cylinder configuration with a shallow dome roof. The shield building has a height of 279.5 ft (85 m) measured from the top of the foundation ring to the top of the dome. The structure is designed to withstand an internal pressure of 40 pounds per square inch gage (psig) and design-basis accidents (DBAs) (FENOC 2010c). DBAs include, but are not limited to, wind and tornado events, water level (floods), and seismic events, where the systems are required to avoid or mitigate the consequences of abnormal operational transients or accidents.

2.1.2 Radioactive Waste

The radioactive waste systems collect, treat, and dispose of radioactive and potentially radioactive wastes that are byproducts of 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 (RCS). Operating procedures for the radioactive waste system ensure that radioactive wastes are safely processed and discharged from Davis-Besse. The systems are designed and operated to assure that the quantities of radioactive materials released from Davis-Besse are as low as is reasonably achievable (ALARA). They also comply with the dose standards set forth in Title 10 of the *Code of Federal Regulations* (CFR) Part 20, "Standards for Protection against Radiation," and Appendix I to 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities." The Davis-Besse offsite dose calculation manual (ODCM) contains the methodology and parameters used to calculate offsite doses resulting from radioactive effluents. The methodology is used to ensure that radioactive material discharged from Davis-Besse meets regulatory dose standards.

Radioactive wastes resulting from Davis-Besse operations are classified as liquid, gaseous, and solid. Radioactive wastes generated by Davis-Besse operations are collected and processed to meet applicable regulations. The design and operational objectives of the radioactive waste management systems are to limit the release of radioactive effluents from Davis-Besse during normal operation and anticipated operational occurrences (FENOC 2010c).

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 a spent fuel pool located in the auxiliary building and in the dry fuel storage facility located south of the containment building (FENOC 2010c).

2.1.2.1 Radioactive Liquid Waste

The liquid radioactive waste system is designed so that effluents released by the system, when mixed with the cooling tower blowdown, meet the requirements in Appendix B of 10 CFR Part 20 and 10 CFR Part 50. The design is based on receiving, segregating, and batch-storing two categories of solutions—clean liquid radwaste and miscellaneous liquid radwaste. The major source of clean liquid radwaste for this system is reactor coolant letdown resulting from boron dilution operations or from coolant expansion during reactor startups. Other sources include leakage, drainage, and relief flows from valves and equipment containing reactor-grade liquid. The major sources of miscellaneous liquid radwaste are further categorized as non-detergent and detergent wastes. Non-detergent wastes are categorized as miscellaneous system leakage, drainage from area washdown, sampling and laboratory operations, and condensate polishing demineralizer backwash (if there is a significant primary-secondary leak). Detergent waste comes from the hot showers (used to decontaminate personnel) and drains in the laboratory.

The liquid radioactive waste system can accommodate the full range of volumes and activities delivered to it. Suitability for discharge is determined not only by comparison of waste samples with applicable limits but also by the opportunity afforded the station to further reduce activity with existing equipment. Before processed water is released to the environment, it is mixed in a collection box with the discharge from the service water system (SWS), the dilution pump, a cooling tower make up pump, or the cooling tower blowdown. Processed liquid waste enters Lake Erie. The ODCM provides the day-to-day methods for determining release rates and cumulative releases and for calculating the corresponding dose rates and cumulative quarterly and yearly doses (FENOC 2010c).

2.1.2.2 Radioactive Gaseous Waste

The gaseous radioactive waste disposal system is designed to process effluents to meet the requirements of 10 CFR Part 20, 10 CFR Part 50, Appendix I, and 40 CFR Part 190. The

system provides selective holdup such that the short-lived isotopes sufficiently decay prior to release. It also provides a 30-day holdup of these gases when refueling cold shutdown degassing is required.

When a decay tank is full, (i.e., contains gas at 150 psig) or when the operator decides, it is valved out-of-service and another is put in its place. A sample is then taken from the isolated tank and analyzed. If it shows a sufficiently low activity level, the stored gas can be released in a controlled manner through waste gas charcoal and high efficiency particulate air filters to the station vent. If the analysis indicates significant radioactivity, the gases are allowed to decay until future sampling shows that they are suitable for release to the environment. Using two of the decay tanks, gases can be held for at least 60 days with release spread out over the next 30 days.

Gaseous wastes that contain little or no radioactivity or may contain oxygen are handled separately. These gases are collected, passed through a charcoal filter, and then released through the station vent.

The ODCM provides the day-to-day methods for determining release rates and cumulative releases and for calculating the corresponding dose rates and cumulative quarterly and yearly doses (FENOC 2010c).

2.1.2.3 Radioactive Solid Waste

The solid waste management system collects, processes, and packages solid radioactive wastes for storage and offsite shipment and burial. The system is located in the low-level radioactive waste storage facility (LLRWSF). The system is designed to process waste while maintaining occupational exposure ALARA. To ensure compliance with applicable regulations in 10 CFR Part 20, 10 CFR Part 61, and 10 CFR Part 71, characterization, classification, processing, waste storage, handling and transportation of solid wastes are controlled by the Davis-Besse Process Control Program.

The materials handled by the solid waste system include bead-type resins, spent filter cartridges, powdered resins, and miscellaneous solid waste such as paper, rags, contaminated clothing, gloves and shoe coverings. The solid waste system area was designed to provide the necessary shielding to prevent the overexposure of operating personnel to radioactive sources. This is accomplished through the use of lead shielding, concrete shielding, and safe operating procedures.

The LLRWSF provides interim onsite storage for dry active waste (DAW) boxes and liners/high-integrity containers (HIC) and also provides DAW compaction and segregation areas. The following activities are also permitted, with administrative controls in place, in the LLRWSFs:

- opening of DAW containers in the cell area for inventory;
- sorting, re-packaging, or both;
- loading a sea land container with DAW and preparing the container for offsite shipment in the truck bay;
- opening of radioactive material (RAM) containers in the cell area for retrieval of tools and equipment; and
- refurbishing, minor repair, or both, of tools and equipment in the cell area.

Approximately 5 years of storage area is available in the LLRWSF. The facility has separate radiation monitoring and floor drain collection systems.

Solid radioactive wastes are packaged and shipped from Davis-Besse in containers that meet the requirements established by the Department of Transportation (DOT) and by the U.S. Nuclear Regulatory Commission (NRC). All Class A radioactive waste is sent out for processing and ultimately transported to Clive, Utah, for disposal at a commercial low-level radioactive waste disposal facility. Class B and Class C resins and filters are shipped in HICs to Studsvic, Inc., in Erwin, Tennessee, for thermal oxidation and reduction processing to reduce the volume for burial (FENOC 2011a).

Class A LLRW waste is shipped to processing facilities as shipping containers are filled. As a result, there is no need for storage of Class A waste. The contract with Studsvic, Inc., for processing Class B and Class C LLRW has resulted in the processing of all Class B and Class C LLRW; consequently, there is no Class B or Class C LLRW in long-term storage onsite (FENOC 2011b).

The LLRWSF has the capability to store 108 HICs of LLRW. Since Class A waste is not stored at the LLRWSF, the space is available for Class B and Class C LLRW storage. FirstEnergy Nuclear Operating Company (FENOC) is currently generating approximately three Class B and Class C HICs during a 2-year operating cycle. Assuming that Davis-Besse had to store Class B and Class C LLRW and not ship it offsite for processing, and assuming that Davis-Besse continued to generate three Class B and Class C HICs during each 2-year operating cycle from 2011 through the period of extended operation (i.e., conservatively, 14 cycles), there would be 14×3=42 HICs that would require long-term storage in the LLRWSF. With storage capacity for 108 HICs in the LLRWSF, Davis-Besse would have sufficient storage space for LLRW for the period of extended operation (FENOC 2011b).

2.1.3 Nonradioactive Waste Management

Davis-Besse generates nonradioactive wastes as part of routine plant maintenance, cleaning activities, and plant operations. The Resource Conservation and Recovery Act of 1976 (RCRA) waste regulations governing the disposal of solid and hazardous waste are contained in 40 CFR Parts 239 through 299. In addition, 40 CFR Parts 239 through 259 contain regulations for solid (nonhazardous) waste, and 40 CFR Parts 260 through 279 contain regulations for hazardous waste. RCRA Subtitle C establishes a system for controlling hazardous waste from “cradle to grave,” and RCRA Subtitle D encourages states to develop comprehensive plans to manage nonhazardous solid waste and mandates minimum technological standards for municipal solid waste landfills. Ohio State RCRA regulations are administered by the Ohio Environmental Protection Agency (OEPA) and address the identification, generation, minimization, transportation, and final treatment, storage, or disposal of hazardous and nonhazardous waste.

2.1.3.1 Nonradioactive Waste Streams

Davis-Besse generates solid waste, defined by the RCRA, as part of routine plant maintenance, cleaning activities, and plant operations. Ohio administers the RCRA Program in Ohio Administrative Code (OAC) 3745-50.

The U.S. Environmental Protection Agency (EPA) classifies certain nonradioactive wastes as hazardous based on characteristics including ignitability, corrosivity, reactivity, or toxicity (hazardous wastes are listed in 40 CFR Part 261). State-level regulators may add wastes to the EPA’s list of hazardous wastes. RCRA supplies standards for the treatment, storage, and disposal of hazardous waste for hazardous waste generators (regulations are available in 40 CFR Part 262).

The EPA recognizes the following main types of the hazardous waste generators (40 CFR 260.10) based on the quantity of the hazardous waste produced:

- large quantity generators that generate 2,200 lb (1,000 kg) per month or more of hazardous waste, more than 2.2 lb (1 kg) per month of acutely hazardous waste, or more than 220 lb (100 kg) per month of acute spill residue or soil,
- small quantity generators that generate more than 220 lb (100 kg) but less than 2,200 lb (1,000 kg) of hazardous waste per month, and
- conditionally exempt small quantity generators that generate 220 lb (100 kg) or less per month of hazardous waste, 2.2 lb (1 kg) or less per month of acutely hazardous waste, or less than 220 lb (100 kg) per month of acute spill residue or soil.

OEPA recognizes Davis-Besse as a small quantity generator of hazardous wastes under OAC 3745-52. However, during refueling outage years, hazardous waste generation may exceed 2,200 lb in a month, requiring Davis-Besse to file a report with the OEPA for a temporary large quantity generator status in accordance with the OAC, Rule 3745-52-41. Davis-Besse hazardous wastes include spent and off-specification (e.g., shelf-life expired) chemicals, laboratory chemical wastes, and occasional project-specific wastes (FENOC 2010).

The EPA classifies several hazardous wastes as universal wastes. These universal wastes include batteries, pesticides, mercury-containing items, and fluorescent lamps. OEPA has incorporated EPA's regulations (40 CFR Part 273) regarding universal wastes in OAC 3745-51. Universal wastes produced by Davis-Besse are disposed of or recycled in accordance with OEPA regulations.

Conditions and limitations for wastewater discharge by Davis-Besse are specified in National Pollution Discharge Elimination System (NPDES) Permit No. 2IB00011*ID. Radioactive liquid waste is addressed in Section 2.1.2 of this supplemental environmental impact statement (SEIS). Section 2.2.4 gives more information about the Davis-Besse NPDES permit and permitted discharges.

The Emergency Planning and Community Right-to-Know Act (EPCRA) requires applicable facilities to supply information about hazardous and toxic chemicals to local emergency planning authorities and the EPA (42 USC 11001). On October 17, 2008, the EPA finalized several changes to the Emergency Planning (Section 302), Emergency Release Notification (Section 304), and Hazardous Chemical Reporting (Sections 311 and 312) regulations that were proposed on June 8, 1998 (63 FR 31268). Davis-Besse is subject to Federal EPCRA reporting requirements; thus, Davis-Besse submits an annual Section 312 (Tier II) report on hazardous substances to local emergency response agencies.

2.1.3.2 Pollution Prevention and Waste Minimization

Currently, Davis-Besse has waste minimization measures in place, which were verified by the NRC during the Davis-Besse site visit conducted in March 2011. In support of nonradiological waste-minimization efforts, the EPA's Office of Prevention and Toxics has established a clearinghouse that supplies information about waste management and technical and operational approaches to pollution prevention (EPA 2010a). The EPA clearinghouse can be used as a source for additional opportunities for waste minimization and pollution prevention at Davis-Besse, as appropriate.

The EPA also encourages the use of environmental management systems (EMSs) for organizations to assess and manage the environmental impacts associated with their activities, products, and services in an efficient and cost-effective manner. The 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 2010b).

2.1.4 Plant Operation and Maintenance

Maintenance activities conducted at Davis-Besse 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 Davis-Besse to maintain, inspect, test, and monitor the performance of facility equipment. These maintenance activities include inspection requirements for reactor vessel materials and pressure vessel inservice inspection and testing, the 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 inservice inspection, and scheduled maintenance. Davis-Besse refuels on an approximate 24-month interval (FENOC 2010c).

2.1.5 Power Transmission System

Three 345-kilovolt (kV) transmission lines connect Davis-Besse to the regional electric grid, all three of which are owned and operated by FirstEnergy Corporation (FirstEnergy). The transmission line description in this section discusses the entire length of the transmission lines that were constructed to connect the Davis-Besse facility with the existing transmission system. At Davis-Besse, an onsite switchyard lies just east of the containment building and south of the cooling tower. Lines beyond this switchyard have been integrated into the regional electric grid and would stay in service regardless of Davis-Besse license renewal. Each of these lines is owned and operated by FirstEnergy and not the applicant, FENOC, and are, therefore, outside of NRC's regulatory purview.

2.1.5.1 Transmission Line Descriptions

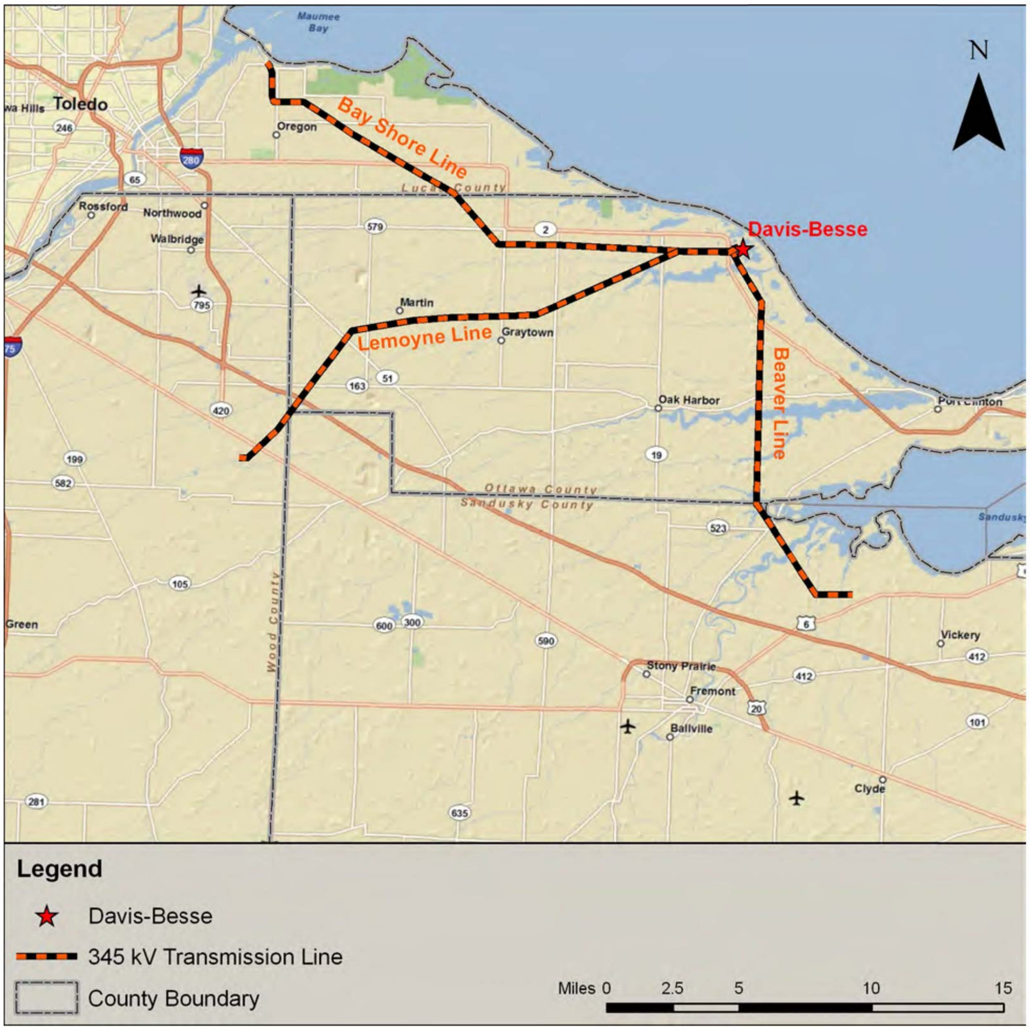
The three transmission lines are as follows (FENOC 2010c):

> A transmission line right-of-way (ROW) is a strip of land used to construct, operate, maintain and repair transmission line facilities. The transmission line is usually centered in the ROW. The width of a ROW depends on the voltage of the line and the height of the structures. ROWs must typically be clear of tall-growing trees and structures that could interfere with a power line.

- *Bay Shore Line*: From the site, this line extends 21 mi west and then northwest to the Bay Shore substation in Lucas County.
- *Lemoyne Line*: From the site, this line extends 21 mi west and then southwest to the Lemoyne Substation in Wood County.
- *Beaver Line*: From the site, this line extends 15 mi south and then southeast to a tie point between Toledo Edison and Ohio Edison's line ownership in Sandusky County.

Figure 2–6 is a map of the Davis-Besse transmission system.

Figure 2–6. Davis-Besse Transmission System



Source: FENOC 2010c

All three transmission lines have 150-ft-wide ROWs that encompass approximately 1,000 ac (405 ha), most of which is comprised of flat to gently rolling agricultural land. In order to ensure power system reliability and to comply with applicable Federal and State regulations, FirstEnergy maintains transmission line ROWs to prevent physical interference that could result in short-circuiting. This maintenance generally consists of removing or cutting tall-growing vegetation under the lines and removing or trimming of any trees near the edge of the ROWs that could fall on the lines. Table 2–1 lists the Davis-Besse transmission lines, and a more detailed discussion of transmission line maintenance appears in the following section.

Table 2–1. Davis-Besse Transmission Lines

Substation	Number of Lines	kV	Approximate Distance mi (km)	ROW Width ft (km)	ROW Area ac (ha)
Bay Shore Line	1	345	21 (34)	150 (0.05)[(b)]	381 (154)
Lemoyne Line	1	345	21 (34)	150 (0.05)	381 (154)
Beaver Line[(a)]	1	345	15 (24)[(c)]	150 (0.05)[(d)]	273 (110)

(a) This is also referred to as the Ohio Edison-Beaver substation.

(b) ROW width is 150 ft except where it parallels the existing Bay Shore to Ottawa 138-kV line. In this region, the ROW is 145 ft, contiguous to the existing 100 ft for the 138 kV line.

(c) The Beaver line has an approximate length of 59 mi. Only 15 mi were constructed for Davis-Besse, the remaining 44 miles were constructed for a separate project.

(d) ROW width was not specifically referenced in the applicants Environmental Report (ER).

Source: FENOC 2010c

2.1.5.2 Transmission Line Maintenance

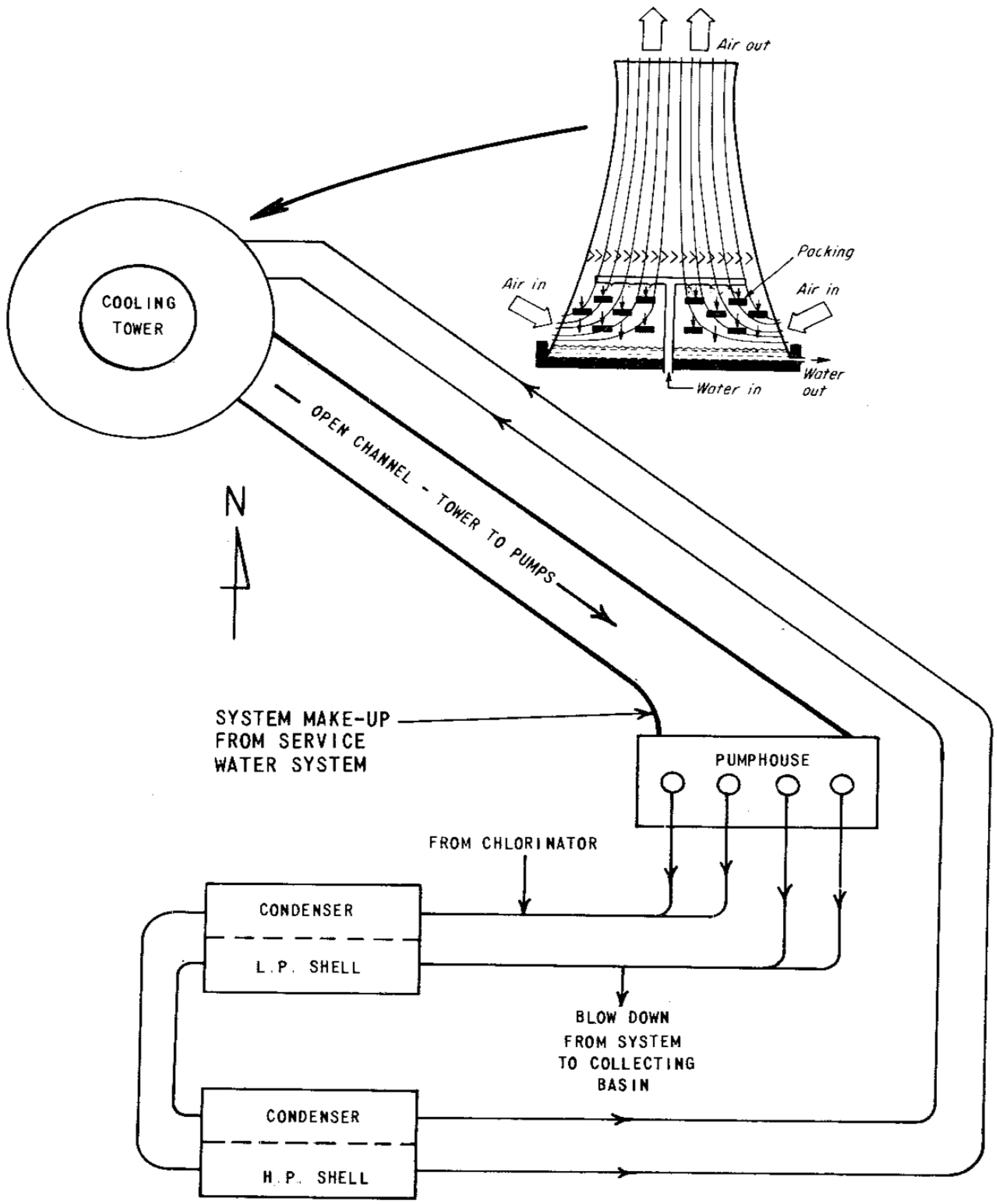
FirstEnergy uses an Integrated Vegetative Management Program that combines manual, mechanical, biological, and chemical control techniques to maintain proper clearance from transmission lines and structures. The degree and type of clearance varies by line voltage and the type, growth rate, and branching characteristics of trees and vegetation. The majority of the in-scope transmission lines traverse agricultural land and wetland habitat. Those areas that are not already cultivated or developed in some other way are maintained to promote herbaceous vegetation, which includes shrubs, bushes, and other low-growing groundcover.

FirstEnergy maintains a “clearance zone” of 15 to 30 ft (4.6 to 9.2 meters (m)) on either side of transmission lines (FENOC 2011c). Within this clearance zone, FirstEnergy cuts back all incompatible vegetation (woody, tall-growing species) as low as practical or treats areas with herbicides on a 4-year cycle. Workers follow the current American National Standards Institute (ANSI) guideline document, “A300 Standards for Tree Care Operations,” which contains requirements and recommendations for tree care practices including pruning, lightning protection, and integrated vegetation management. In areas where herbicides are applied, FirstEnergy’s vegetative management protocol (FirstEnergy 2007) requires all herbicide applicators to hold a current and appropriate pesticide application license from the State. Transmission line maintenance workers and contractors must follow FirstEnergy’s established procedures, *FirstEnergy Vegetative Management Specifications*, and *FirstEnergy Guide to Vegetation Control with Herbicides*, to ensure compliance with all applicable State and Federal regulations.

2.1.6 Cooling and Auxiliary Water Systems

Davis-Besse uses a closed-cycle heat-dissipation system that withdraws water from, and discharges cooling tower blowdown to, Lake Erie. Davis-Besse has one natural draft hyperbolic cooling tower that dissipates heat from the plant’s steam cycle to the atmosphere. Unless otherwise noted, information contained in this section was gathered from FENOC’s ER, the final environmental statement (FES) related to the construction of Davis-Besse (AEC 1973), and the FES related to the operation of Davis-Besse (NRC 1975). Figure 2–7 illustrates Davis-Besse’s cooling water system.

Figure 2–7. Davis-Besse Cooling Water System



Source: AEC 1973

2.1.6.1 Water Intake

When withdrawn, water from Lake Erie first enters a submerged intake crib located approximately 3,000 ft (900 m) offshore at a water depth of 14 ft (4.3 m). The intake crib is octagonal in shape, and water enters the intake crib via slots in the top of the structure. At its design capacity, the intake crib can withdraw a maximum of 42,000 gallons per minute (gpm) (160 cubic meters per minute (m3/min)). However, during normal operations, the intake crib

withdraws 21,000 gpm (80 m3/min). Water flows into the intake crib at about 0.25 feet per second (fps) (0.08 meters per second (m/s)).

After water enters the intake crib, it travels through an 8-ft (2.4-m) diameter intake pipe buried beneath Lake Erie's bottom at a maximum rate of 1.8 fps (0.55 m/s). Once through the intake pipe, water flows into the intake canal, which is separated from the lake by a beach and beachfront dike. The intake canal functions as a reservoir for station water use. Water flows through the intake canal at about 0.11 fps (0.03 m/s).

The intake canal widens into a forebay as it reaches the intake structure. Before entering the intake structure, water in the intake canal flows through trash racks with 4 in. x 26 in. (10 cm x 66 cm) openings and then through traveling screens with $^{1}/_{4}$-in. (0.635-cm) openings and backwash sprays. These features prevent debris and aquatic organisms from entering the intake structure. Debris and aquatic organisms washed off the screens are deposited in a holding basin and disposed of onsite. Once water passes through the traveling screens, it enters one of three pumps that then circulate the water through the condenser for use as cooling water.

2.1.6.2 Cooling Tower Blowdown and Water Discharge

Four pumps carry heated cooling water from Davis-Besse's condenser at a rate of 480,000 gpm (1,800 m^3/min)—120,000 gpm (450 m^3/min) per pump. Heated cooling water that is pumped into the cooling tower is either lost to evaporation, drift, blowdown, or flows back to the circulating pumps. The cooling tower dissipates 98 percent of the total heat that the condenser adds to the cooling water. The remaining 2 percent of heat is discharged to Lake Erie as cooling water blowdown.

FENOC monitors and controls the cooling tower blowdown's dissolved solids concentration and periodically chlorinates water that is returned to the circulating water system with sodium hypochlorite and sodium bromide to prevent algae growth within the system.

Before cooling tower blowdown returns to Lake Erie, it is routed to an open-air settling basin. In the settling basin, the cooling tower blowdown mixes with dilution water, which dissipates some of the heat load remaining in the cooling tower blowdown. From the settling basin, water travels 1,300 ft (400 m) eastward through a 6-ft (1.8-m) diameter buried pipe and discharges into Lake Erie 9 ft (2.7 m) below the lake's surface through a jet discharge. Water flows out of the discharge at about 3.6 fps (1.1 m/s), and an average of 11,000 gpm (42 m^3/min) of water discharges to Lake Erie during normal operations—9,225 gpm [35 m^3/min] of blowdown water plus 1,775 gpm [7 m^3/min] of dilution water.

2.1.6.3 Makeup Water

The service water system supplies makeup water to the cooling system to account for cooling tower blowdown loss. The service water system supplies approximately 18,450 gpm (70 m^3/min) to account for the 9,225 gpm (35 m^3/min) in evaporative loss and 9,225 gpm (35 m^3/min) in blowdown loss. The service water system draws water from Lake Erie as previously described under the subsection "Water Intake."

2.1.7 Facility Water Use and Quality

The dominant water usage at the Davis-Besse plant is the makeup water, obtained from Lake Erie, for the plant's cooling system. Groundwater is not used as a resource at the site. The following sections describe water use by the facility.

2.1.7.1 Surface Water Use

As discussed in Section 2.1.6, the intake system is comprised of an intake crib, a pipeline, and an intake canal. The crib is a wooden structure about 3,000 ft offshore in Lake Erie, in water that is 11 ft below the lake's low water datum (AEC 1973). Water entering the crib flows through an 8-ft diameter pipe buried beneath the lake bottom and then enters the intake canal. The canal is separated from the lake by a beach and a beachfront dike.

The intake flow rate averages 21,000 gpm (or 30 million gallons per day (mgd)) according to the applicant's ER (FENOC 2010c).The facility has a state registration to withdraw water at a rate up to 50 mgd (Toledo Edison 1990).

Closed-system cooling at Davis-Besse is provided by the circulating water system (CWS). This system includes the condenser, natural draft cooling tower, circulating water pumps, makeup pumps, and water chlorination and chemical feed systems (FENOC 2010c). Four pumps withdraw water from the discharge channel of the cooling tower basin and deliver it to the condenser.

The Davis-Besse service water system (SWS) supplies cooling water to components in the turbine building during normal power-generating operation. Water for the SWS is obtained from Lake Erie. Three pumps are present at the intake structure, although only two are needed for normal operation (FENOC 2010c). The SWS also is the main source of makeup water for the CWS. Water is taken from the intake structure for use in the makeup water treatment system to supply high-quality water for primary and secondary plant makeup following a vendor's treatment process to create demineralized water (FENOC 2010c). According to FENOC staff during the site audit, the vendor is Ecolochem, and reverse osmosis is used to produce the demineralized water. Pumps at the intake structure can also use lake water directly as makeup water (FENOC 2010c).

Discharge of blowdown, other effluents, and dilution water to Lake Erie occurs via a submerged discharge structure 1,300 ft offshore (AEC 1973), as discussed in Section 2.2.4.

Domestic water for the facility is supplied by the offsite Carroll Township water system (FENOC 2010c). The source for this system is an intake on Lake Erie northwest of Davis-Besse. This water is filtered and treated to meet the requirements of the OEPA. The Carroll Township system pressure is maintained by an elevated 500,000-gallon storage tank (FENOC 2010b).

2.1.7.2 Groundwater Use

The Davis-Besse facility does not use groundwater for plant operations. There are no plans to use groundwater from the site for current operations or during the period of extended operation (FENOC 2010b).

No drinking water wells are known to be within 5 mi of the site (ERM 2007). The groundwater is unsuitable as a drinking water source because of strong hydrogen sulfide odor and high levels of carbonate and total dissolved solids (ERM 2007). Private wells within 2 to 3 mi of the site are not used for drinking water but rather for irrigation and sanitary purposes (FENOC 2010c).

During site construction, a grout curtain was installed, and dewatering wells were operated to remove groundwater from the excavation area. Dewatering no longer takes place.

2.2 Affected Environment

2.2.1 Land Use

Davis-Besse is located on the southwestern shore of Lake Erie in Ottawa County, Ohio. The site is comprised of 954 ac (386 ha), of which approximately 733 ac (297 ha) is undisturbed marshland and additional maintained lands. The Ottawa National Wildlife Refuge encompasses much of the marshland area (see Figure 2–1). The developed portion of the station, containing the power block and associated plant structures, is located approximately in the center of the site, 3,000 ft (914.4 m) from the shoreline, which provides a minimum exclusion distance of 2,400 ft (731.5 m) from any point on the site boundary (FENOC 2010c).

To the west is the main unit of the Ottawa National Wildlife Refuge and the State of Ohio Magee Marsh Wildlife Area. The Navarre Marsh, which is part of the Ottawa National Wildlife Refuge, partially surrounds the station to the north, east, and southeast. On the southern boundary is the Toussaint River, which empties into Lake Erie. The entrance to the Magee Marsh Wildlife Area is less than 1 mi east of the power station. The land area surrounding the site is generally agricultural with no major industry in the vicinity.

Motor vehicle access to the site is by a two-lane road off State Highway 2, which is a two-lane artery located west of the station. U.S. Highway 80 is about 14 mi south of the site.

Oak Harbor is the nearest community to Davis-Besse at approximately 8 mi (13 km) southeast, Fremont 16 mi (26 km) south, and Toledo 25 mi (40 km) west northwest (FENOC 2010c). Features within a 6-mi radius of Davis-Besse are shown on Figure 2–2. Prominent features within 50 mi of the Davis-Besse plant site are shown in Figure 2–1.

2.2.2 Air and Meteorology

The climate of Ohio is humid continental, characterized by a relatively wide range of seasonal variability, from warm and humid summers to cold winters (NCDC 2011a). Due to equal exposure to air from Canada and the Tropics, Ohio experiences drastic changes in daily weather and a wide range of extremes. Warm maritime tropical air masses bring summer heat and humidity into the State, but can also produce occasional mild winter days. Ohio also experiences cold and dry continental arctic air masses, which bring cool and bright summer days and very cold winter days. Northern counties in Ohio along Lake Erie experience moderating effects resulting from lake and land breezes, water’s higher heat capacity, and wintertime lake ice cover.

Davis-Besse is located 0.5 mi (0.8 km) west off the southwestern shore of Lake Erie in Ottawa County, Ohio. The topography of the site and vicinity is flat with marsh areas bordering the lake. The upland area rises 10 to 15 ft (3.0 to 4.6 m) above the lake low-water datum level in the general surrounding area (FENOC 2010c). Davis-Besse’s topography has no special influence on local climate. Due to its proximity to Lake Erie, the site location experiences milder climate, smaller diurnal and seasonal temperature ranges, higher cloudiness, and more precipitation than a site located further inland of comparable latitude.

The wind can blow from any direction in Ohio, depending on the relative location of high-pressure systems and storm systems that are continually alternating across the country. However, the primary wind direction over much of Ohio is from the southwest (NCDC 2011a). Meteorological data—wind speed, temperature, and precipitation—collected at the Toledo Express Airport, located about 37 mi (60 km) west of the Davis-Besse, is presented below.

From 1955 through 2012, annual average temperature at the airport was 49.4 °Fahrenheit (F) (9.7 °Celsius (C)) (NCDC 2013a). January is the coldest month with an average minimum of 16.5 °F (–8.6 °C), and July is the warmest month with an average maximum of 84.1 °F (28.9 °C). As mentioned above, the proximity to Lake Erie and other Great Lakes has a moderating effect on the temperature, and extremes seldom occur. In warm months, onshore breezes from the relatively cool lake make the site cooler than more inland areas. From 1955 to 2012 the highest temperature, 104 °F (40.0 °C), was reached in July 1995. The lowest, -20 °F (-28.9 °C), was reached in January 1984.

In Ohio, precipitation from October through March occurs due to mid-latitude wave cyclones traversing the country, while the remainder of the year experiences varying amounts of convective thunderstorm rainfall (NCDC 2011a). From 1955 through 2012, annual precipitation at the airport averaged about 33.28 in. (84.5 cm) (NCDC 2013a). Precipitation is rather uniformly distributed throughout the year, with monthly precipitation ranging between 2.0 and 3.5 in. (5.0 and 8.9 cm). At the airport, precipitation tends to be the highest in summer and lowest in winter. Heavy snowstorms typically occur once or twice a winter, but light snows are common (NOAA 2009). Snow in this area starts as early as October and continues as late as May. Most of the snow falls from November through March. The annual average snowfall at the airport is about 36.8 in. (93.5 cm).

Wind data collected at the airport indicates that wind blows predominantly from the west-southwest or southwest throughout the year, with the exception of March and April, when the winds blow from the east or east-northeast (NCDC 2013a). From 2008 through 2012, average wind speed was about 7.7 miles per hour (mph). Average wind speeds were the highest in winter and lowest in summer.

The prominence of convective weather during the warm season causes Ohio to be subjected to thunderstorm-induced severe weather (NCDC 2011a). Severe weather events—such as floods, hail, high winds, thunderstorm winds, winter storms, and tornadoes, have been reported for Ottawa County (NCDC 2013b). From January 2000 through October 2012, the following severe weather events were reported for Ottawa County:

- Floods: 4,
- Hail events: 74,
- Thunderstorm winds: 89,
- High wind events: 27,
- Tornadoes: 4, and
- Winter storms: 17.

Hurricanes and tropical storms were not reported from 2000 through 2012 in the area.

Recent research on global climate change impacts in the U.S. developed by the U.S. Global Change Research Program (USGCRP) has been considered in preparation of this SEIS. USGCRP reports that from 1895 to 2012, average surface temperature in the United States has increased by 1.3 °F to 1.9 °F (0.72 to 1.06 °C), and since 1900, average annual precipitation has increased by 5 percent (USGCRP 2014). Climate change research indicates that the observed warming is caused by the buildup of greenhouse gases in the atmosphere resulting from human activities (USGCRP 2014). For the Midwest region, where Davis-Besse is located, average air temperatures from 1900 to 2010 increased by 1.5 °F (0.83 °C), and warming in recent decades has been increasing at a faster rate (USGCRP 2014). For the license renewal period of Davis-Besse (2017-2037), climate models indicate an increase in annual mean

temperature for the Midwest of 2.5 to 3.5 °F (1.4 to 1.9 °C) (between 2021–2050 relative to the reference period (1971–1999)) (NOAA 2013; USGCRP 2014).

From 1958 to 2012, the Midwest region experienced a 37 percent increase in heavy precipitation; projected future changes in precipitation patterns have been difficult to quantify at a regional scale. Climate model simulations (for the time period 2021–2050) indicate a 0 to 6 percent increase in annual mean precipitation for the Midwest region and a 0 to 3 percent increase for Ohio. On a seasonal basis, winter and spring will experience the greatest increase in precipitation, while summer months will experience a decrease in precipitation (NOAA 2013). However, these changes in precipitation are only statistically significant under higher greenhouse gas emission scenarios (NOAA 2013). Model projections, however, do indicate continued increases in heavy precipitation events (USGCRP 2014).

The onsite meteorological observation system at Davis-Besse has been in place since October 1968. This monitoring system will continue to serve in that capacity for the period of extended operations with no major changes or upgrades anticipated. The current meteorological monitoring system consists of primary and auxiliary towers and equipment shelters that collect meteorological data and process the information into usable data. The primary 328-ft (100-m) meteorological tower is located about 2,950 ft (900 m) southwest of the reactor building, and the 33-ft (10-m) auxiliary tower is located near the primary tower. The primary tower has instruments at three levels (33 ft (10 m), 246 ft (75 m), and 328 ft (100 m)). The base of the tower is 574 ft (175 m) above mean sea level (MSL) (FENOC 2005). Wind speed and wind direction are collected at 33 ft (10 m) on the auxiliary tower and 246 ft (75 m) and 328 ft (100 m) on the primary tower. Temperature differences are measured between 328 and 33 ft levels and between the 246 and 33 ft levels on the primary tower to determine the atmospheric stability. Ambient temperature, barometric pressure, dew point, and solar insolation is collected at the 33 ft (10 m) level on the primary tower. Precipitation is collected near the base of the auxiliary tower.

Each sensor is wired to environmentally controlled shelters located near the base of the towers, which house the recording and signal-conditioning equipment. Signals from tower-mounted instruments are converted from analog to digital at the meteorological data processing system (MDPS), which collects all real-time data and yields 15-minute and hourly averages. These outputs are transmitted on a continuous basis directly to the control room and emergency control room via data acquisition display system (DADS) to display and record meteorological data. Most of these signals are also fed to strip-chart recorders.

2.2.2.1 Air Quality Impacts

The Division of Air Pollution Control (DAPC) of the OEPA is the regulatory agency whose primary responsibility is to achieve and maintain air quality that is protective of public health and the natural environment. In doing so, DAPC reviews, issues, and enforces permits for installation and operation of sources of air pollution and operates an extensive ambient air monitoring network. DAPC also oversees an Automobile Emission Testing Program to minimize mobile source emissions.

A facility is defined as a "major" source if it has the potential to emit 100 tons (90.7 metric tons) or more per year of one or more of the criteria pollutants, 10 tons (9.07 metric tons) or more per year of any of the listed hazardous air pollutants (HAPs), or 25 tons (22.7 metric tons) or more per year of an aggregate total of HAPs. Under the Clean Air Act (CAA), the U.S. EPA has set National Ambient Air Quality Standards (NAAQS) for pollutants considered harmful to public health and the environment (40 CFR Part 50). NAAQS are established for criteria pollutants—carbon monoxide (CO); lead (Pb); nitrogen dioxide (NO_2); particulate matter with an aerodynamic diameter of 10 microns or less and 2.5 microns or less (PM_{10} and $PM_{2.5}$,

respectively); ozone (O_3); and sulfur dioxide (SO_2), as shown in Table 2–2 (EPA 2012a). A HAP is defined as any pollutant listed under Section 112(b) of the Federal CAA.

Major sources are subject to Title V of the CAA (42 U.S.C. 7401 et seq.), which standardizes air quality permits and the permitting process across the U.S. Permit stipulations include regulating source-specific emission limits, monitoring, operational requirements, recordkeeping, and reporting. A "synthetic minor" (or "conditional major") source has the potential to exceed major source emission thresholds but is the one that avoids major source requirements by accepting permit conditions limiting emissions below major source thresholds. The "small" (or "minor") source has no potential to exceed major source emission thresholds.

The Davis-Besse sources of criteria pollutants and HAPs include the following:

- combustion sources, such as auxiliary boiler, station blackout diesel generators, emergency diesel generators, and fire pump engines;
- bulk material storage, such as diesel, gasoline, and lube oil storage tanks;
- other sources, such as natural draft cooling towers and sandblasting and painting operations; and
- miscellaneous sources, such as small diesel generators, welding, and laboratory hoods.

No OEPA air permits have been issued to Davis-Besse for emissions to the atmosphere during normal operations (OEPA 2011a). The only conventional air pollution sources at Davis-Besse are the emergency diesel generators and startup boilers, which are not used during normal operations. Davis-Besse currently has one operation permit for an auxiliary boiler (Permit Application No. 0362000091B001) (FENOC 2010c). Davis-Besse applied to OEPA for a "synthetic minor" permit to encompass all site-wide emission sources on July 9, 2012 (FENOC 2013a).

Air emission sources at Davis-Besse emit criteria pollutants, volatile organic compounds (VOCs), and HAPs into the atmosphere. Emissions inventory data reported to the OEPA for calendar years 2006 through 2010 are presented in Table 2–2, which includes air emissions from all stationary sources at the site (FENOC 2011c). During the period from 2006 through 2010, emissions of criteria pollutants, VOCs, and HAPs varied from year to year, but all reported annual emissions were well below the emission thresholds for a major source. In recent years, Davis-Besse has not received a notice of violation (NOV) associated with site operations from the OEPA.

On February 25, 2010, NRC issued an NOV to Davis-Besse associated with the failure to implement the emergency classification and action level scheme during an actual event for an explosion in the switchyard on June 25, 2009 (NRC 2010). During the event, the transformers caught on fire. During fires, polychlorinated biphenyls (PCBs) and chlorinated benzenes in the transformers can produce polychlorinated dibenzofurans (PCDFs) and polychlorinated dibenzo-p-dioxins (PCDDs), respectively (EPA 1987). EPA determined that the continued use of PCBs-contaminated transformers (50 to 500 ppm PCBs) and non-PCB transformers (less than 50 ppm PCBs) did not present unreasonable risks to public health. In 1992, Davis-Besse completed a program to eliminate PCB transformers onsite; electrical transformers were either changed out with non-PCB fluid or retrofilled with non PCB-liquid (FENOC 2011b). Hence, potential impacts of emissions from non-PCB transformers at the site would likely be minor.

As shown in Table 2–2, annual emissions for greenhouse gases (GHGs), which include those from stationary and mobile sources, are presented in terms of carbon dioxide equivalent

(CO_2e).[1] Total annual GHG emissions from Davis-Besse was 4,693 metric tons CO_2e in 2010 (FENOC 2011c), which is well below the U.S. EPA's mandatory reporting threshold of 25,000 metric tons CO_2e per year (74 FR 56264).

Table 2–2. Annual Emissions Inventory Summaries for Sources at Davis-Besse, 2006–2010

Annual Emissions (tons/yr)[a]							
Year	**CO**	**NO_x**	**$PM_{10}/PM_{2.5}$**	**SO_x**	**VOCs**	**HAPs**	**CO_2e**
2006	2.31	9.72	0.54	7.35	0.17	0.8[b]	-[c]
2007	1.14	4.31	0.14	1.37	0.11	0.8	-
2008	2.42	10.16	0.56	2.35	0.18	0.8	-
2009	1.90	7.77	0.39	1.87	0.15	0.8	-
2010	2.31	9.75	0.56	2.09	0.17	0.8	5,173 (4,693)[d]

[a] CO = carbon monoxide; CO_2e = carbon dioxide equivalent; HAPs = hazardous air pollutants; NO_x = nitrogen oxides; $PM_{2.5}$ = particulate matter $\leq$2.5 μm; PM_{10} = particulate matter $\leq$10 μm; SO_x = sulfur oxides; and VOCs = volatile organic compounds.

[b] Maximum HAP emissions are estimated based on maximum potential operating hours (500 hours per year for diesel generators and fire pumps and 8,760 hours per year for auxiliary boilers). Actual emissions are substantially lower than these maximum emissions.

[c] A hyphen denotes that the data are not available.

[d] Values in parentheses are in metric tons carbon dioxide equivalent.

Source: FENOC 2011c

The CAA established two types of NAAQS—primary standards to protect public health, including sensitive populations, such as asthmatics, children, and the elderly and secondary standards to protect public welfare, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings. Any individual state can have its own State Ambient Air Quality Standards (SAAQS), but SAAQS must be at least as stringent as the NAAQS. If a state has no standard corresponding to one of the NAAQS or the SAAQS is not as stringent as the NAAQS, then the NAAQS apply. The State of Ohio has its own SAAQS (OEPA 2011b), which are almost the same as the NAAQS presented in Table 2–3.

[1] A measure used to compare the emissions from various greenhouse gases (GHG) on the basis of their global warming potential (GWP), defined as the cumulative radiative forcing effects of a gas over a specified time horizon resulting from the emission of a unit mass of gas relative to a reference gas, CO_2. The carbon dioxide equivalent (CO_2e) for a gas is derived by multiplying the mass of the gas by the associated global warming potential GWP. The carbon dioxide equivalent for a gas is derived by multiplying the tons of the gas by the associated GWP. For example, the GWP for CH_4 is estimated to be 21; thus, one 1 ton of CH_4 emission is equivalent to 21 tons of CO_2 emissions.

Table 2–3. National Ambient Air Quality Standards and Ohio State Ambient Air Quality Standards[a]

Pollutant[b]	Averaging Time	NAAQS Value	NAAQS Type[c]	SAAQS
CO	1-hour	35 ppm (40 mg/m^3)	P	35 ppm
	8-hour	9 ppm (10 mg/m^3)	P	9 ppm
Pb	Quarterly average	-[d]	-	1.5 µg/m^3
	Rolling 3-month average	0.15 µg/m^3 [e]	P, S	-
NO_2	1-hour	100 ppb	P	-
	Annual (arithmetic average)	53 ppb	P, S	53 ppb (100 µg/m^3)
PM_{10}	24-hour	150 µg/m^3	P, S	150 µg/m^3
$PM_{2.5}$	24-hour	35 µg/m^3	P, S	35 µg/m^3
	Annual (arithmetic average)	12.0 µg/m^3	P	15 µg/m^3
	Annual (arithmetic average)	15 µg/m^3	S	15 µg/m^3
O_3	1-hour	0.12 ppm[f]	P, S	-
	8-hour	0.08 ppm (1997 standard)	P, S	0.08 ppm
	8-hour	0.075 ppm (2008 standard)	P, S	-
SO_2	1-hour	75 ppb	P	-
	3-hour	0.5 ppm	S	1,300 µg/m3 (0.5 ppm)
	24-hour			365 µg/m3 (0.14 ppm)
	Annual (arithmetic average)			80 µg/m3 (0.03 ppm)

[a] Refer to 40 CFR Part 50 for detailed information on attainment determination and reference method for monitoring.

[b] CO = carbon monoxide; NO_2 = nitrogen dioxide; O_3 = ozone; Pb = lead; $PM_{2.5}$ = particulate matter $\leq$2.5 μm; PM_{10} = particulate matter $\leq$10 μm; and SO_2 = sulfur dioxide.

[c] P = primary standards, which set limits to protect public health, including the health of "sensitive" populations such as asthmatics, children, and the elderly. S = secondary standards, which set limits to protect public welfare including protection against decreased visibility, damage to animals, crops, vegetation, and buildings.

[d] A hyphen denotes that no standard exists.

[e] Final Rule signed October 15, 2008. The 1978 lead standard (1.5 µg/m^3 as a quarterly average) remains in effect until 1 year after an area is designated for the 2008 standard, except that in areas designated nonattainment for the 1978 standard, the 1978 standard remains in effect until implementation plans to attain or maintain the 2008 standard are approved.

[f] EPA revoked the 1-hour ozone standard in all areas, although some areas have continuing obligations under that standard ("anti-backsliding").

Source: EPA 2013; OEPA 2011b

Areas considered to have air quality as good as or better than NAAQS are designated by EPA as "attainment areas." Areas in which air quality is worse than NAAQS are designated as

"non-attainment areas." Areas that previously were non-attainment areas but where air quality has since improved to meet the NAAQS are redesignated "maintenance areas," subject to an air quality maintenance plan. Ottawa County, which encompasses Davis-Besse, is located in the Sandusky Intrastate Air Quality Control Region (AQCR) (40 CFR 81.203), including north-central counties in Ohio, such as Erie, Huron, Sandusky, and Seneca Counties. Ottawa County is designated as an attainment area for carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), particulate matter less than 2.5 μm ($PM_{2.5}$), for particulate matter less than 10 μm (PM_{10}), and is not designated for sulfur dioxide (SO_2) (OEPA 2013). Lucas and Wood Counties abutting Ottawa County to the north and west, respectively, are designated as maintenance areas for 1997 ozone 8-hour NAAQS. Monroe County in Michigan, to the northwest of Davis-Besse, is designated as a maintenance area for $PM_{2.5}$ and 1997 8-hr ozone NAAQS (EPA 2014). The nearest non-attainment area is Wayne County, Michigan, for the 2010 SO_2 NAAQS (EPA 2014).

Through operation of a network of air monitoring stations, OEPA has determined that the area complies with the NAAQS and SAAQS. Only PM_{10} was collected in Ottawa County until 2001 and in other counties in the Sandusky Intrastate AQCR until 2004 (EPA 2011g). However, PM_{10} monitoring was discontinued due to consistently low concentrations in the Sandusky Intrastate AQCR. The nearest monitoring station around Davis-Besse is located about 13 mi (21 km) west-northwest in Lucas County, where ozone is measured. There are five monitoring stations in the city of Toledo, Lucas County. These stations are located within a range of about 21 mi (34 km) to 29 mi (47 km) west or west-northwest of Davis-Besse. Pollutants monitored at these stations include PM_{10}, $PM_{2.5}$, O_3, and SO_2. Two additional monitoring stations can be found in Waterville, Lucas County and Bowling Green, Wood County. These stations are located 33 mi (53 km) and 31 mi (50 km), respectively, west-southwest of Davis-Besse. Ozone is the pollutant measured at these stations.

While the NAAQS place upper limits on the levels of air pollution, prevention of significant deterioration (PSD) regulations (40 CFR 52.21) place limits on the total increase in ambient pollution levels above established baseline levels for SO_2, NO_2, PM_{10}, and $PM_{2.5}$, thus preventing "polluting up to the NAAQS." These allowable increments are smallest in Class I areas, such as national parks and wilderness areas, and less limiting in other areas. A major new or modification of an existing major source located in an attainment or unclassified area must meet stringent control technology requirements. As a matter of policy, EPA recommends that the permitting authority notify the Federal Land Managers (FLMs) when a proposed PSD source will be located within 62 mi (100 km) of a Class I area. If the source's emissions are considerably large, EPA recommends that sources beyond 62 mi (100 km) be brought to the attention of the FLMs. The FLMs then become responsible for demonstrating that the source's emissions could have an adverse effect on air quality-related values (AQRVs), such as scenic, cultural, biological, and recreational resources. There are no Class I areas in Ohio, and none of the Class I areas in other states are situated within the aforementioned 62-mi (100-km) range. The nearest Class I area is Otter Creek Wilderness Area in West Virginia managed by the U.S. Forest Service (40 CFR 81.435), which is located about 253 mi (407 km) southeast of Davis-Besse. Considering the locations and elevations of any Class I areas around Davis-Besse, prevailing southwesterly wind directions, distances from Davis-Besse, and the minor nature of air emissions from Davis-Besse, there is little likelihood that activities at Davis-Besse would adversely impact air quality and AQRVs in any of these Class I areas.

2.2.3 Geologic Environment

Davis-Besse Station is situated in the eastern lake section of the central lowland physiographic province (USGS 2011). The topography is characterized as being very flat, resulting from

fine-grained sediment deposition in a glacial lake. The marsh bottom is slightly below lake level, while the upland areas are about 6 ft above lake level (FENOC 2010c).

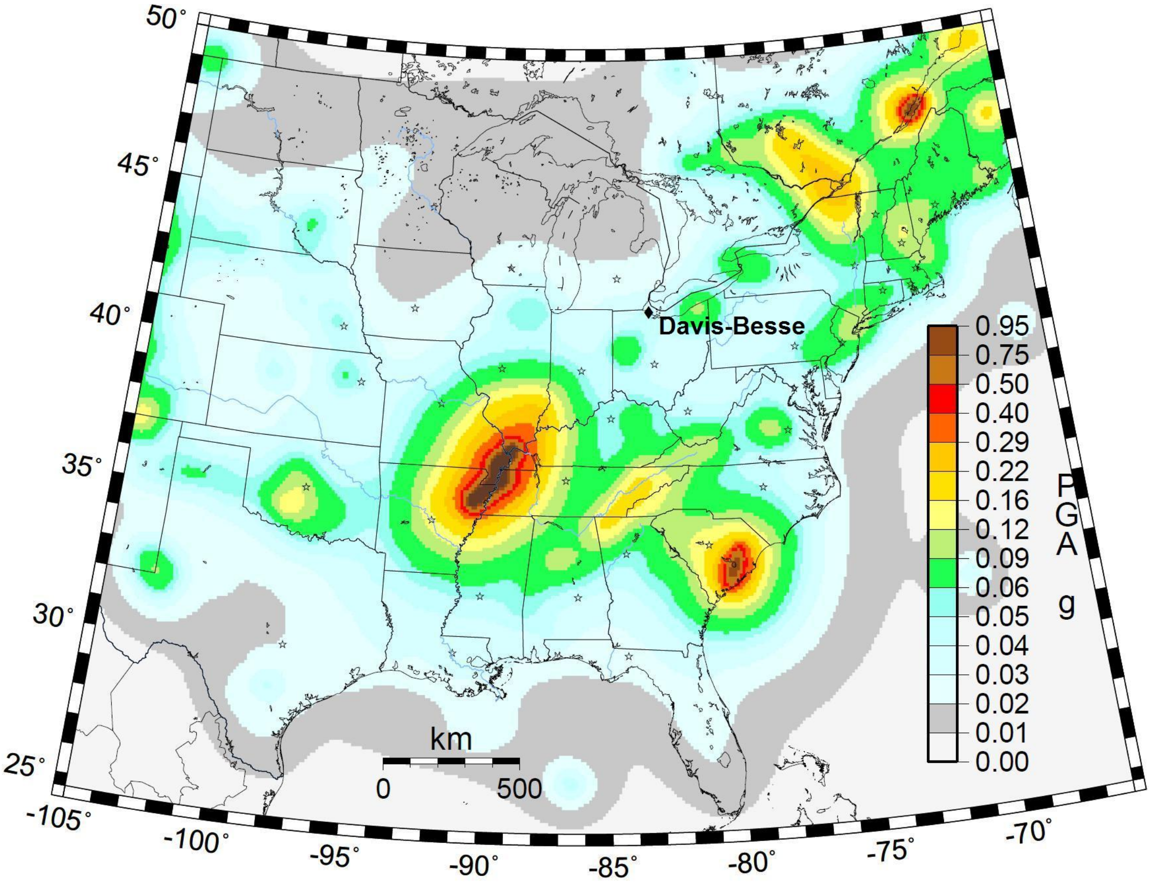
Soil unit mapping by the Natural Resources Conservation Service (NRCS) (NRCS 2011) identifies the majority of the Davis-Besse site as gently sloping fill soils. Adjacent areas are Toledo silty clay, derived from glaciolacustrine sediments. The Toledo silty clay is very poorly drained, has a slope of 0 to 2 percent, and is ponded in the nearby marsh areas.

The surface material is comprised of glaciolacustrine sediments (cohesive brown silt with some sand and clay) and till (brown to dark gray silty clay), along with fill (ERM 2008). Below the unconsolidated material, at a depth of about 13 ft, is the Silurian age Tymechtee-Greenfield Formation (AEC 1973). The uppermost portion of the bedrock is about 10 ft of laminated dolomite (thin layers of interbedded dolomite, gypsum, anhydrite, and shale) (ERM 2008). Below this is about 10 ft of massive dolomite, underlain by laminated dolomite (ERM 2008).

Foundations for Seismic Class I station facilities are mat or strip footings on bedrock, glacial till, or compacted granular fill, or pier footings into bedrock (FENOC 2010b). The nearest fault is the Bowling Green Fault, located 35 mi west of the site (FENOC 2010b). No evidence of fault traces, offset geomorphologic features, shear zones, faults, sand boils, soil flows, or any other direct or indirect physical effects of prior earthquakes have been observed in site investigations (FENOC 2010b). The U.S. Geological Survey (USGS) Earthquake Hazards Program designates the Davis-Besse region as having a 0.02 g peak horizontal acceleration with a 10 percent probability in 50 years, and a 0.06 g peak horizontal acceleration with a 2 percent probability in 50 years (USGS 2008).

Figure 2–8. Seismic Hazard Map

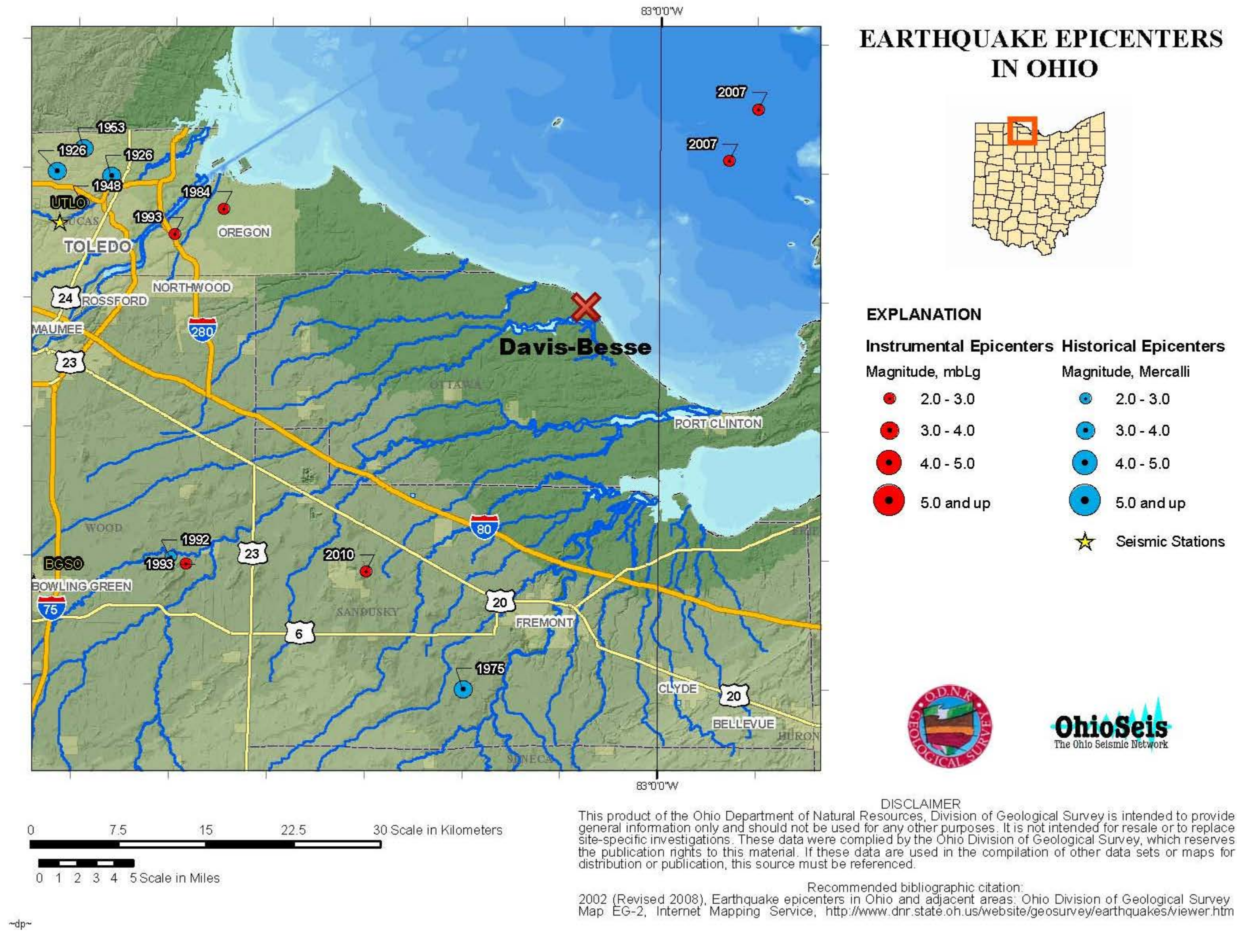
Peak Ground Acceleration - 2% Probability in 50 years



Source: USGS 2008

The Ohio Department of Natural Resources, Division of Geologic Survey, as part of the Ohio seismic network, compiles and updates the occurrences of seismic events. The database includes information such as the epicenter location, magnitude, time and date, and whether the earthquake was measured with an instrument or if the information is reliant on historical information and reports. The database reflects over 220 earthquakes that have occurred in Ohio since 1804. The mapping software shows four earthquakes that had an epicenter within approximately 20 mi of the Davis-Besse site (ODNR 2008). Figure 2–9 shows the locations of the epicenters.

Figure 2–9. Earthquake Epicenters near Davis-Besse



Source: ODNR 2008

On January 1, 1984, at 8:14 pm, a 2.6 magnitude earthquake (as measured on the Richter scale) occurred approximately 20 mi west of Davis-Besse. The earthquake occurred in Lucas County, east of Toledo, Ohio. Four historical and one instrumental earthquake, ranging from a magnitude of 2 to 3.5 have been recorded within 2 to 8 mi in this general vicinity (ODNR 2008).

On April 12, 2007, at 10:03 pm, a 2.5 magnitude earthquake occurred approximately 11 mi northeast of Davis-Besse. The earthquake occurred in western Lake Erie approximately 5 km below the calculated surface. This occurrence did not have any reports of being felt. Prior to this incident, no previous records of seismic activity were recorded or historically reported in this general area of Lake Erie (ODNR 2008).

On April 24, 2007, at 1:09 am, a 2.3 magnitude earthquake occurred approximately 14 mi northeast of Davis-Besse. The earthquake occurred in western Lake Erie approximately 5 km below the calculated surface. This occurrence did not have any reports of being felt. Prior to this incident; the Geological Survey of Canada recorded microearthquakes in this approximate location at their station on Pelee Island on April 15 and two on April 17 (ODNR 2008).

On May 13, 2010, at 1:02 pm, a 2.6 magnitude earthquake occurred approximately 18 mi southwest of Davis-Besse. The earthquake occurred approximately 3 mi west of Hessville, Ohio. Approximately 8 mi from this epicenter, a historical earthquake of Magnitude 3.3 was recorded (ODNR 2008).

2.2.4 Surface Water Resources

> NPDES permits require the monitoring of TRO and TRC due to chlorines toxicity on aquatic species.

Davis-Besse's discharge to surface water is permitted under an NPDES permit, which was renewed on July 1, 2011 (FENOC 2014). The permit specifies discharge limits and sampling frequency at the main station outfall (Outfall 001) for dissolved oxygen, pH (acidity and alkalinity), total residual oxidants (TRO), total residual chlorine (TRC), and chlorination and bromination duration. It also calls for the sampling frequency for water temperature and copper concentration, and for the 24-hour estimate of flow rate. Permit requirements regarding TRO and TRC specify that these cannot be discharged from any single generating unit for more than 2 hours per day. A modification to the permit (OEPA 2006a) that was proposed by the state and accepted by FENOC, allowed such discharges to be greater than 2 hours in duration, provided the discharge is dosed with a dehalogenating agent to achieve specified limits of TRC and TRO.

Outfall 001 is downstream of the "collection box," which receives discharges from the cooling tower blowdown, settling basins, stormwater runoff, and radwaste systems. These discharges are combined, within the collection box, with dilution water (FENOC 2010d). The dilution water is pumped directly from the intake to the collection box to reduce concentrations in the discharge water. Water flows by gravity from the collection box, through a 6-ft diameter underground pipe, to the discharge structure about 1,300 ft offshore (AEC 1973). The combined average flow rate at Outfall 001 is 29.0 mgd (FENOC 2010d). Average flow rates of contributions are 13.50 mgd of blowdown, 9.00 mgd of dilution water, 7.05 mgd from the primary and secondary heat exchangers, and small amounts from water treatment and radwaste systems (FENOC 2010d).

Several internal outfalls supply discharge to the collection box. These include outfalls receiving water from turbine building drains, boiler drains, pump house sumps, the wastewater treatment system, water treatment residues, condensate polishing resins, and stormwater runoff (Davis-Besse 2004a, 2009). In addition to the NPDES discharge requirements described for Outfall 001, these internal outfalls may have discharge limits or sampling frequencies or both for total suspended solids, oil and grease, and biochemical oxygen demand (OEPA 2006b). Some of the outfalls require the monitoring of flow, specific metals, arsenic, color, odor, and turbidity.

The facility has a group of onsite basins for wastewater (FENOC 2010d). The southernmost is the sewage treatment plant pond. The central one is the No. 1 settling basin, which receives discharge from the sewage treatment plant pond along with demineralizer system discharge and building sumps and drains. The northernmost is the No. 2 settling basin, which receives discharge from a screen wash outfall and from the No. 1 settling basin.

The NPDES permit calls for an annual sewage sludge report to be filed with the OEPA, describing the amount of sludge, the method of disposal, and a summary of all analyses made on the sludge. During the site audit, FENOC staff stated that the sewage sludge is analyzed for radioactivity using gamma spectroscopy. The facility documented a procedure for this monitoring and calls for approval of the radiation protection supervisor for release of the sludge (Davis-Besse 2004b). This monitoring is performed in support of NRC guidance (NRC 1988), which encourages licensees to monitor their sewage sludge. Annual submittals to the OEPA for the last 5 years indicate that 30,000 to 129,700 gallons of sewage sludge have been removed each year and transferred to Sandusky Waste Water Treatment Plant (FENOC 2007, 2008, 2009, 2010a, 2011a).

The liquid radioactive waste system is one of the internal outfalls that discharge into the collection box. Its effluents, when mixed in the collection box with dilution water and other flows

(as described above), meet the requirements in Appendix B of 10 CFR Part 20 and 10 CFR Part 50 (FENOC 2010c).

An EPA online database indicates that Davis-Besse has had no effluent exceedances in the last 3 years and no Clean Water Act NOVs, enforcement actions, or penalties in the last 5 years (EPA 2011a, 2011b). In addition, detailed online discharge data from 2006 through 2010 (EPA 2011c) were inspected by NRC staff, and no infractions were noted. Infractions noted elsewhere by the state have been a pH violation of 0.1 standard units (S.U.) above the limit of 9.0 S.U. (OEPA 2010a) and a dissolved oxygen measurement frequency violation (OEPA 2010b).

An application for an NPDES permit renewal (FENOC 2010d) was made prior to the expiration of the 5-year permit, granted in 2011. The application includes a diagram of all site flows (intake, CWS, SWS, blowdown, process waters, sanitary effluent, stormwater, marsh discharge) along with the associated flow rates. It also includes outfall criteria for maximum daily concentration and, in some cases, maximum daily mass for numerous chemical and physical parameters. The permit application includes EPA Form 2F, "Application for Permit to Discharge Storm Water Discharges Associated with Industrial Activity." On the form, the applicant listed the stormwater treatment at specific outfalls, including floatation and sedimentation. The form also states that "there have been no significant leaks or spills of any toxic or hazardous pollutants at the Davis-Besse Plant in the last three years."

During the site audit, FENOC staff indicated there have been violations of the NPDES permit. These violations would not, however, appear in the OEPA online database unless the violations were ongoing, and changes were not made to correct the problem. They provided several examples. In December 2010, they failed to sample on a 2-week sampling frequency. In August 2010, they observed a high pH reading at the training center pond. Historically, they have received several NOVs due to overuse of chlorine in the SWS and CWS. A dechlorination system has, therefore, been in place for about 15 years with treatment occurring at the collection box.

FENOC staff explained, during the site audit, a change anticipated in their chemical usage in 2012. They plan to use zinc acetate, which is commonly used in PWRs to lower the risk of corrosion cracking during operations and outages. An application to make this change was submitted to the OEPA and approved, and zinc acetate is now being used at the plant.

Blowdown from the cooling tower takes place in order to limit the dissolved solids concentration in the circulating water. Slime and algae control in the CWS is provided by addition of sodium hypochlorite (FENOC 2010c). Sodium bromide may also be added to increase the biocide treatment without increasing the level of chlorine (FENOC 2010c). A chemical feed system is used to control scaling and to disperse silt (FENOC 2010c).

The lake intake and pipe are monitored by divers for silt and debris, according to FENOC staff during the site audit. The discharge structure in Lake Erie is about 1,300 ft offshore where the lake is about 9 ft deep (AEC 1973). Beyond the discharge point, the lake bottom is covered with a riprap rock surface for about 200 ft (60 m) to minimize scouring and turbidity.

According to FENOC staff during the site audit, dredging does not take place in the intake canal's safety-related portion, which is the portion closest to the site structures and which satisfies NRC regulations (RG 1.27) by holding an appropriate volume of water for a safe shutdown. This portion of the canal has walls designed to satisfy seismic safety requirements. In the remaining portion of the canal, hydraulic dredging last took place in 2008 due to silt buildup. Along the southeast edge of the canal, settling pits were excavated in non-wetland

areas to receive the hydraulic dredging discharge. The canal is monitored for silt every 3 years. In the past, spoils were placed at the Unit 2 site south of the operating Unit 1 site.

Stormwater at the site drains to the collection box or to the training center pond (FENOC 2010d). From the pond, stormwater flows via an outfall to Navarre Marsh Pool No. 3, where it may be pumped to the Toussaint River (FENOC 2010d). Several pools in the surrounding marsh are pumped by Davis-Besse to reduce their volume under the direction of the U.S. Fish and Wildlife Service (FWS). Discharge is to Lake Erie or the Toussaint River. Davis-Besse has a stormwater pollution prevention plan that includes procedures for inspections, best management practices, employee training, and spill response procedures (Davis-Besse 2009). Stormwater sampling does not normally take place, but it was performed for the NPDES application.

2.2.5 Groundwater Resources

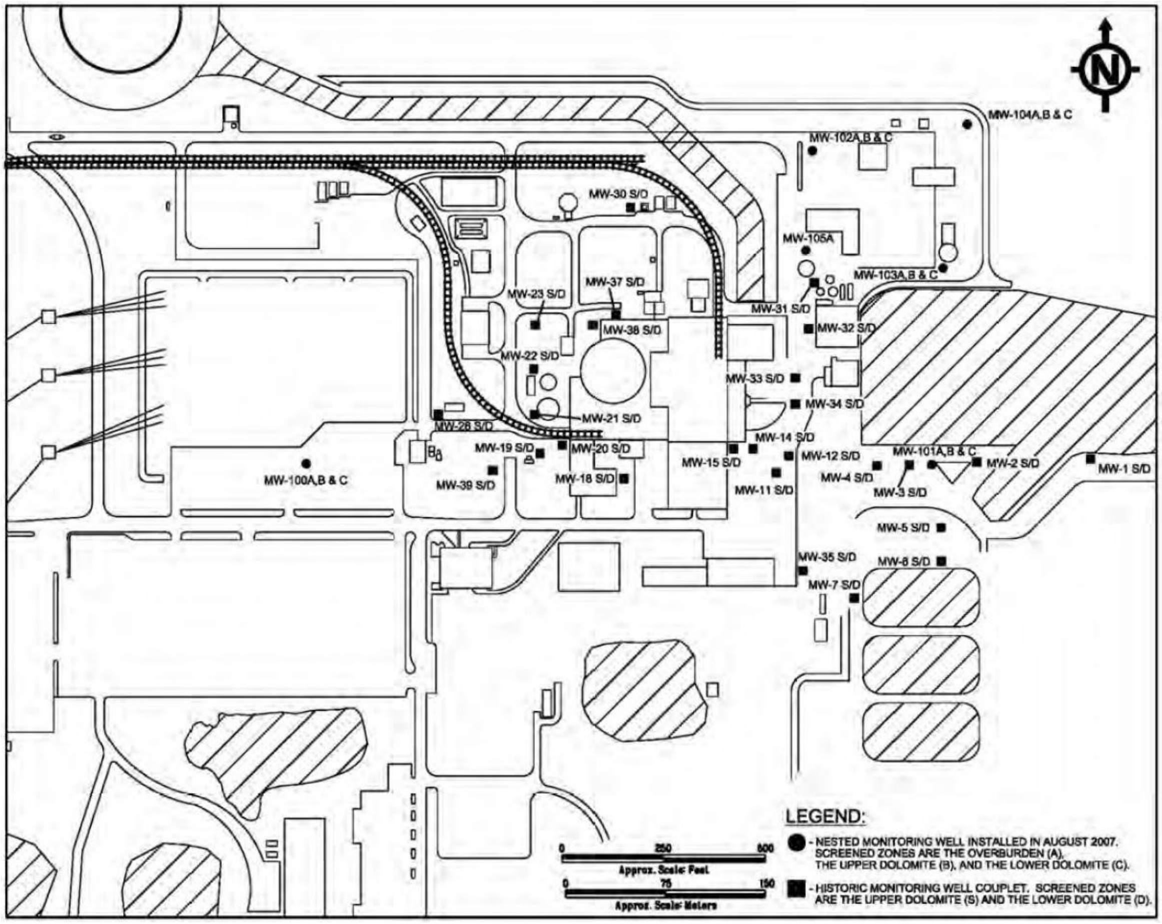
The local shallow stratigraphy is described by ERM (2008) and summarized above in Section 2.2.3. Groundwater flow in the glacial drift, shallow dolomite, and deeper dolomite is generally to the east toward the marshes and Lake Erie; however, flow is complicated by the grout curtain, fractures in the bedrock, and excavated bedrock (ERM 2008).

The nearest aquifer designated as a sole source aquifer by the U.S. EPA is the Catawba Island aquifer (OEPA 2011). This aquifer is over 10 mi (16 km) east of the facility, across a portion of Lake Erie.

The site has had a total of 78 historical wells (in 39 locations with pairs of shallow and deep wells), including some installed for the purpose of dewatering the excavation during site construction (ERM 2008). Some of these wells are used as groundwater monitoring wells. However, 24 of these wells (12 shallow and deep pairs) cannot be located and are assumed to have been destroyed.

In response to the Nuclear Energy Institute’s (NEI’s) groundwater protection initiative, 16 new monitoring wells were installed based on the site hydrogeology (Figure 2–10). Groundwater sampling takes place at the new wells plus some of the historical wells. Tritium monitoring results from June through August of 2007 indicated that the highest tritium observed in the monitoring well network (up to 7,535 pCi/L in well 32S) is east of the containment and is higher in shallow dolomite than in deep dolomite (ERM 2008). The background level of tritium has been established to be 178 to 348 pCi/L (ERM 2008). The U.S. EPA drinking water limit is 20,000 pCi/l (40 CFR 141.66).

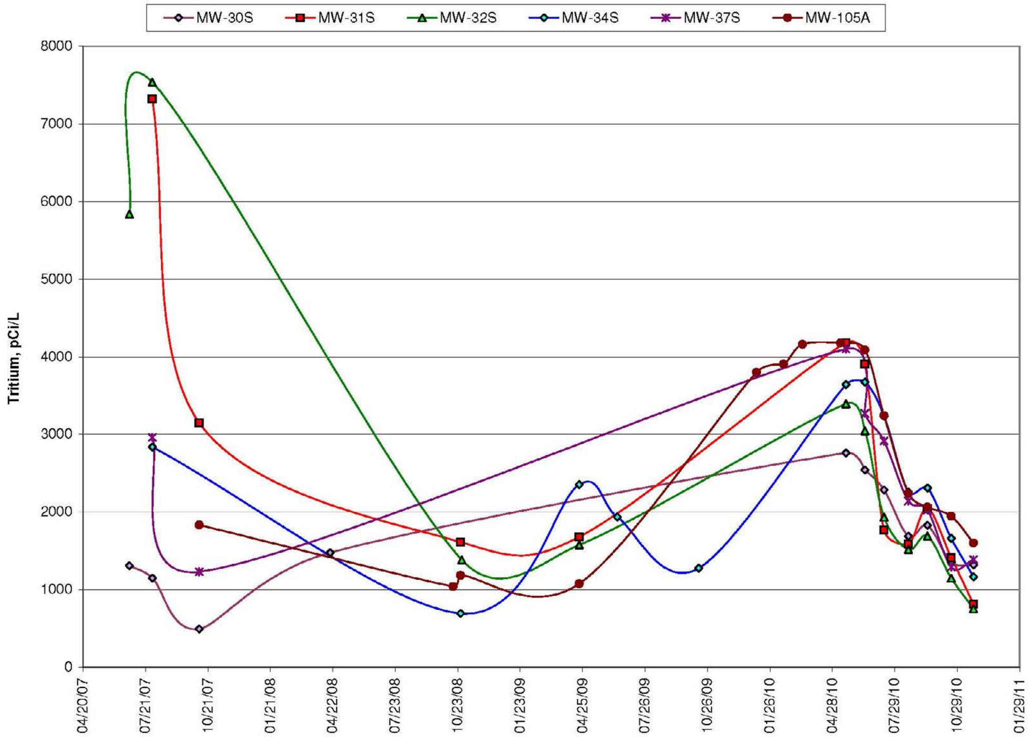
Figure 2–10. Groundwater Monitoring Well Locations



Source: FENOC 2011c

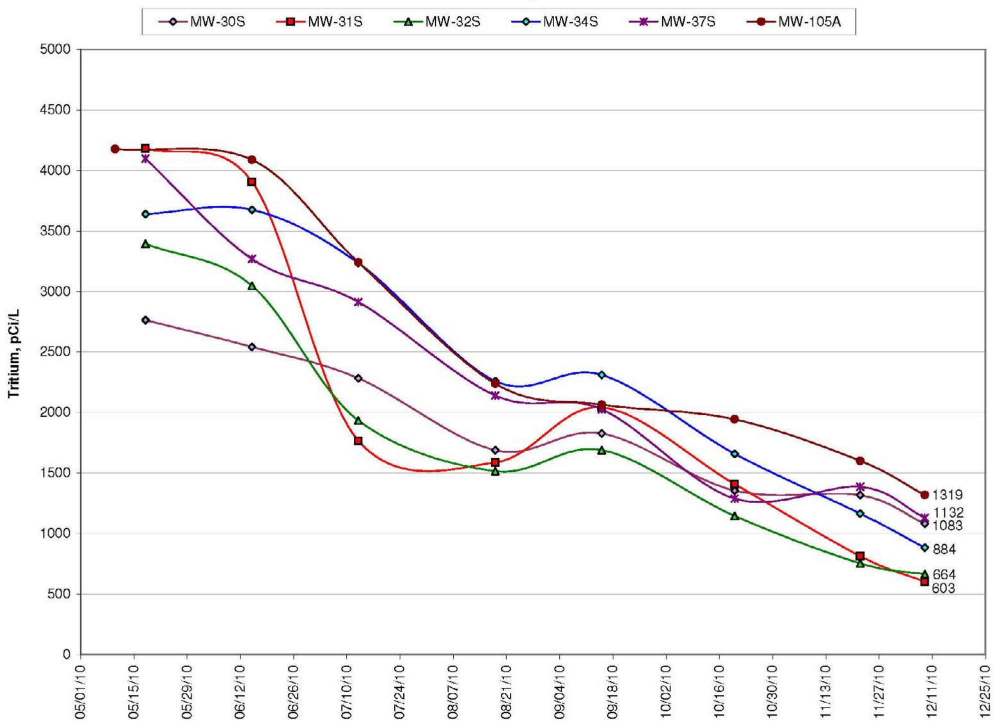
Graphs of tritium results at six wells with relatively high tritium levels were provided by FENOC staff for viewing during the site audit. The graphs of tritium concentrations are included as Figure 2–11 and Figure 2–12. The graphs covered the period of summer 2007 through December 2010 at monitoring wells 30S, 31S, 32S, 34S, 37S, and 105A. The activity concentrations in the wells showed erratic behavior from 2007 to the spring of 2010. The highest levels were at wells 32S and 31S, which were both above 7,000 pCi/L in summer 2007. Well 32S was above 6,000 pCi/L in spring 2007, but all other measurements in this 2007 to 2010 timeframe at the six wells were below 5,000 pCi/L. Beginning in spring 2010 and continuing to December 2010, tritium levels in all six wells showed a strong downward trend. All six wells have been below 2,000 pCi/L in the October through December 2010 timeframe. The tritium levels continued to trend downward through 2011, and, by the end of the year, tritium levels in all wells were below 1,000 pCi/L. The maximum value reported at the end of 2011 was 794 pCi/L in well 37s (FENOC 2012).

Figure 2–11. 2007–2011 Groundwater Monitoring Tritium Concentrations



Source: FENOC 2011c

Figure 2–12. May 2010–December 2010 Groundwater Monitoring Tritium Concentrations



Source: FENOC 2011c

ERM (2008) provided a plausible explanation regarding tritium release and migration. It stated that "potential inadvertent releases from the power block, including the spent fuel pool, would migrate vertically down through the unsaturated zone to the water table. Potential releases from structures below ground could release tritium directly to the upper or lower dolomite unit." Potential tritium sources in the power block are the reactor containment, auxiliary building, circulating water pump house, turbine building, and borated water storage tank (ERM 2007), (ERM 2008). In addition, several spent fuel pool leaks have been documented (Davis-Besse Undated).

In 2012, tritium values remained below 1,000 pCi/L (FENOC 2013b). In 2013, elevated tritium values were found in three wells (MW-32S, MW-34S, and MW-37S). Late in 2013, tritium values in these three wells ranged from 1,338 to 1,966 pCi/L. The apparent cause was a short-term leak of water containing tritium from temporary piping used during an outage in July 2013. In 2013, the frequency of groundwater quality sampling was increased to determine the size of the affected area. Monitoring does not indicate that there is an active ongoing leak. There is no evidence that groundwater containing tritium traveled off site (FENOC 2014). All tritium concentrations are well below the U.S. EPA drinking water limit of 20,000 pCi/L.

In May 1990, leaking piping from the east turbine building sump and condensate demineralizer backwash receiving tank resulted in low-level radioactivity in soil around the broken piping (NRC 1991). The licensee initiated Potential Condition Adverse to Quality (PCAQ) Report No. 90-0404 on May 11, 1990, and the leak was repaired September 12, 1990. Soil excavation to remediate took place in August 1990; sampling showed Cs-137 from 7×10^{-7} to 2×10^{-5} µCi/g, and Cs-134 from 8×10^{-8} to 9×10^{-6} µCi/g (NRC 1991).

The facility has had several spills of petroleum products, resulting in product retrieval wells and in situ bioremediation. In 1998, a diesel tank overfill resulted in a spill of over 50 gallons (FENOC 1998). This tank was an aboveground tank classified as an underground tank because of placement of an earthen cover for missile protection. Because there was no apparent release to the environment beyond the immediate vicinity of the spill, and because of the purpose of the earthen cover, contaminated soils were not removed. Davis-Besse intends to investigate and remediate soil as appropriate upon closure of the tank facility.

In 1994, a spill of about 1,300 gallons of gasoline occurred by Service Building 4 (Centerior Energy 1994). An equipment malfunction was repaired and, as of 5 weeks after the event, about 500 gallons of product had been recovered. The remaining gasoline was believed to be in the porous fill beneath a parking lot. It remained onsite and was not observed in the marsh area. Stormwater lines were plugged as a precaution (Centerior Energy 1994).

During the audit, another incident was described that involved an underground leak of fuel oil, which appeared in a stormwater catch basin and in the training center pond. Booms and an underflow weir were used to remediate the product, and there was no offsite release.

FENOC staff also described during the audit that the sodium hypochlorite tank has leaked twice, but no release to the environment occurred because of the tank's secondary containment system.

2.2.6 Aquatic Resources

2.2.6.1 Lake Erie Overview

Davis-Besse is located on the southwestern shore of Lake Erie, the shallowest of the Great Lakes. The Detroit River accounts for 80 percent of freshwater inflow to Lake Erie. Precipitation accounts for 11 percent of inflow, and the remaining 9 percent comes from tributaries that flow into the lake from Michigan, Ohio, Pennsylvania, New York, and Ontario, Canada (EPA 2004). Lake Erie discharges into Lake Ontario through the Niagara River. Lake Erie is divided into three basins—the western basin, the central basin, and the eastern basin. Davis-Besse lies along the western basin, which has a mean depth of 24.1 ft (7.4 m) and a maximum depth of 62 ft (19 m) (EPA 2004). All waters in the western basin are classified as seasonally cool water (68 to 80 °F (20 to 28 °C)). Generally, Lake Erie is considered to be mesotrophic (having moderate levels of nutrients) (Tyson et al. 2009).

Because a third of the total Great Lakes population lives within the Lake Erie watershed, Lake Erie experiences the greatest impacts from residential and industrial development, agricultural production, and other human-caused stressors. Lake Erie was the first of the Great Lakes to develop problems with nutrient loading in the 1950s, which led to high levels of eutrophication and major algal blooms, oxygen depletion, and subsequent die-offs of fish and other biota (EPA 2004). Toxic contaminants from point and non-point sources have also threatened the water quality of Lake Erie. By the late 1970s, chemical bans, more stringent water quality standards, and the development of the Great Lakes Water Quality Agreement (GLWQA) in 1972 aided in lessening the threat of accelerated eutrophication. Under the GLWQA, the U.S. and Canada must develop and implement lakewide management plans (LaMPs) for lake waters and Remedial Action Plans for EPA-designated Areas of Concern. The Lake Erie LaMP work group completed the most recent update to the Lake Erie LaMP in 2008. The 2008 LaMP highlighted that a large load of PCB-contaminated sediments have been removed from the Ashtabula River area of concern, numerous habitat improvement projects have begun in the Buffalo River Area of Concern, and over 400 ac (160 ha) of forest and wetland habitat has been restored in southwest Ontario (EPA 2008).

Davis-Besse lies within the Maumee River Area of Concern. Environmental stressors in this area include contaminated sediments, loss of habitat, combined sewer overflows, agricultural and urban non-point source runoff, and hazardous waste sites (EPA 2008). Within the Area of Concern, a Remedial Action Plan has been developed to improve water quality of both the Maumee River and Lake Erie. Since 1987, the Remedial Action Plan has been implemented through partnerships between citizens, government agencies, businesses, and industries working to restore the health of the Maumee Area of Concern's streams (PCS 2001).

In a study of the correlation between lake productivity (eutrophication level) and species richness, Ludsin et al. (2001) found that the decrease in phosphorus levels between 1969 and 1996 as a result of various phosphorus abatement programs was likely correlated with the increased species richness in the Lake Erie central basin over the same period. From 1969 through 1996, bottom anoxia stopped occurring in the summers; macroinvertebrate prey species, such as *Hexagenia* spp., recovered; and water clarity improved (Ludsin et al. 2001). All of these factors allowed many previously depleted fish populations to begin to recover.

Invasive species serve as another major stressor to Lake Erie and have caused drastic changes to the Lake Erie fish community over the past century. The first recorded invasive fish, the alewife (*Alosa pseudoharengus*), invaded the Great Lakes as early as 1819 (Emery 1985). As of 2008, 132 non-native invasive species have been discovered in the Lake Erie watershed, which include 23 fish, 12 mollusks, and 20 algae (EPA 2008). The International Joint Commission (IJC) estimates that a new invasive species enters the Great Lakes system every 8 months (IJC 2004). In 1993, the U.S. passed regulations that required ships entering the Great Lakes to exchange their ballast water with seawater. This regulation change has not slowed the rate of aquatic invasive introductions; however, the Great Lakes system has experienced a shift to smaller, open water non-native organisms such as zooplankton and phytoplankton beginning in the 1990s and 2000s (IJC 2004).

The sea lamprey (*Petromyzon marinus*), which invaded the Great Lakes in the early 1900s, and the zebra mussel (*Dreissena polymorpha*), which was introduced to Lake Erie in the 1980s, have caused the most noticeable changes to the biological community (EPA 2004). The sea lamprey is an aggressive predator that had been attributed to the collapse of lake trout (*Salvelinus namaycush*), lake whitefish (*Coregonus clupeaformis*), and lake herring (*Coregonus artedi*) populations beginning in the 1940s and 1950s (GLFC 2000). Zebra and quagga mussels (*D. rostriformis bugensis*) easily outcompete native mussel species and have significantly altered the Lake Erie food web and nutrient and contaminant cycling (EPA 2004). Prior to the introduction of these dreissenid mussels, amphipods, chironomids, annelids, ephemeropterans, and unionid clams dominated Lake Erie's shallow and nearshore waters (Conroy and Culver 2005). Once zebra and quagga mussel populations became established in Lake Erie, they changed the flow of energy through the lake's food web by adding an additional level between lower (pelagic) and higher (benthic) trophic levels, which ultimately slowed the energy transfer through the lake's biological system (Conroy and Culver 2005).

Because of the exotic species discussed above and other exotic predators, many native predators, such as the lake trout, sauger (*Sander canadensis*), and blue pike (*Sander vitreus glaucus*), have suffered population depletion or even disappeared from the lake. The lake herring, lake whitefish, and lake sturgeon (*Acipenser fulvescens*) are also species that have been severely reduced in number. Meanwhile, small, short-lived, exotic species, such as rainbow smelt (*Osmerus mordax*), white perch (*Morone americana*), and alewife, have increased in numbers and now maintain large and relatively stable populations (GLFC 2003).

In their *Twelfth Biennial Report* on Great Lakes water quality, the IJC (2004) focused on the Lake Erie watershed to illustrate the changes in the Lake Erie ecosystem and explain how these

changes related to ecosystem integrity. The IJC (2004) noted that many trends in water and ecosystem quality have varied year-to-year, are not able to be linked to clear causes and effects, and are simultaneously positive and negative. For instance, the invasive zebra and quagga mussels have caused the decline of native mussel species and may be causing seasonal increases in phosphorus levels each spring (IJC 2004). However, zebra and quagga mussels have also been linked to increased water clarity, which, in turn, has allowed for a dramatic increase in established rooted aquatic plant populations (IJC 2004). Table 2–4 includes a summary of the positive and negative trends identified by the IJC in their *Twelfth Biennial Report*.

Table 2–4. Positive and Negative Trends in the Lake Erie Ecosystem Since the 1990s

Trend	Positive	Negative
Blue-green algae blooms		x
Burrowing mayfly recovery	x	
Cladophora shoreline accumulations		x
Diporeia decline		x
Establishment of invasive species		x
Fish & wildlife die-offs from botulism		x
Increased water clarity	x	
Lake whitefish decline (eastern basin)		x
Lake whitefish recovery (central basin)	x	
Phosphorus increase in water column		x
Phytoplankton decline in offshore waters		x
Re-establishment of rooted aquatic plant communities	x	
Walleye recovery	x	

Source: IJC 2004

In the 1990s, burrowing mayflies (*Hexagenia* spp.) began to recolonize Lake Erie's western basin after a 40-year absence (Bridgeman et al. 2006). Mayflies are an indicator of environmental health and are an important food source for commercially valuable species such as the yellow perch (*Perca flavescens*) (Bridgeman et al. 2006). Their return indicates that the pollution and eutrophication concerns in Lake Erie are lessening.

Aquatic Invertebrates

In the 1970s, the Center for Lake Erie Area Research (CLEAR) studied aquatic invertebrate abundance and composition as part of monitoring to determine the effects of Davis-Besse's thermal discharge on the aquatic environment (Reutter et al. 1980). Diatoms were the most abundant phytoplankton in the Locust Point region of Lake Erie and typically peaked in the spring and fall. Species of the genera *Melosira*, *Fragillaria*, *Asterionella*, *Stephanodiscus*, and *Synedra* were the most common diatoms. Green algae (class Chlorophyceae) densities were much lower than diatom densities and must less predictable over the study period. Cyanobacteria, or blue-green algae (class Myxophyceae), generally demonstrated sudden, large mid-summer increases.

Zooplankton in Lake Erie's western basin generally consist of protozoans, rotifers, and microcrustaceans. Reutter et al. (1980) found *Brachionus*, *Keratella*, *Polyarthra*, and *Synchaeta* species to be the dominant rotifers. Rotifers generally peaked in October. Copepods were most abundant in spring and fall and were dominated by calanoid and cyclopoid forms.

In addition to phytoplankton and zooplankton, Reutter et al. (1980) described many benthic macroinvertebrates typical of the area. Generally, benthic macroinvertebrate populations were highest in early summer and fall. Burrowing oligochaetes and chironomid midge larvae were the dominant annelids. Freshwater mussels and fingernail clams were the dominant mollusks. Crustaceans typical of the area included the amphipod *Gammarus fasciatus*, water fleas, isopods, seed shrimp, and crayfish.

Fish

Lake Erie's fish community has changed drastically during the past century due to the environmental factors already mentioned. Before 1900, lake trout highly influenced the fish community because it was the dominant predator. Walleye (*Sander vitreus*) and burbot (*Lota lota*) were also major predators at that time. Prey species included emerald shiner (*Notropis atherinoides*), spottail shiner (*N. hudsonius*), gizzard shad (*Dorosoma cepedianum*), and cisco (*Coregonus* spp.) (Tyson et al. 2009). The lake trout was extirpated from Lake Erie in the early 1900s (Tyson et al. 2009). From 1900 to 1950, walleye and blue pike became the major predators in the lake (Tyson et al. 2009). By the 1960s, many invasive species, including sea lamprey, alewife, white perch, and rainbow smelt established stable populations and began to outcompete native predators. The blue pike's population dipped and eventually became extinct by the late 1950s to early 1960s after the last reported spawning in 1954 (Niskanen 2008). The cisco, lake whitefish, and walleye populations severely declined during that time as well. Beginning in the 1980s, the lake's fish community stabilized and only natural annual fluctuations in abundance are now observed (Tyson et al. 2009).

Of the estimated 143 fish species in Lake Erie, 19 are commercially or recreationally harvested or both. Lake Erie fisheries are unique in that they (unlike other Great Lakes fisheries) are sustained by naturally reproducing fish (Tyson et al. 2009). The lake trout is the exception to this because natural resource agencies are working together to recover the population. Overall, sport fishing yields more landings annually than commercial fishing within the lake and its tributaries. The Ohio Department of Natural Resources (ODNR) manages Lake Erie fisheries and publishes yearly status reports on yellow perch, walleye, smallmouth bass (*Micropterus dolomieu*), steelhead trout (*Oncorhynchus mykiss*), lake whitefish, temperate basses (*Morone* spp.), and other major species. A summary of sport and commercial harvests of major species for 2008 appears in Table 2–5. In 2008, 9.6 million pounds of fish were harvested from Lake Erie and its tributaries (ODNR 2009a). Commercial and sport fishing accounted for 43.4 percent and 56.6 percent of landings, respectively (ODNR 2009a). Yellow perch accounted for the majority of commercial landings (36 percent of commercial landings; about 1.5 million pounds), while walleye dominated the sport harvest (69 percent of sport landings; about 3.8 million pounds) (ODNR 2009a).

Table 2–5. Sport and Commercial Harvests of Major Species in Ohio Waters of Lake Erie and its Tributaries, 2008

Scientific Name	Common Name	Sport Harvest	Commercial Harvest	Total Combined Harvest
Aplodinotus grunniens	freshwater drum	14,939	423,705	438,644
Ictalurus punctatus	channel catfish	7,014	447,232	454,246
Micropterus dolomieu	smallmouth bass	3,406	0	3,406
Morone americana	white perch	15,379	545,138	560,517
Morone chrysops	white bass	91,406	424,225	515,631
Oncorhynchus mykiss	steelhead trout	19,605	0	19,605
Perca flavescens	yellow perch	1,528,460	1,515,666	3,044,126
Sander vitreus	walleye	3,779,130	0	3,779,130
Other species[a]		-	827,551	827,551
TOTAL		**5,459,339**	**4,183,517**	**9,642,856**

[a] Data is not available for sport harvest of species other than those listed. Commercial harvest of “other species” include buffalo (*Ictiobus* spp.), bullhead (*Ameiurus* spp.), burbot, carp (family Cyprinidae), gizzard shad, goldfish (*Carassius auratus auratus*), quillback (*Carpiodes cyprinus*), suckers (family Catostomidae), and lake whitefish.

Source: ODNR 2009a

2.2.6.2 Impingement Studies at Davis-Besse

In 1980, CLEAR published a report that summarized an impingement study conducted jointly by CLEAR and the Toledo Edison Company at Davis-Besse (Reutter 1981b). The impingement study ran from January 1 through December 31. Toledo Edison personnel checked the traveling screens regularly, collected impinged fish from the screens, and froze the collected fish for sampling. CLEAR identified, measured, and weighed each sample. During the study year, Reutter (1981b) estimated that 9,056 fish within 23 taxa were impinged on the Davis-Besse traveling screens. Goldfish and gizzard shad accounted for the overwhelming majority of impinged individuals during the sample year at an estimated 47.2 percent and 28.8 percent, respectively. Yellow perch, emerald shiner, and white crappie (*Pomoxis annularis*) accounted for a combined estimate of 15.3 percent. The remaining 18 taxa accounted for an estimated 8.7 percent.

Table 2–6 summarizes the 23 taxa that appeared in the impingement sampling and each taxa’s relative abundance.

Table 2–6. Relative Abundance of Species in Impingement Sampling, 1980

Scientific Name	Common Name	Estimated Impingement (%)
Carassius auratus auratus	goldfish	47.2
Dorosoma cepedianum	gizzard shad	28.7
Perca flavescens	yellow perch	8.3
Notropis atherinoides	emerald shiner	3.8
Pomoxis annularis	white crappie	3.3
Pomoxis nigromaculatus	black crappie	2.0
Aplodinotus grunniens	freshwater drum	2.0
Osmerus mordax	rainbow smelt	1.3
Percina caprodes	logperch darter	0.7
Percopsis omiscomaycus	trout-perch	0.6
Morone chrysops	white bass	0.5
Alosa pseudoharengus	alewife	0.3
Umbra limi	mudminnow	0.3
family Centrarchidae	unidentified sunfish	0.3
Lepomis macrochirus	bluegill	0.2
Ameiurus nebulosus	brown bull head	0.1
Notropis hudsonius	spottail shiner	0.1
Pomoxis spp.	unidentified crappie	0.1
Lepomis gibbosus	pumpkinseed sunfish	<0.1
Lepomis cyanellus	green sunfish	<0.1
Ameiurus spp.	unidentified bullhead	<0.1
family Cyprinidae	carp	<0.1
Noturus flavus	stonecat madtom	<0.1

Source: Reutter 1981b

The relative number of individuals lost to impingement correlated with lake populations for all but five species—goldfish, black bullhead (*Ameiurus melas*), brown bullhead (*A. nebulosus*), black crappie (*Pomoxis nigromaculatus*), and white crappie. These species' relative abundance was higher in impingement samples than in Lake Erie, which indicated that these species most likely use the intake canal as a permanent residence (Reutter 1981b). Reutter (1981b) also concluded that these five species likely spawn within the intake canal due to the high proportion of impinged young-of-the-year.

2.2.6.3 Entrainment Studies at Davis-Besse

In addition to the 1980 impingement sampling conducted at Davis-Besse (Reutter 1981b), CLEAR and the Toledo Edison Company conducted entrainment sampling from April through August 1980 (Reutter 1981a). During 13 samples days, CLEAR took four 3-minute bottom-to-surface tows at the intake with a 0.75-m diameter plankton net and then computed entrainment density by comparing the samples to the volume of water taken into the plant. Table 2–7 summarizes the estimated entrainment densities of eggs and larvae by taxa. Gizzard shad, freshwater drum (*Aplodinotus grunniens*), yellow perch and white bass (*Morone chrysops*) were entrained at the highest densities (Reutter 1981a). Reutter (1981a) concluded that the entrainment losses at Davis-Besse were relatively small when compared to lake-wide populations and that the loss of gizzard shad, walleye, and perch eggs and larvae accounted for a loss of fecundity of less than 0.2 percent of the number captured in sport fishery in 1980.

Table 2–7. Entrainment Densities in Entrainment Sampling, 1980

Scientific Name	Common Name	Estimated Entrainment Density (larvae/100 m^3)
Dorosoma cepedianum	gizzard shad	189.18
Aplodinotus grunniens	freshwater drum	130.67
Perca flavescens	yellow perch	91.00
Morone chrysops	white bass	23.80
Sander vitreus	walleye	2.76
Notropis hudsonius	spottail shiner	1.75
family Cyprinidae	carp	1.67
Osmerus mordax	rainbow smelt	0.97
Notropis atherinoides	emerald shiner	0.86
Percina caprodes	logperch darter	0.85
Coregonus spp.	whitefish	0.49
unidentified spp.	unidentified spp.	0.34
family Cottidae	unidentified sculpin	0.30
Cottus bairdii	mottled sculpin	0.20

Source: Reutter 1981a

2.2.6.4 Thermal Studies at Davis-Besse

From 1972 to 1979, CLEAR gathered data on the aquatic environment surrounding Davis-Besse to determine the thermal impacts of Davis-Besse's operation, which began in 1977. The results of this study were summarized in a report prepared for the ODNR (Reutter et al. 1980). CLEAR collected phytoplankton, zooplankton, benthic macroinvertebrate, fish, and ichthyoplankton samples from 25 stations in Lake Erie—18 on the open lake, 2 in the intake canal, 2 in the marshes, and 3 along the shoreline—plus several control stations. The species composition and abundances observed during this study are discussed previously in this section under the heading "Aquatic Invertebrates." Reutter et al. (1980) concluded that no clear correlation existed between any aquatic populations and Davis-Besse's thermal discharge.

2.2.7 Terrestrial Resources

2.2.7.1 Davis-Besse Ecoregion and Surrounding Vicinity

Davis-Besse lies in the Marblehead Drift/Limestone Plain Level IV subecoregion within the larger Huron/Erie Lake Plains Level III ecoregion. The Marblehead Drift/Limestone Plain subecoregion lies along the southern shore of Lake Erie from Ottawa National Wildlife Refuge east to Huron, Ohio. It encompasses Sandusky Bay and spreads inland to Tiffin, Ohio. Broad, flat plains with thin glacial drifts and limestone-dolomite ridges characterize the area. Historically, beech forests, elm-ash swamp forests, mixed oak forests, wetland, and fen habitats were prevalent. Today, the area has been largely converted to farmland for hay, soybeans, and corn (EPA 2009).

The ODNR characterizes the State's geographic profile by dividing it into five physiographic regions. Davis-Besse lies within the Lake Plains region, a narrow strip of land along the southern shore of Lake Erie that broadens west of Cleveland, Ohio (ODNR 2011e). Effectively, this physiographic region covers the U.S. EPA's Marblehead Drift/Limestone Plain subecoregion as well as the adjacent Erie Lake Plain subecoregion. ODNR (2011e) notes that the northwestern area of the Lake Plains physiographic region (where Davis-Besse is located) was historically called the Great Black Swamp and is characterized by rich, black soils, and poor drainage. The Great Black Swamp originally encompassed about an area 120 mi (190 km) in length and an average of 40 mi (60 km) in width (ODNR and OEPA 1999). Between the mid-1700s and 1980s, residential and commercial development and associated wetland draining reduced the Great Black Swamp to about 5 percent of its historic size, and much of what remains of the swamp consists of isolated wetlands on uncultivated farmland (ODNR and OEPA 1999).

In the immediate vicinity of the Davis-Besse site, the majority of the undeveloped or uncultivated land is wetlands. Within Ottawa County, wetlands account for about 14 percent of the land use type (ODNR and OEPA 1999). The major wetland types present in Ottawa County, as classified by ODNR and OEPA (1999), are hydric woods, open water, shallow marsh, and shrub scrub. Originally, the majority of wetlands were naturally seasonal with some permanent wetlands lying behind barrier beaches along the Lake Erie coast (FWS 2001). Lakefront development and wetland draining has drastically reduced the amount of wetlands and changed the water regimes of those remaining wetland areas. The majority of remaining wetlands in the region are in Federal refuges, state management areas, and private hunting clubs and are surrounded by man-made dikes, which protect the wetlands from wave damage during high water storm events (FWS 2001). American elm (*Ulmus americana*), red maple (*Acer rubrum*), and black ash (*Fraxinus nigra*) make up the majority of climax vegetation (FENOC 2010).

The Ottawa National Wildlife Refuge lies adjacent to and to the west of the Davis-Besse site and encompasses 4,755 ac (1,924 ha). This refuge was established in 1961 and contains two discontinuous sections—the Darby Marsh and the Navarre Marsh. The Darby Marsh contains a combined FWS office and visitor's center and limited access public hiking trails. The Navarre Marsh portion is owned by FENOC and leased to the FWS for management as part of the wildlife refuge. The Navarre Marsh is discussed in more detail below under "Davis-Besse Site." According to the FWS's (2011g) national wetlands inventory, the majority of the refuge consists of freshwater emergent wetland and freshwater forested and shrub wetland.

The Ottawa National Wildlife Refuge is part of a larger complex of three national wildlife refuges (Ottawa, Cedar Point, and West Sister Island) that comprise approximately 9,000 ac (3,600 ha) in total. Cedar Point National Wildlife Refuge lies along the coast of Lake Erie about 15 mi (24 km) to the west of the Davis-Besse site. It was established in 1965 and comprises 2,445 ac

(989 ha) of contiguous marsh—the largest stretch of contiguous marsh along Lake Erie (ONWRA 2011). West Sister Island National Wildlife Refuge lies to the north of Davis-Besse about 10 mi (16 km) offshore of Lake Erie. The 82-ac (33-m) island is home to the largest wading bird colony in the U.S. Great Lakes and was designated as part of the National Wilderness Preservation System in 1975 (ONWRA 2011). The island is 35 ft (11 m) above MSL at its highest point and is covered by an almost pure stand of hackberry (*Celtis* spp.) (OWL 2011). Thick mats of poison ivy (*Toxicodendron radicans*), ferns, wildflowers, and mushrooms make up the understory (FWS 2011a).

<u>Birds</u>

A vast diversity of birds inhabit and migrate through the natural habitats surrounding Davis-Besse. The Ottawa National Wildlife Refuge complex and surrounding region provides habitat for over 325 species of birds (FWS 2001). The National Audubon Society recognizes 600,000 ac (240,000 ha) on the Lake Erie western basin (including the Davis-Besse site and surrounding vicinity) as an important bird area because it provides essential wintering, breeding, and migrating habitat for many species of birds to include the following (Audubon 2011):

- ruddy duck (*Oxyura jamaicensis*),
- American black duck (*Anas rubripes*),
- red-breasted merganser (*Mergus serrator*),
- ring-billed gull (*Larus delawarensis*),
- great black-backed gull (*L. marinus*),
- herring gull (*L. smithsonianus*),
- common tern (*Sterna hirundo), and*
- bald eagle (*Haliaeetus leucocephalus*).

Though the Mississippi Flyway lies to the west of the Great Lakes, many major branches of the flyway follow the southwestern shore of Lake Erie. The Black Swamp Bird Observatory (BSBO), located just to the west of Davis-Besse, conducts long-term research projects on bird migration and breeding in the area. In 2009, the BSBO recorded 152 species of migrating passerines, 30 species of migrating shorebirds, and 22 species of migrating raptors in Lake Erie marshes alone (BSBO 2009a, 2009b, 2009c).

Table 2–8 lists the passerine, shorebird, and raptor species that the BSBO most commonly reported as occurring during migrations in Lake Erie marshes. Note that, for passerines, the bird species provided are specific to Navarre Station, which is located within Navarre Marsh on the Davis-Besse property.

Table 2–8. Most Common Migrating Bird Species Near the Davis-Besse Site

Spring Migration	Fall Migration
Passerines at the Navarre Station	
• eastern screech owl (*Megascops asio*)	• blackpoll warbler (*D. striata*)
• hairy woodpecker (*Picoides villosus*)	• Swainson's thrush (*Catharus ustulatus*)
• red-headed woodpecker (*Melanerpes erythrocephalus*)	• white-throated sparrow (*Z. albicollis*)
• Gambel's white-crowned sparrow (*Zonotrichia leucophrys* ssp. *gambelii*)	• golden-crowned kinglet (*Regulus satrapa*)
• yellow palm warbler (*Dendroica palmarum* ssp. *hypochrysea*)	• hermit thrush (*C. guttatus*)
Shorebirds in Lake Erie Marshes	
• common snipe (*Gallinago gallinago*)	• killdeer (*Charadrius vociferous*)
• pectoral sandpiper (*Calidris melanotos*)	• short-billed dowitcher (*Limnodromus griseus*)
• American golden plover (*Pluvialis dominica*)	• least sandpiper (*Calidris minutilla*)
• lesser yellowlegs (*Tringa flavipes*)	• solitary sandpiper (*T. solitaria*)
• greater yellowlegs (*T. melanoleuca*)	• semipalmated sandpiper (*Calidris pusilla*)
Raptors in Lake Erie Marshes	
• turkey vulture (*Cathartes aura*)	• cooper's hawk (*A. cooperii*)
• red-tailed hawk (*Buteo jamaicensis*)	• bald eagle (*Haliaeetus leucocephalus*)
• sharp-shinned hawk (*Accipiter striatus*)	• northern harrier (*Circus cyaneus*)
• broad-winged hawk (*B. platypterus*)	• osprey (*Pandion haliaetus*)
• red-shouldered hawk (*B. lineatus*)	• American kestrel (*Falco sparverius*)

Source: BSBO 2009a, 2009b, 2009c

The region also provides wintering habitat for dabbling ducks (subfamily Anatinae), diving ducks (subfamily Aythyinae), geese, and other waterfowl (Herdendorf 1987). Gulls (family Laridae), terns (family Sternidae), and cormorants (family Phalacrocoracidae) nest along the coast of Lake Erie and on the islands off the coast of the lake. Raptors, including the bald eagle, turkey vulture (*Cathartes aura*), osprey (*Pandion haliaetus*), American kestrel (*Falco sparverius*), and many hawk species also nest in the area (Herdendorf 1987).

On West Sister Island, the FWS estimates that a colony of great blue herons (*Ardea herodias*), great egrets (*Ardea alba*), double-crested cormorants (*Phalacrocorax auritus*), and black-crowned night herons (*Nycticorax nycticorax*) totals 3,500 nesting pairs (FWS 2001). This colony contains the largest black-crowned night heron rookery in the Great Lakes (FWS 2001). Because the shores of West Sister Island do not provide any wading habitat, birds that nest on West Sister Island fly to the Lake Erie shore to feed multiple times per day.

Despite the vast array of birds that make use of habitat within the Davis-Besse region, the Ohio Audubon Society reports that many common species are in decline due to urban sprawl, non-native invasive species, and the expansion of industrialized agriculture.

The Ohio Audubon Society (2007) summarized the most vulnerable common species in decline and their percent decline since 1967 as follows:

- green heron (*Butorides virescens*)—82 percent decline,
- red-headed woodpecker (*Melanerpes erythrocephalus*)—78 percent decline,
- eastern meadowlark (*Sturnella magna*)—75 percent decline,
- northern flicker (*Colaptes auratus*)—67 percent decline, and
- yellow-breasted chat (*Icteria virens*)—63 percent decline.

In addition to these five common species in decline, the Ohio Audubon Society's (2009) watch list identifies five species of birds that are the most critically imperiled birds in the U.S. and at greatest risk of regional extirpation. These five species are the red-headed woodpecker (also included above on the "most vulnerable" list), Henslow's sparrow (*Ammodramus henslowii*), prothonotary warbler (*Protonotaria citrea*), prairie warbler (*Dendroica discolor*), and cerulean warbler (*Dendroica cerulean*).

Mammals

Northwestern Ohio's mammal population is dominated by rodents, smaller predators, and deer. About 30 species in total occur in the Ottawa Refuge Complex (FWS 2001). Common mammals in the region include muskrat (*Ondatra zebethicus*), raccoon (*Procyon lotor*), and white-tailed deer (*Odocoileus virginianus*), all of which inhabit or use wetland habitats. Numerous muskrat houses are visible within inundated areas of Darby Marsh. Eastern cottontail (*Sylvilagus floridanus*), woodchuck (*Marmota monax*), fox squirrels (*Sciurus niger*), and striped skunk (*Mephitis mephitis*) occupy meadows, dikes, and forest edges. Small predators in the western Lake Erie marshes include long-tailed weasels (*Mustela frenata*), mink (*M. vison*), and red fox (*Vulpes fulva*). The majority of larger predators were extirpated from the area when northwestern Ohio was first settled. These include the wolverine (*Gulo gulo*), panther (*Felis concolor*), lynx (*F. lynx*), bobcat (*F. rufus*), gray wolf (*Canis lupus*), and black bear (*Ursus americanus*) (Herdendorf 1987).

Amphibians and Reptiles

A variety of amphibians and reptiles inhabit the area, including salamanders, newts, toads, and frogs. One lizard (the five-lined skink (*Eumeces fasciatus*)) and 16 species of turtles and snakes occur in the Ottawa Refuge Complex (FWS 2001). Mudpuppies (*Necturus maculosus*)—a species of aquatic salamander—inhabit wetlands and small streams with soft bottoms (Herdendorf 1987). Spotted salamanders (*Ambystoma maculatum*), tiger salamanders (*A. tigrinum*), Jefferson salamanders (*A. jeffersonianum*), and smallmouth salamanders (*A. texanum*) hatch and develop in wetlands, move to moist woodlands at adulthood, and return to wetlands annually to breed and lay eggs. The dusky salamander (*Desmognathus fuscus*) and red back salamander (*Plethodon cinereus*) inhabit the Lake Erie coast. Toads and frogs use both wetland waters, ponds, streams, and a variety of land habitats. Common species in the region include the American toad (*Bufo americanus*), spring peepers (*Pseudacris crucifer*), western chorus frog (*Pseudacris triseriata*), cricket frogs (*Acris* spp.), pickerel frog (*Rana palustris*), and northern leopard frog (*R. pipiens*). The snapping turtle (*Chelydra* spp.) is the largest reptile in western Lake Erie. Members of the water and box turtle family—map turtles (*Graptemys* spp.), spotted turtle (*Clemmys guttata*), midland painted turtle (*Chrysemys picta* ssp. *marginata*), box turtles (*Terrapene* spp.), and Blanding's turtle (*Emys blandingii*)—inhabit ponds and wetlands with standing water and thick aquatic vegetation. The Lake Erie water snake is the most common snake species in the region. Gartner snakes (*Thamnophis* spp.),

black rat snakes (*Elaphe obsolete*), Dekay's snakes (*Storeria dekayi*), and hog-nosed snakes (family Colubridae) also inhabit the area (Herdendorf 1987).

Vegetation

The Lake Erie western basin has the greatest diversity of wetland plant species. The majority (over 700 of the estimated 800 vascular plant species) of vegetation in the region are grasses, reeds, aquatic plants, and other non-tree or shrub species (Bolsenga and Herdendorf 1993). Dominant wetland species include cattail (*Typha* spp.), bur reed (*Sparganium* spp.), grasses (*Echinochloa* spp., *Leersia oryzoides*, *Calamagrostis Canadensis*), spatterdock (*Nuphar advena*), water lily (*Nymphaea* spp.), and water smartweed (*Polygonum coccineum*) (Bolsenga and Herdendorf 1993). Within dikes, common greenbriar (*Smilax rotundifolia*), thistles, coneflower, common milkweed (*Asclepias syriaca*), asters (*Aster* spp.), river bank grape (*Vitis riparia*), and burdock (*Arctium* spp.) dominate (FENOC 2010c). Within swamps, riparian, and forested areas, eastern cottonwood (*Populus deltoides*), hackberry, sycamore (*Platanus occidentalis*), riverbank grape, black willow (*Salix nigra*), and staghorn sumac (*Rhus typhina*) constitute the climax vegetation assemblage (FENOC 2010c).

Many invasive species are present in the region, including purple loosestrife (*Lythrum salicaria*), reed canary grass (*Phalaris arundinacea*), common reed (*Phragmites australis*), and flowering rush (*Butomus umbellatus*). FENOC does not manage these species on its site. However, the FWS uses a variety of techniques (hand-pulling, burning, and mowing; herbicides; and loosestrife-controlling weevils and beetles) to control invasive plants within the Ottawa National Wildlife Refuge, which includes Navarre Marsh on the Davis-Besse site (FWS 2001).

2.2.7.2 Davis-Besse Site

The Davis-Besse site consists of 954 ac (386 ha), of which 733 ac (297 ha) is the Navarre Marsh. As previously mentioned, the FWS leases the Navarre Marsh for management as part of the Ottawa National Wildlife Refuge. The remaining 221 ac (89 ha) of the site is composed of developed areas containing facility buildings, structures, and parking lots; woodlands; low grasslands; and marginal agricultural land (FENOC 2010c).

The Navarre Marsh lies on the southeast end of the Davis-Besse site and is composed of freshwater marsh, swamp forest, wet meadow, and small areas of deciduous forest (FENOC 2010c). A beach ridge separates the Navarre Marsh from the southern shore of Lake Erie. Sandbar willow (*Salix interior*), staghorn sumac, and elderberry (*Sambucus* spp.) dominate this beach ridge (FENOC 2010c). A hardwood swamp—part of Navarre Marsh—lies directly behind the beach ridge. As discussed previously, the BSBO has a research station within the Navarre Marsh where it conducts migration surveys.

2.2.7.3 Transmission Line Corridors

FENOC manages approximately 1,800 ac (730 ha) of transmission line corridors as part of its transmission line maintenance, the majority of which is flat agricultural land (FENOC 2010c). The transmission lines also traverse a combination of wetlands, forests, streams, and developed land, and the Beaver Line crosses the Toussaint and Portage rivers to the south of the Davis-Besse site. Management of these corridors is discussed in Section 2.1.5.

2.2.8 Protected Species and Habitats

This section discusses species and habitats that are: (1) Federally protected under the Endangered Species Act of 1973, as amended (ESA); (2) Federally protected under the Bald and Golden Eagles Protection Act of 1940, as amended; (3) Federally protected under the

Migratory Bird Treaty Act of 1918, as amended (MBTA); and (4) State-protected species under Chapter 1518, *Endangered* Species, of the Ohio Revised Code.

No essential fish habitat exists in the vicinity of the Davis-Besse site; therefore, species protected under the Magnuson–Stevens Fishery Conservation and Management Act, as amended, are not considered in this section. Additionally, no marine waters are affected by the proposed license renewal; therefore, species protected under the Marine Mammal Protection Act of 1972, as amended, are not considered in this section.

2.2.8.1 Species and Habitats Protected Under the Endangered Species Act

The FWS and the National Marine Fisheries Service (NMFS) jointly administer the ESA of 1973 (16 USC 1531 et seq.). The FWS manages the protection of and recovery effort for listed terrestrial and freshwater species, while the NMFS manages the protection of and recovery effort for listed marine and anadromous species.

<u>Action Area</u>

The implementing regulations for section 7(a)(2) of the ESA define "action area" as all areas affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02). The action area effectively bounds the analysis of ESA-protected species and habitats because only species that occur within the action area may be affected by the Federal action. The action area includes the lands and waters described below. The NRC staff expects all direct and indirect effects of the proposed action to be contained within these areas.

The Davis-Besse site lies on the southwestern shore of Lake Erie in Ottawa County, Ohio. The site encompasses 954 ac (386 ha), of which FENOC leases approximately 733 ac (297 ha)—designated as "Navarre Marsh"—to the FWS for management as part of the Ottawa National Wildlife Refuge. The remaining 221 ac (89 ha) of the site are composed of developed areas containing facility buildings, structures, and parking lots; woodlands; low grasslands; and marginal agricultural land. The proposed license renewal would include continued operation of the site and continued lease of Navarre Marsh to the FWS. License renewal would not involve any new construction on either the developed or the undeveloped portions of the site. The proposed license renewal would continue to use the existing onsite switchyard and transmission

facilities and would not require the construction or modification of the existing transmission system.[2]

Davis-Besse withdraws water from, and discharges cooling tower blowdown to, Lake Erie. Water is withdrawn approximately 3,000 ft (900 m) offshore. During normal operations, 21,000 gpm (80 m^3/min) of water is withdrawn at a rate of about 0.25 fps (0.08 m/s). Water is returned to the lake via a 6-ft (1.8-m) diameter buried pipe located about 9 ft (2.7 m) below the lake's surface. During normal operations, an average of 11,000 gpm (42 m^3/min) of water is discharged at a rate of 3.6 fps (1.1 m/s). The proposed license renewal would involve the continued use of Lake Erie as a source of cooling water. Section 2.2.6 describes the ecology of Lake Erie.

Within the action area, Federally listed terrestrial species could experience impacts such as habitat disturbance associated with refurbishment or other ground-disturbing activities, cooling tower drift, collisions with cooling towers and transmission lines, exposure to radionuclides, and other direct and indirect impacts associated with station, cooling system, and in-scope transmission line operation and maintenance. The proposed action has the potential to affect Federally listed aquatic species in several ways: impingement or entrainment of individuals into the cooling system; alteration of the riverine environment through water level reductions, changes in dissolved oxygen, gas supersaturation, eutrophication, and thermal discharges from cooling system operation; habitat loss or alteration from dredging; and exposure to radionuclides.

Species and Habitats Under NMFS's Jurisdiction

No Federally listed species or critical habitats under NMFS's jurisdiction exist in the action area. The NMFS confirmed this by letter dated December 21, 2010 (NMFS 2010).

Species and Habitats Under FWS's Jurisdiction

Table 2–9 identifies species under the FWS's jurisdiction within Ottawa County. The NRC created this list based on the FWS's Endangered Species Program online database (FWS 2013); ODNR's online Natural Heritage Database (ODNR 2013); correspondence between the NRC and FWS (FWS 2010c); and additional communications between the NRC and FWS staff pursuant to consultation under section 7 of the ESA.

[2] The GEIS (NRC 1996) does not define the scope of transmission lines that should be considered for the site-specific (Category 2) issue, "Threatened or Endangered Species." In 1999, the NRC staff made a policy decision to consider the scope of transmission lines for its "Threatened or Endangered Species" analyses to be that defined at 10 CFR 51.53(c)(3)(ii)(H), which states that "If the applicant's transmission lines that were constructed for the specific purpose of connecting the plant to the transmission line system do not meet the recommendations of the National Electric Safety Code for preventing electric shock from induced currents, an assessment of the impact of the proposed action on the potential shock hazard from the transmission lines must be provided." (NRC 1999b). The NRC has consistently applied this scope to its "Threatened or Endangered Species" license renewal analyses since that time. In preparing the GEIS, Revision 1 (NRC 2013), the NRC staff reviewed and incorporated lessons learned and knowledge gained from license renewal environmental reviews conducted by the NRC since 1996. The 2013 GEIS recognizes that since construction, many transmission lines have been incorporated into the regional power grid and that, in many cases, lines are no longer owned or managed by NRC licensees, and would, thus, remain energized regardless of license renewal. The 2013 GEIS concludes that "only those transmission lines that connect the power plant to the switchyard where electricity is fed into the regional distribution system (encompassing those lines that connect the nuclear plant to the first substation of the regional electric power grid) and power lines that feed the plant from the grid during outages are considered within the regulatory scope of license renewal environmental review[s]." In the case of Davis-Besse, an onsite switchyard lies just east of the containment building and south of the cooling tower. This switchyard is the first substation of the Toledo Edison grid, at which point electricity is fed into the regional distribution system. Lines beyond this switchyard are owned and operated by FirstEnergy and not the NRC applicant, FENOC. These lines would stay in service regardless of Davis-Besse license renewal because they are interconnected with other utilities (FENOC 2010c) and, thus, would not be affected by the proposed action. For these reasons, the NRC staff will consider the scope of the transmission lines for its "Threatened or Endangered Species" analysis to be that defined in the 2013 GEIS. Under this definition, all in-scope transmission lines are contained within the footprint of the Davis-Besse site.

Table 2–9. ESA Species Under FWS's Jurisdiction That Occur in Ottawa County

Species	Common Name	Federal Status[a]
Birds		
Calidris canutus rufa	red knot	LT
Charadrius melodus[b]	piping plover	LE
Setophaga kirtlandii	Kirtland's warbler	LE
Mammals		
Myotis septentrionalis	northern long-eared bat	LT
Myotis sodalis	Indiana bat	LE
Plants		
Platanthera leucophaea	eastern prairie fringed orchid	LT
Tetraneuris herbacea	lakeside daisy	LT

[a] LE=Federally listed as endangered; LT=Federally listed as threatened
[b] Great Lakes watershed population

Sources: 80 FR 17974; FWS 2010c, 2013; ODNR 2013

Red Knot (*Calidris canutus rufa*). The FWS published a final rule to list the red knot as threatened throughout its range on December 11, 2014 (79 FR 73705). The final rule does not designate critical habitat but indicates that the FWS intends to publish a separate proposal to designate critical habitat in the future. Loss of breeding and nonbreeding habitat, reduced prey availability, and increasing frequency and severity of asynchronies in the timing of the birds' annual migratory cycle relative to favorable food and weather conditions are factors that have contributed to this species' decline. Unless otherwise cited, the information in this section is derived from the FWS's listing document (78 FR 60023).

The red knot is a medium-sized (9 to 11 in. [23 to 28 cm] in length) shorebird. It migrates annually between its breeding grounds in the Canadian Arctic and several wintering regions, including the Southeastern United States, Northeast Gulf of Mexico, northern Brazil, and Tierra del Fuego off the coast of the southern tip of South America. Between both its spring and fall migrations, the red knot uses key staging and stopover areas to rest and feed.

Red knots live up to 7 years (Niles et al. 2008) and likely begin breeding at 2 years (Harrington 2001). The species breeds in June in inland areas near arctic coasts and nests in dry, slightly elevated tundra areas. Breeding success can vary dramatically from year to year based on weather, food availability (insects and other terrestrial invertebrates), and abundance of predators (the arctic lemmings *Dicrostonyx torquatus* and *Lemmus sibericus*). Little information is available on mating fidelity, but the species is known to return to the same breeding grounds each year, and pairs seem to form monogamous bonds throughout the breeding season (Niles et al. 2008). Females lay one clutch of three to four eggs per season. Males and females participate in egg incubation, which lasts for approximately 22 days (Niles et al. 2008). Chicks are born in early July, and the fledgling period lasts 18 days (Niles et al. 2008).

Red knots migrate up to 19,000 mi (30,000 km)—one of the longest migrations known in the animal kingdom—each year, and individuals can undertake flights of several thousand miles without stopping. Stopover habitat most often includes muddy or sandy coastal areas near

mouths of bays and estuaries (Niles et al. 2008). In the spring, stopover areas include the Atlantic coast of Argentina, eastern and northern Brazil, the Virginia barrier islands, and the Delaware Bay. Important fall stopover sites include southwest Hudson Bay, James Bay, the St. Lawrence River, the Mingan Archipelago, and the Bay of Fundy, the coasts of Massachusetts and New Jersey, the mouth of the Altamaha River in Georgia, the Caribbean, and the northern coast of South America from Brazil to Guyana. During both migrations, red knots may stopover along the coast of the Great Lakes. During migration, red knots eat bivalves, gastropods, amphipods, and occasionally polychaetes (Niles et al. 2008).

The Black Swamp Bird Observatory (BSBO), located just to the west of the Davis-Besse site, regularly records small numbers of red knots during both spring and fall shorebird migration surveys (see Table 2–10). BSBO conducts its spring migration survey from March through late November at sites within the Ottawa National Wildlife Refuge complex and surrounding Lake Erie wetlands. The total number of surveyed sites and sample days varies each year, but typically includes 6 to 11 sites and 50 to 250 trips (sample days/sites sampled) per season. Surveys are conducted by vehicle or foot, and shorebird observations are recorded using the International Shorebird Survey protocol. The BSBO's surveys positively indicate that the red knot occurs in the action area.

Table 2–10. Red Knots Present in Lake Erie Shorebird Migration Surveys, 2003–2010

	Number of Individuals Observed	
Year	**Spring Migration**	**Fall Migration**
2003	9	90
2004	55	17
2005	2	28
2006	0	5
2007	1	7
2008	1	8
2009	1	26
2010	0	10

Sources: BSBO 2003b, 2004b, 2005, 2006a, 2007a, 2008a, 2009b, 2010a

<u>Piping Plover (*Charadrius melodus*)—Great Lakes Watershed Population</u>. The FWS listed the Great Lakes watershed population of piping plover as endangered in 1985 (50 FR 50726). The species occurs through much of the northern Great Plains, Great Lakes region, Atlantic coast, and Gulf Coast region. A recent study of the taxonomy of the species (Miller et al. 2009) confirmed genetic uniqueness of only two subspecies—Atlantic (*C.m. melodus*) and Interior (*C.m. circumcinctus*), though the FWS recognizes three distinct population segments in its ESA rulemakings—the Atlantic Coast, the Great Lakes, and the Northern Great Plains populations (FWS 2009a). The Atlantic Coast population is *C.m. melodus*, while the Great Lakes and Northern Great Plains populations are *C.m. circumcinctus*.

Piping plovers inhabit open, sandy, sparsely vegetated beaches and barrier islands along the Great Lakes' shorelines. They avoid high bluffs or areas where the beach has been severely eroded. Historically, the Great Lakes watershed population bred throughout the Great Lakes' shorelines in within eight states, including Ohio, as well as Ontario (Haig 1992). Currently, breeding is restricted to several beaches along Lake Superior and Lake Michigan in northern

Michigan (Haig 1992). The population winters along the Gulf coasts of Texas, Louisiana, Alabama, and Florida.

Piping plovers have not nested on Lake Erie since 1942 (ODNR 2011d). Since the late 1970s, piping plovers have been considered extirpated from the Great Lakes beaches in Ohio, Illinois, Indiana, New York, Pennsylvania, and Ontario (FWS 2003). In its five-year review of the species, the FWS (2009b) noted that piping plovers are infrequently sited in Ohio during migration on Headlands Beach in Mentor and Sheldon Marsh in Huron, which lie about 150 mi (240 km) and 110 mi (180 km) west of Davis-Besse, respectively. In the available data years (2003-2010), the BSBO has recorded the piping plover in 4 years within the Lake Erie marsh region (see Table 2–11). Thus, shoreline within the Davis-Besse site may provide marginal habitat for migrating piping plovers, but the occurrence of this species within the action area would be rare.

Table 2–11. Piping Plovers Observed During BSBO's Lake Erie Marsh Migration Survey, 2003–2010

	Number of Individuals Observed	
Year	Spring Migration	Fall Migration
2003	0	0
2004	0	0
2005	0	1
2006	0	0
2007	1	0
2008	0	2
2009	0	0
2010	0	5

Sources: BSBO 2003b, 2004b, 2005, 2006a, 2007a, 2008a, 2009b, 2010a

The FWS designated critical habitat for the Great Lakes breeding population in May 2001 (66 FR 22938). Two critical habitat units (OH-1 and OH-2) are located within Ohio. However, these units lie outside of the action area in Erie and Lake Counties.

Kirtland's Warbler (*Setophaga kirtlandii*). The FWS included the Kirtland's warbler in its first list of threatened and endangered species in 1970 (35 FR 8491). No critical habitat has been designated for the species. The primary threats to the continued existence of Kirtland's warblers are loss of breeding habitat and nest parasitism by the brown-headed cowbird (*Molothrus ater*) (FWS 2009c).

The Kirtland's warbler is a relatively large (14 cm [5.5 in.] in length and 12 to 15 grams [0.42 to 0.53 ounces] in weight) wood warbler with bluish-gray plumage on the head, back, and wings, and a yellow throat, belly, and breast (FWS 2012a). The wings and back also include black and white streaking. Males are more brightly colored than females. Kirtland's warblers nest in jack pine (*Pinus banksiana*) forest within Michigan, Wisconsin, and Ontario, Canada, and winter in the Bahamas archipelago. During migration, individuals travel a fairly direct route and enter and leave North America at the North and South Carolina coast (FWS 1985). Stopover habitat typically includes shrub/scrub or forested habitat in Ohio, West Virginia, Virginia, the Carolinas, and Georgia (FWS 1985). However, Petrucha et al. (2013) indicates that the species has been

reported across 24 states, the District of Columbia, Manitoba, Ontario, and Québec. Kirtland's warblers are insectivorous and forage in pine needles, leaves, and other ground cover for various types of larvae, moths, flies, beetles, grasshoppers, ants, aphids, spittlebugs, blueberries, pine needles, and pitch from twigs and jack pine (FWS 2012a).

Birds arrive at breeding grounds in early May (Petrucha et al. 2013). Breeding pairs form within a week of arrival, and pairs may be monogamous or polygynous (FWS 2012a). Females typically lay four to five eggs beginning in mid- to late May over a 5- to 6-day period (FWS 2012a). Females incubate the eggs, and eggs hatch in 13 to 15 days (FWS 2012a). Young fledge the nest about 9 days after hatching (FWS 2012a). Individuals leave nesting grounds to migrate to wintering grounds in late August to mid-September (Petrucha et al. 2013).

Migration lasts from 13 to 23 days, including stopovers (Ewert et al. 2012). Records of spring-migrant Kirtland's warblers are concentrated in southern Michigan, Ontario, northern Ohio, and Illinois, but records also span Wisconsin, Indiana, Ohio (south of Lake Erie), western Pennsylvania, and the Atlantic coasts of Florida, South Carolina, and Georgia (Petrucha et al. 2013). Fall migration is more widely scattered across the Midwest and eastern states (Petrucha et al. 2013). In a review of migration records, Petrucha et al. (2013) found that stopover habitat is typically shrub/scrub (82.4 percent of records). Other habitats included residential (10.7 percent), parks with widely scattered trees or shrubs (3.7 percent), woodlands with closed canopies (1.6 percent), orchards (1.1 percent), and open land with exposed soil and little vegetation (0.5 percent).

According to the FWS (2012b), migrating Kirtland's warblers can be expected to occur along the shore of Lake Erie between April 22 and June 1 during spring migration and between August 15 and October 15 during fall migration. The western basin of Lake Erie has the highest concentration of migrating Kirtland's warbler observations of any place in the United States outside of Michigan, where it breeds (FWS 2012b). Petrucha et al. (2013) collected 112 records of spring-migrating Kirtland's warbler occurrences in Ohio dating between 1880 and 2011. Eight of the records were within Ottawa County, and one record from May 2000 was in shrub/scrub habitat within Navarre Marsh on the Davis-Besse site. Various birding Web sites and blogs have anecdotally reported observing the species in Magee Marsh, which lies west of the Davis-Besse site, in 2010, 2012, and 2013. The NRC was unable to locate any official confirmations of these sightings. However, the available information indicates that the Kirtland's warbler occurs in the action area.

<u>Northern Long-Eared Bat (*Myotis septentrionalis*)</u>. The FWS listed the northern long-eared bat as threatened on April 2, 2015 (80 FR 17974). The FWS did not designate critical habitat for the species because it found that such habitat was not determinable at this time of listing. White nose syndrome, wind energy development, and loss of habitat specifically linked to surface coal mining in prime summer habitat are factors that have contributed to this species' decline. Unless otherwise cited, the information in this section is derived from the FWS's listing documents (78 FR 61046; 80 FR 17974).

The northern long-eared bat is a medium-sized forest-dwelling bat that is distinguished from other *Myotis* species by its long ears, which average 0.7 in. (17 mm) in length. This bat inhabits 39 states in the eastern and north central United States and all Canadian provinces west to the southern Yukon Territory and eastern British Columbia. Populations tend to be patchily distributed across its range and are typically composed of small numbers. More than 780 winter hibernacula have been recorded in the United States (three in Ohio), most of which contain only a few (one to three) individuals. Northern long-eared bats are infrequently found in winter hibernacula surveys across the Midwest. The largest population in Ohio includes over 300 individuals and occurs in the southwestern portion of the state in Preble County. In

summer, northern long-eared bats are regularly collected as incidental catches during Ohio mist-net surveys for Indiana bats. The FWS recognizes four U.S. populations. Northern long-eared bats inhabiting Ohio are considered part of the Midwest population.

In summer, bats roost alone or in small colonies under the bark of live or dead trees; in caves or mines; or in manmade structures, such as barns, sheds, and other buildings. The species opportunistically roosts in a variety of trees, including several species of oaks, maples, beech, and pine. Several studies indicate that northern long-eared bats prefer intact, older forests (Carter and Feldhamer 2005; Lacki and Schwierjohann 2001). Henderson et al. (2008) found that the probability of the species being present increases by 1.60 for every increase of 100 ha (250 ac) of deciduous forest. Owen et al. (2003) and Krynak (2010) indicate that northern long-eared bats prefer large, intact upland forest tracts with a higher degree of vertical structure and canopy cover for roosting and foraging compared to other bat species.

Northern long-eared bats forage both in-flight and on the ground and eat a variety of moths, flies, leafhoppers, caddisflies, and beetles. The species breeds from late July to early October, after which time it migrates to winter hibernacula. Northern long-eared bats are short-distance migrators and will travel 35 to 55 mi (56 to 89 km) from summer roosts to winter hibernacula. Northern long-eared bats will often compose a small number of the bats hibernating in a particular hibernaculum. Other species that commonly occupy the same habitat include the little brown bat (*Myotis lucifugus*), big brown bat (*Eptesicus fuscus*), eastern small-footed bat (*M. leibii*), tri-colored bat (*Perimyotis subflavus*), and Indiana bat.

Hibernating northern long-eared bat females that have mated prior to hibernation will store sperm until spring emergence and give birth to one pup approximately 60 days after fertilization in May or June. Females raise young in maternity colonies of 30 to 60 individuals.

The FWS (2014) indicates that the seasonal habitat use of northern long-eared bats in Ohio is as follows:

Season	Dates
hibernating	November 15–March 15
spring staging	March 16–May 14
summer maternity	April 1–September 30
fall swarming	August 16–November 15

The NRC staff did not identify any records or other studies that suggest the occurrence of northern long-eared bats in the action area. The Davis-Besse site (described in Section 2.2.7 of the SEIS) includes 221 ac (89 ha) of land developed for industrial use and 733 ac (297 ha) of freshwater marsh, swamp forest, wet meadows, and small areas of deciduous forest. Based on the northern long-eared bat's preference for larger, intact forest, it is unlikely to regularly inhabit the site. However, the site may provide marginal roosting or foraging habitat. Thus, the NRC staff conservatively assumes that the species may occur in the action area.

Indiana Bat (*Myotis sodalis*). The FWS listed the Indiana bat as endangered wherever found in 1967 under the Endangered Species Preservation Act of 1966, the predecessor of the ESA (32 FR 4001). Indiana bats appear dark brown in color, but individual hairs are tricolored, which distinguishes the Indiana bat from the little brown bat (Myotis lucifugus) (ODNR 2011c). Indiana bats inhabit Ohio seasonally during the spring and summer months, during which time they rear young. Menzel et al., (2005) concluded that habitat use is highly correlated with insect abundance, which means that Indiana bats often forage in riparian areas where insect densities are highest. Menzel et al., (2005) also found that Indiana bats were more closely associated with linear landscape features (forest corridors and roads) than open areas (agricultural land,

grasslands, or meadows). The Davis-Besse site includes riparian areas that may provide habitat to the species. Thus, this species may occur in the action area.

FENOC's (2011) "Environmental Best Management Practices" include procedures for cutting trees in areas with suitable Indiana bat habitat. The procedure directs staff to cut trees between September 30 and April 1. If trees must be cut outside these months, FENOC must complete a net survey in May or June prior to cutting to ensure that the cutting will not result in disturbance of Indiana bat roosts. These specifications apply to the Davis-Besse site as well as the in-scope transmission line corridors. The FWS has not designated critical habitat for the species in Ohio (41 FR 41914).

Eastern Prairie Fringed Orchid (*Platanthera leucophaea*). The eastern prairie fringed orchid is a Federally threatened species. The species is an 8- to 40-in. (20- to 100-cm) tall perennial herb with lance shaped leaves and a single flower spike of small white flowers. The orchid grows in mesic prairie, sage meadows, marsh edges, bogs, and other wetland habitats with full sun (FWS 2011c). Eastern prairie fringed orchids form a mycorrhizal association with soil fungus and are pollinated by hawkmoths (FWS 2011c). Though suitable habitat exists in the action area, during the NRC's site audit (NRC 2011), the FWS noted that it was unable to find any eastern prairie fringed orchid populations during a 2010 survey within the Ottawa National Wildlife Refuge. Thus, the NRC staff concludes that the species does not occur in the action area. The FWS has not designated any critical habitat for this species.

Lakeside Daisy (*Tetraneuris herbacea*). The lakeside daisy is a Federally threatened species. It inhabits full sun areas of dry, rocky prairie grassland that contain limestone deposits (ODNR 2011f). Suitable habitat for this species does not exist within the action area. The FWS has not designated any critical habitat for this species.

2.2.8.2 Species Protected Under the Bald and Golden Eagle Protection Act

The Bald and Golden Eagle Protection Act prohibits anyone from taking bald eagles (*Haliaeetus leucocephalus*) or golden eagles (*Aquila chrysaetos*), including their nests or eggs, without a FWS-issued permit. The term "take" in the Act is defined as to "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest, or disturb" (50 CFR 22.3). "Disturb" means to take action that causes injury to an eagle; decreases its productivity by interfering with breeding, feeding, or sheltering behavior; or results in nest abandonment (50 CFR 22.3).

According to the ODNR, Ottawa County has one of the highest densities of bald eagle nests in Ohio (FWS 2010b). Many bald eagle nests are located on the Davis-Besse site and along each of the four transmission line corridors described in Section 2.1.5. Two bald eagle nests are specifically located on the Davis-Besse site—one within Navarre Marsh and one northwest of the cooling tower near the site boundary (FWS 2010b).

FENOC's (2011) "Environmental Best Management Practices" include procedures to ensure that bald eagles and their nests are not disturbed during ground disturbing activities, tree clearance, or other habitat modifications. The procedure directs FENOC staff and contractors to avoid any activities that could disturb eagles within 660 ft (200 m) of any known nest from January 1 through July 31. If activities that have the potential to disturb eagles must be conducted within these months, FENOC must coordinate with the FWS to discuss potential mitigation options that could reduce or minimize impacts to eagles. These specifications apply to the Davis-Besse site as well as the in-scope transmission line corridors.

2.2.8.3 Species Protected Under the Migratory Bird Treaty Act

The FWS administers the MBTA, which prohibits anyone from taking native migratory birds or their eggs, feathers, or nests. The MBTA definition of a "take" differs from that of the ESA and

is defined as “to pursue, hunt, shoot, wound, kill, trap, capture, or collect, or any attempt to carry out these activities” (50 CFR 10.12). Unlike a take under the ESA, a take under the MBTA does not include habitat alteration or destruction. The MBTA protects 1,007 migratory bird species (75 FR 9282). Of these 1,007 species, the FWS allows for the legal hunting of 58 species as game birds (FWS undated). Within Ohio, the ODNR manages migratory bird hunting seasons and associated hunting licenses. All Federally and State-listed bird species that appear in Tables 2–9 and 2–12 are protected under the MBTA. Additionally, all U.S.-native bird species that belong to the families, groups, or species listed at 50 CFR 10.13 are protected under the MBTA. Section 2.2.8.4 discusses occurrences of protected bird species on and near the Davis-Besse site in more detail.

2.2.8.4 Species Protected by the State of Ohio

Ohio adopted a Statewide Threatened and Endangered Species Program in 1974. The Ohio Revised Code prohibits the taking or possession of State-designated endangered wildlife or the willful uprooting, destruction, or removal of native and State-designated threatened or endangered plants from public highways, public property, or waters of the state (Ohio Revised Code §1518.02; Ohio Revised Code §1531.25). Table 2–12 lists the Ohio-protected species that occur in Ottawa County.

Table 2–12. State-Listed Species That Occur in Ottawa County

Species	Common Name	State Status[(a)]
Birds		
Accipiter striatus [(b)]	sharp-shinned hawk	SC
Anas clypeata	northern shoveler	SI
Anas crecca	green-winged teal	SI
Anas strepera	gadwall	SI
Aythya americana	redhead	SI
Bartramia longicauda	upland sandpiper	T
Botaurus lentiginosus	American bittern	E
Casmerodius albus [(b)]	great egret	SC
Catharus guttatus [(b)]	hermit thrush	T
Chlidonias niger	black tern	E
Circus cyaneus [(b)]	northern harrier	E
Cistothorus platensis	sedge wren	SC
Cygnus buccinator [(b)]	trumpeter swan	E
Dendoica magnolia [(b)]	magnolia warbler	SI
Egretta thula [(b)]	snowy egret	E
Empidonax minimus [(b)]	least flycatcher	T
Falco peregrinus [(b)]	peregrine falcon	T
Gallinago delicata [(b)]	Wilson's snipe	SI
Grus canadensis [(b)]	sandhill crane	E
Haliaeetus leucocephalus	bald eagle	T
Ixobrychus exilis	least bittern	T
Nycticorax nycticorax [(b)]	black-crowned night-heron	T
Oporornis philadelphia [(b)]	mourning warbler	SI
Oxyura jamaicensis	ruddy duck	SI
Pandion haliaetus [(b)]	osprey	T
Porzana carolina	sora	SC
Protonotaria citrea	prothonotary warbler	SC
Rallus elegans	king rail	E
Rallus limicola	Virginia rail	SC
Sphyrapicus varius [(b)]	yellow-bellied sapsucker	E
Sterna hirundo	common tern	E
Sturnella neglecta	western meadowlark	SI
Vermivora chrysoptera [(b)]	golden-winged warbler	E
Wilsonia canadensis [(b)]	Canada warbler	SI

Species	Common Name	State Status[a]
Fish		
Acipenser fulvescens	lake sturgeon	E
Fundulus diaphanus menona	western banded killifish	E
Percina copelandi	channel darter	T
Freshwater Mussels		
Cyclonaias tuberculata	purple wartyback	SC
Ligumia nasuta	eastern pondmussel	E
Ligumia recta [c]	black sandshell	T
Obliquaria reflexa	threehorn wartyback	T
Ptychobranchus fasciolaris	kidneyshell	SC
Truncilla donaciformis	fawnsfoot	T
Truncilla truncata	deertoe	SC
Insects		
Aeshna canadensis	Canada darner	E
Plants		
Acorus americanus [c]	American sweet-flag	P
Ammophila breviligulata	American beach grass	T
Arabis drummondii	Drummond’s rock cress	E
Arabis hirsuta var. *adpressipilis*	southern hairy rock cress	P
Artemisia campestris	beach wormwood	T
Astragalus canadensis	Canada milk-vetch	P
Cakile edentula [c]	inland sea rocket	P
Calamintha arkansana	limestone savory	T
Campanula rotundifolia	harebell	T
Carex aquatilis	leafy tussock sedge	P
Carex atherodes	wheat sedge	P
Carex aurea	golden-fruited sedge	P
Carex bebbii	Bebb’s sedge	P
Carex brevior	tufted fescue sedge	T
Carex cephaloidea	thin-leaved sedge	P
Carex garberi	Garber’s sedge	E
Carex sprengelii	Sprengel’s sedge	T
Carex viridula	little green sedge	P
Cyperus diandrus	low umbrella-sedge	P
Cyperus schweinitzii	Schweinitz’s umbrella-sedge	T
Dichanthelium lindheimeri	Lindheimer’s panic grass	T
Draba reptans	Carolina whitlow-grass	T
Eleocharis compressa	flat-stemmed spike-rush	P

Species	Common Name	State Status[a]
Eleocharis geniculata	Caribbean spike-rush	E
Eleocharis ovata	ovate spike-rush	E
Euphorbia polygonifolia	seaside spurge	P
Hedeoma hispida	rough pennyroyal	P
Juncus alpinoarticulatus	alpine rush	P
Juncus balticus	Baltic rush	P
Minuartia michauxii	rock sandwort	P
Nuphar variegata	bullhead-lily	E
Oenothera oakesiana	Oakes' evening-primrose	P
Packera paupercula	balsam squaw-weed	T
Panicum philadelphicum	Philadelphia panic grass	E
Panicum tuckermanii	Tuckerman's panic grass	T
Phragmites australis ssp. *americanus*	American reed grass	T
Platanthera leucophaea	prairie fringed orchid	T
Potamogeton natans	floating pondweed	P
Potamogeton richardsonii	Richardson's pondweed	P
Potamogeton zosteriformis	flat-stemmed pondweed	T
Potentilla argute	tall cinquefoil	E
Ranunculus fascicularis	early buttercup	T
Rosa blanda	smooth rose	T
Sagittaria cuneata	wapato	T
Sagittaria rigida	deer's-tongue arrowhead	P
Salix candida	hoary willow	P
Schoenoplectus smithii	Smith's bulrush	E
Sisyrinchium mucronatum	narrow-leaved blue-eyed-grass	E
Spiranthes magnicamporum	great plains ladies'-tresses	P
Tortella inclinata	curved tortella	E
Triglochin palustris	marsh arrow-grass	P
Triplasis purpurea [c]	purple sand grass	P
Ulmus thomasii	rock elm	P
Viola nephrophylla	northern bog violet	E
Zizania aquatic	wild rice	T

Species	Common Name	State Status[a]
Reptiles		
Elaphe vulpina gloydi	eastern fox snake	SC
Emydoidea blandingii	Blanding's turtle	SC
Nerodia sipedon insularum	Lake Erie water snake	E
Thamnophis sirtalis [c]	melanistic garter snake	SC

[a] State status defined by the Ohio Department of Natural Resources under Ohio Revised Code 1531.25. E=endangered; P=potentially threatened; SC=species of concern; SI=special interest; T=threatened.

[b] The ODNR's Natural Heritage Database (ODNR 2013) does not list these species as occurring in Ottawa County. However, the BSBO (2003a, 2004a, 2006b, 2007b, 2007c, 2008a, 2008d, 2008f, 2008e, 2009b, 2009e, 2009f, 2010b, 2011a) observed these species during annual bird surveys.

© The ODNR's Natural Heritage Database (ODNR 2013) does not list these species as occurring in Ottawa County. However, in correspondence between ODNR and FENOC (ODNR 2010a), these species were identified as occurring on or near the Davis-Besse site.

Sources: BSBO 2003a, 2004a, 2006b, 2007b, 2007c, 2008a, 2008d, 2008f, 2008e, 2009b, 2009e, 2009f, 2010b, 2011a; ODNR 2010a, 2013

Birds

The majority of the State-listed birds in Table 2–12 occur on the Davis-Besse site based on data from the BSBO, which conducts long-term research on breeding and migration of songbirds, raptors, shorebirds, and rails.

For songbirds, Table 2–13 summarizes the number of individuals banded in 2003, 2004, 2008, and 2009 at the BSBO's Navarre Station, which is located within Navarre Marsh (discussed in more detail in Section 2.2.7.2) on the Davis-Besse site. According to the BSBO's progress report data, the Davis-Besse site and surrounding area provides habitat for eight of the State-listed songbirds. State-listed species account for an average of 10.9 percent of the birds banded each season. The magnolia warbler (*Dendroica magnolia*) and hermit thrush (*Catharus guttatus*) are the most common State-listed songbirds during both the spring and fall migration. The Canada warbler (*Wilsonia canadensis*), mourning warbler (*Oporornis philadelphia*), and least flycatcher (*Empidonax minimus*) primarily use the Davis-Besse area during spring migration, but they are present in very small numbers during the fall migration as well. The golden-winged warbler (*Vermivora chrysoptera*) and yellow-bellied sapsucker (*Sphyrapicus varius*) are present, but rare, during both the spring and fall migration. The sedge wren (*Cistothorus platensis*) was not banded during any of the data years, but one individual was observed on a point count in Navarre Marsh in 2009 (BSBO 2009a). The western meadowlark (*Sturnella neglecta*) was not banded at Navarre Station or any of the other monitoring stations and was also not observed on point counts for the data years.

Table 2–13. Songbird Bandings During Annual Migration Surveys, 2003–2009

Species	Number of Individuals Banded							
	Spring Migration				Fall Migration			
	2003	2004	2008	2009	2003	2004	2008	2009
Canada warbler	90	156	106	125	2	4	9	9
golden-winged warbler	2	2	1	3	1	0	0	0
magnolia warbler	600	879	414	686	190	103	88	115
mourning warbler	126	19	88	109	6	10	5	12
hermit thrush	123	95	95	142	187	172	169	212
least flycatcher	131	39	56	108	2	7	7	2
yellow-bellied sapsucker	1	5	2	1	5	3	3	8
Total Banded (State-Listed Species)	**1,073**	**1,195**	**1,762**	**1,174**	**393**	**299**	**281**	**358**
Total Banded (All Species)	**7,841**	**8,970**	**7,822**	**10,042**	**4,191**	**3,206**	**2,790**	**3,645**

Sources: BSBO 2003a, 2004a, 2008a, 2009b

For raptors, the BSBO conducts annual spring surveys between late February and early May. Table 2–14 summarizes the number of birds counted by species for the available data years (2006 through 2009). The BSBO surveys 23 sites throughout the marshes on the southwestern shore of Lake Erie. State-listed raptor species make up an average of 9.7 percent of the observed raptors each year. Sharp-shinned hawks (*Accipiter striatus*) and bald eagles (*Haliaeetus leucocephalus*) are the most commonly observed raptors, while peregrine falcons (*Falco peregrinus*) are the least commonly observed.

Table 2–14. Spring Raptor Survey Counts in the Lake Erie Marsh Region, 2006–2009

Species	Number of Individuals Observed			
	2006	2007	2008	2009
sharp-shinned hawk	245	492	389	467
northern harrier	95	122	167	61
peregrine falcon	10	8	3	4
bald eagle	247	181	371	153
osprey	12	14	29	31
Total Count (State-Listed Species)	**364**	**817**	**959**	**716**
Total Count (All Species)	**4,339**	**8,645**	**8,760**	**7,184**

Sources: BSBO 2007c, 2008f, 2009f

For ducks, swans, and shorebirds, the BSBO conducts annual spring surveys in Navarre Marsh that captures species presence or absence on each day during the spring migration period (generally from early April through early June). Table 2–15 summarizes whether each species was observed in the survey for the years 2006 through 2011. Of the state-listed duck, swan, and shorebird species, six were consistently observed each survey year—the great egret (*Ardea alba*), black-crowned night-heron (*Nycticorax nycticorax*), trumpeter swan (*Cygnus buccinator*), Virginia rail (*Rallus limicola*), sora (*Porzana carolina*), and common tern (*Sterna hirundo*). The least bittern (*Ixobrychus exilis*), northern shoveler (*Anas clypeata*), and ruddy duck (*Oxyura jamaicensis*) were observed during the majority of the survey years (4 out of the 6 years). The remaining species listed in Table 2–15 are relatively rare in the area and were observed less than half of the survey years. The king rail (*Rallus elegans*), black tern (*Chlidonias niger*), piping plover, and upland sandpiper (*Bartramia longicauda*) were not observed during the annual spring surveys. However, as discussed previously, the piping plover is known to seasonally occur in the area based on the BSBO's spring and fall banding program. Though not recorded in the annual spring surveys, the upland sandpiper has been recorded during the BSBO's shorebird migration and habitat use surveys in 2003, 2007, and 2009.

Table 2–15. Ducks, Swans, and Shorebirds Observed in Annual Spring Surveys at Navarre Marsh, 2006–2010

	Species Observed During Survey Year (Y/N)					
Species	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
great egret	Y	Y	Y	Y	Y	Y
snowy egret	Y	N	Y	N	N	N
black-crowned night-heron	Y	Y	Y	Y	Y	Y
least bittern	N	Y	Y	Y	N	Y
American bittern	N	Y	Y	N	N	Y
trumpeter swan	Y	Y	Y	Y	Y	Y
green-winged teal	N	N	Y	Y	N	Y
northern shoveler	N	Y	Y	Y	N	Y
redhead	N	N	N	Y	Y	Y
ruddy duck	N	N	Y	Y	Y	Y
sandhill crane	N	N	N	Y	N	Y
Virginia rail	Y	Y	Y	Y	Y	Y
sora	Y	Y	Y	Y	Y	Y
Wilson's snipe	N	N	N	Y	N	N
common tern	Y	Y	Y	Y	Y	Y

Sources: BSBO 2006b, 2007b, 2008d, 2008e, 2009e, 2010b, 2011a

Plants

The ODNR (ODNR 2010) identified one Ohio-listed plant species as occurring onsite—the Canada milk-vetch (*Astragalus canadensis*). The Canada milk-vetch inhabits moist prairies, open woodlands, roadsides, and streambanks. Because this species occurs in a wide variety of habitats, it may occur on both the developed and undeveloped portions of the Davis-Besse site. However, the ODNR (2010) last recorded the Canada milk-vetch on the Davis-Besse site in 1979, and FENOC did not specifically note the occurrence of this species on the site in their ER. Therefore, it is unknown whether the species still occurs on the Davis-Besse site.

The ODNR (2010) noted six additional Ohio-listed plant species that are known to occur along the Davis-Besse site perimeter or just outside of the site. The six species and their habitats are as follows:

- Schweinitz's umbrella-sedge (*Cyperus schweinitzii*)—sandy shores, beaches, and barrens;
- inland sea rocket (*Cakile edentula*)—sandy beaches above the high tide line;
- purple sand grass (*Triplasis purpurea*)—sand dunes;
- seaside spurge (*Euphorbia polygonifolia*)—sand dunes;
- deer's-tongue arrowhead (*Sagittaria rigida*)—swamps and shallow water; and
- American sweet-flag (*Acorus americanus*)—emergent wetlands.

ODNR (2010) has recorded three of these species—Schweinitz's umbrella-sedge, purple sand grass, and deer's-tongue arrowhead—as occurring in the vicinity of the Davis-Besse site as recently as 2009. The inland sea rocket was last recorded in 1997, the sea side spurge in 1990, and the American sweet-flag in 1971 (ODNR 2010). Due to these species' habitat requirements, if they occur on the Davis-Besse site, all six of these plants would be restricted to the Lake Erie shoreline and Navarre Marsh. None of these species are likely to occur on the developed portion of the Davis-Besse site.

Fish and Freshwater Mussels

Within the vicinity of Davis-Besse, three State-listed fish species potentially occur. However, none of these species were identified by the ODNR (ODNR 2010) as occurring on or in the immediate vicinity of the Davis-Besse site.

Five Ohio-listed mussel species have been recorded as occurring in Lake Erie near the portion of the shoreline adjacent to the Davis-Besse site (ODNR 2010a). These species are:

- purple wartyback (*Cyclonaias tuberculata*),
- fawnsfoot (*Truncilla donaciformis*),
- eastern pondmussel (*Ligumia nasuta*),
- black sandshell (*L. recta*), and
- deertoe (*T. truncata*).

However, the ODNR (2010) has not recorded any of these species as occurring in this area since the late-1960s to late-1970s. The lack of recorded native mussel occurrences likely coincides with the introduction of the Eurasian dreissenid mussels—the zebra (*Dreissena polymorpha*) and quagga (*Dreissena rostriformis bugensis*) mussels—to Lake Erie in the 1980s.

From 2007 through 2009, Crail et al. (2011) surveyed numerous sites along the Lake Erie coast and within associated coastal marshes for native mussel species. The Toussaint River, which

lies near the southern boundary of the Davis-Besse site, was one of the surveyed sites. Crail et al. (2011) found live mussels of eight species at the Toussaint River site, none of which were any of the five State-listed species above. However, Crail et al. (2011) identified three State-listed species at other sites northeast of the Davis-Besse site—live eastern pondmussel and deertoe individuals in Bayshore; fresh dead deertoe individuals at the Maumee Bay site; and fresh dead fawnsfoot individuals at Luna Pier. The Crail et al. (2011) survey indicates that though these mussel species may no longer occur in the immediate vicinity of Davis-Besse, at least three of the State-listed species continue to occur within Lake Erie's western basin.

<u>Reptiles</u>

The ODNR (2010) identified three Ohio-listed reptiles as having known occurrences on the Davis-Besse site—the Blanding's turtle (*Emydoidea blandingii*), the eastern fox snake (*Elaphe vulpina gloydi*), and the melanistic garter snake (*Thamnophis sirtalis*). The Blanding's turtle is a semi-aquatic turtle that occurs in coves, bays, ponds, and shallow marsh waters. The eastern fox snake is found in freshwater marshes along Lake Erie and Lake Huron, exclusively. The melanistic garter snake occurs in a wide variety of habitats, including forests, fields, prairies, streams, wetlands, meadows, and ponds. All three of these species are likely to inhabit Navarre Marsh on the Davis-Besse site.

<u>Insects</u>

The ODNR (2010) did not identify the occurrence of any State-listed insects on or near the Davis-Besse site. The BSBO conducts annual butterfly surveys within Navarre Marsh and other areas with the Ottawa National Wildlife Refuge. According to survey results from 2006 through 2009, the BSBO did not observe any State-listed butterfly species during their surveys (BSBO 2006c, 2007d, 2008c, 2009d). Navarre Marsh is likely to provide suitable habitat for the Canada darner (*Aeshna canadensis*), which inhabits wooded lakes and ponds, as well as marshes and bogs, fens, and slow-moving streams.

2.2.9 Socioeconomic Factors

This section describes current socioeconomic factors that have the potential to be directly or indirectly affected by changes in operations at Davis-Besse. Davis-Besse and the communities that support it can be described as a dynamic socioeconomic system. The communities provide the people, goods, and services required to operate the nuclear power plant. Power plant operations, in turn, provide wages and benefits for people and dollar expenditures for goods and services. The measure of a communities' ability to support Davis-Besse operations depends on the ability of the community to respond to changing environmental, social, economic, and demographic conditions.

The socioeconomic region of influence (ROI) is defined by the area where Davis-Besse employees and their families reside, spend their income, and use their benefits, thereby affecting the economic conditions of the region. The Davis-Besse ROI consists of a four-county area (Lucas, Ottawa, Sandusky, and Wood counties), where approximately 88 percent of Davis-Besse employees reside (FENOC 2010c).

FENOC employs a permanent workforce of approximately 825 employees at Davis-Besse (FENOC 2010c). Approximately 722 employees, or 88 percent, live in Ottawa, Lucas, Wood, and Sandusky Counties (Table 2–16). Most of the remaining 12 percent of the workforce are divided among 21 counties in Ohio, Michigan, and Pennsylvania, with numbers ranging from 1 to 46 employees per county. Given the residential locations of Davis-Besse employees, the most significant impacts of plant operations are likely to occur in Ottawa, Lucas, Wood, and

Sandusky Counties. The focus of the socioeconomic impact analysis in this SEIS is, therefore, on the impacts of continued Davis-Besse operations on these four counties.

Table 2–16. Davis-Besse, Employee Residence by County

County	Number of Employees	Percentage of Total
Ohio		
Lucas	163	19.8
Ottawa	307	37.2
Sandusky	124	15.0
Wood	128	15.5
Other counties	103	12.5
Total	**825**	**100.0**

Source: FENOC 2010c

Refueling outages at Davis-Besse normally occur at 24-month intervals. During refueling outages, site employment increases by as many as 1,300 temporary workers for approximately 48 days (FENOC 2010c). Most of these workers are assumed to be similarly distributed across the same geographic areas as Davis-Besse employees. The following sections describe the housing, public services, offsite land use, visual aesthetics and noise, population demography, and the economy in the ROI surrounding Davis-Besse.

2.2.9.1 Housing

Table 2–17 lists the total number of occupied and vacant housing units, vacancy rates, and median value in the four-county ROI. According to 2010 Census estimates, there were approximately 310,000 housing units in the socioeconomic region, approximately 271,000 of which were occupied. The vacancy rate was lowest in Wood County (8.1 percent) and highest in Ottawa County (37.3 percent) of the four counties. The 2009 through 2011 3-year estimated median value of owner occupied housing units in Lucas, Ottawa, Sandusky, and Wood Counties was $113,500, $137,200, $112,300, and $153,900, respectively (USCB 2012).

Table 2–17. Housing in Lucas, Ottawa, Sandusky, and Wood Counties in Ohio in 2010

	Lucas	Ottawa	Sandusky	Wood	ROI
total	202,630	27,909	26,390	53,376	310,305
occupied housing units	180,267	17,503	24,182	49,043	270,995
vacant units	22,363	10,406	2,208	4,333	39,310
vacancy rate (percent)	11.0	37.3	8.4	8.1	12.7
median value, owner occupied housing (dollars) (estimated)	113,500	137,200	112,300	153,900	129,225

Source: USCB 2012

2.2.9.2 Public Services

This section presents information regarding public services including water supply, education, and transportation.

Water Supply

There are six major public water suppliers In Lucas and Ottawa Counties. Toledo Public Water System in Lucas County serves a population of 380,000, while Ottawa County Regional system serves a population of 14,500 with the largest capacity and daily demand served, with smaller systems supplying other municipalities in the county (Table 2–18). There are also two major public water suppliers in Sandusky County—Fremont City Public Water System has the largest capacity at 7,500,000 gallons per day, while the Clyde Public Water System, serves a population of 5,900.

Davis-Besse obtains water from the Carroll Township water system, which has excess capacity of 700,000 gallons per day (FENOC 2010c).

Table 2–18. Major Public Water Supply Systems (Million Gallons Per Day)

Counties	Public Water System	Population Served	Water Use	Treatment Capacity
Lucas	Toledo	380,000	75,838	181,000
	Oregon City	18,334	4,463	8,087
Ottawa	Marblehead Village	1,600	193	553
	Put-in-Bay Village	700	67	140
	Ottawa County Regional	14,500	3,507	9,000
	Carroll	200	300	1,000
Sandusky	Clyde	5,900	958	2,000
	Fremont City	500	4,317	7,500
Wood	Bowling Green City	30,000	3,389	5,400
	North Baltimore	3,361	550	1,600

Source: FENOC 2010a

Education

There are eight school districts in Lucas County with 117 schools and an enrollment of 55,548 students during the 2009 to 2010 school year. Sandusky County has four school districts with 19 schools and 8,537 students. Wood County has 10 school districts with 49 schools and 17,917 students. In Ottawa County, the county in which Davis-Besse is located, there are seven school districts with 19 schools and 5,530 students (NCES 2010).

There are three public universities within 50 mi of Davis-Besse, which employed approximately 6,024 full- and part-time faculty during the 2009 school year. Student enrollment at the public universities in 2009 was approximately 80,176 (IES 2010).

Transportation

There are many major roads used by plant workers commuting to Davis-Besse. State Highway Route 2, located immediately adjacent to Davis-Besse, provides local access to the surrounding area. State Highway Route 2 runs through mostly rural and uncongested areas. The two-lane

highway is used extensively by commercial truck carriers. Approximately 6 mi east of the site (and continuing east), Route 2 becomes a four-lane, divided and limited-access highway (FENOC 2010c). Table 2–19 lists commuting routes to Davis-Besse 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 2–19. Major Commuting Routes in the Vicinity of Davis-Besse, 2009 Average Annual Daily Traffic Count

Roadway & Location	Average Annual Daily Traffic (AADT)[(a)]
SR-2, West of Davis-Besse	
at Lucas County line	6,200
at SR-579 intersection	6,510
at SR-590 intersection	7,310
at SR-19 intersection	7,330
SR-2, East of Davis-Besse	
at SR-358 intersection	6,950
at SR-163 intersection	11,990
at SR-53 intersection	12,970

[(a)] All AADTs represent traffic volume during the average 24-hour day during 2009.

Source: OHDOT 2010

2.2.9.3 Offsite Land Use

Offsite land use conditions in Lucas, Ottawa, Sandusky, and Wood Counties are described in this section because 88 percent of the Davis-Besse permanent workforce lives in these four counties.

Lucas County has the largest urban area, accounting for nearly 37 percent of the total county area. It is also the most populated of the of the four-county area, with Toledo being the county seat and largest city (Lucas 2011). Ottawa County, the smallest of the four counties in land area (approximately 260 m^2 (670 km^2), is typical of the rural land-use character of the four-county area. Over 90 percent of the total county area comprises cropland, pasture, forest, open water, and wetlands. Urban areas, on the other hand, account for less than 10 percent of the total county area. Wood and Sandusky Counties have a similar distribution of land area. Ottawa County, although the smallest in land area, has the most open water (7 percent), as its northeastern boundary abuts Lake Erie and includes a peninsula and several islands (Ottawa 2011). Sandusky County is similar in land category to Wood County, with most land in farms. The county's land area (approximately 410 m^2 (1,060 km^2)), number of farms (770) is second only to Wood County (Sandusky 2011). Wood County is the largest county in land area (approximately 620 m^2 (1,600 km^2)) and comprises the most land in farms (269,000 ac) and most number of farms (1,180). Wood and Sandusky county have a similar average farm size at approximately 230 ac (90 ha)) (Wood 2011).

2.2.9.4 Visual Aesthetics and Noise

The topography of the Davis-Besse site and vicinity is relatively flat, bordered by marsh areas, Lake Erie, and the upland area rising to only 10 to 15 ft above the lake level. The site varies in

elevation from marsh bottom, below lake level, to approximately 6 ft above lake level (FENOC 2010c).

The developed portions of the Davis-Besse site have 17 major structures, located approximately 3,000 ft (914 m) from the Lake Erie shoreline. The turbine building is 104 ft (approximately 32 m) high. West of the turbine building is the containment building standing 225 ft (approximately 69 m) high. West of the containment building is the switchyard and south of there is the 328 ft (100 m) meteorological tower. Visible from State Highway 2 and Lake Erie, the cooling tower stands approximately 490 ft (150 m) high (AEC 1973).

Given the industrial nature of the Davis-Besse station site, noise emissions from the site are intermittent minor nuisance in the vicinity. Noise levels may sometimes exceed the 55 dba level that the U.S. EPA uses as a threshold to protect against excess noise during outdoor activities (EPA 1974). To date, FENOC has received no complaints concerning noise from station operations.

2.2.9.5 Demography

According to the 2010 Census, an estimated 105,944 U.S. residents live within 20 mi (32 km) of Davis-Besse, which equates to a population density of 178 persons per square mile (CAPS 2012). This translates to a Category 4, "least sparse," population density using the GEIS measure of sparseness (greater than or equal to 120 persons per square mile within 20 mi (32 km) of the plant). An estimated 1,809,026 U.S. residents live within 50 mi (80 km) of Davis-Besse with a population density of 365 persons per square mile (CAPS 2012). This translates to a Category 4, "in close proximity," population using the GEIS measure of proximity (greater than or equal to 190 persons per square mile within 50 mi (80 km) of the plant). Therefore, Davis-Besse is located in a high-population area based on the GEIS sparseness and proximity matrix.

Table 2–20 shows population projections and growth rates from 1970 through 2050 in Lucas, Ottawa, Sandusky, and Wood Counties in Ohio. The growth rate in Lucas and Sandusky Counties showed a decrease of 2.9 and 1.4 percent, respectively, for the period of 2000 through 2010. Ottawa and Wood County population shows an increase from 1990 through 2000 (1.1 and 3.6 percent, respectively). Wood County population is expected to increase over the next decades and through 2050, while Lucas and Sandusky Counties are expected to continue to decrease; Ottawa County population is expected to initially decrease and then slightly increase over the same period.

Table 2–20. Population and Percent Growth in Lucas, Ottawa, Sandusky, and Wood Counties from 1970–2010 and Projected for 2020–2050

	Lucas		Ottawa		Sandusky		Wood	
Year	Population	Percent Growth[a]	Population	Percent Growth[a]	Population	Percent Growth[a]	Population	Percent Growth[a]
1970	484,370	-----	37,099	-----	60,983	-----	89,722	-----
1980	471,741	-2.6	40,076	8.0	63,267	3.7	107,372	19.7
1990	462,361	-2.0	40,029	-0.1	61,963	-2.1	113,269	5.5
2000	455,050	-1.6	40,990	2.4	61,790	-0.3	121,070	6.9
2010	441,815	-2.9	41,428	1.1	60,944	-1.4	125,488	3.6
2020	434,648	-1.6	40,269	-2.8	57,903	-5.0	133,326	6.2
2030	417,873	-3.9	38,522	-4.3	56,416	-2.6	141,877	6.4
2040	410,519	-1.8	40,638	5.5	56,831	0.7	150,388	6.0
2050	400,011	-2.6	40,854	0.5	55,922	-1.6	158,266	5.2

---- = No data available.

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

Sources: Population data for 1970–2000 (USCB 2012); population projections for 2010–2030 (ODD 2003); projections for 2040 and 2050 (calculated)

Demographic Profile

The demographic profiles of the four-county ROI population are presented in Table 2–21. In 2010, minorities (race and ethnicity combined) comprised 22.7 percent of the total four-county population. The largest minority populations in the four-county area include Black or African American at 13 percent, followed by Hispanic or Latino (of any race) at 5.9 percent.

Table 2–21. Demographic Profile of the Population in the Davis-Besse Four-County Socioeconomic Region of Influence in 2010

	Lucas	Ottawa	Sandusky	Wood	ROI
total population	441,815	41,428	60,944	125,488	669,675
Race (Percent of Total Population, Not-Hispanic or Latino)					
White	71.0	93.6	86.2	90.1	77.3
Black or African American	18.7	0.7	2.7	2.3	13.0
American Indian & Alaska Native	0.2	0.1	0.2	0.2	0.2
Asian	1.5	0.3	0.3	1.5	1.3
Native Hawaiian or other Pacific Islander	0.0	0.0	0.0	0.0	0.0
some other race	0.2	0.0	0.1	0.1	0.1
two or more races	2.3	1.0	1.7	1.3	2.0
Ethnicity					
Hispanic or Latino	26,974	1,755	5,435	5,663	39,827
percent of total population	6.1	4.2	8.9	4.5	5.9
Minority Population (Including Hispanic or Latino Ethnicity)					
total minority population	128,219	2,648	8,417	12,467	151,751
percent minority	29.0	6.4	13.8	9.9	22.7

Source: USCB 2012

Transient Population

Within 50 mi (80 km) of Davis-Besse, colleges and recreational opportunities attract daily and seasonal visitors who create demand for temporary housing and services. In 2009, there were approximately 105,672 students attending universities within 50 mi (80 km) of Davis-Besse (IES 2010).

There are 19 counties across two states within a 50-mi radius of Davis-Besse. Of those counties, approximately 3.0 percent of the housing units are considered temporary housing for seasonal, recreational, or occasional use in 2010. Over 30 percent of the housing units in Ottawa County are considered seasonal housing. By comparison, seasonal housing accounted for 0.4, 1.1, and 0.6 percent of total housing units in Lucas, Sandusky and Wood Counties, respectively (USCB 2012). Four counties in Michigan within 50 mi (80 km) of Davis-Besse, only one (Lenawee) has seasonal housing units comprising more than 5 percent of total housing units. Table 2–22 provides information on seasonal housing for the 19 counties located all or partly within 50 mi of Davis-Besse (USCB 2012).

Table 2–22. Seasonal Housing in Counties Located Within 50 Miles of Davis-Besse

County[a]	Housing Units	Vacant Housing Units—for Seasonal, Recreational, or Occasional Use	Percent
Ohio			
Ashland	22,141	413	1.9
Crawford	20,167	90	0.4
Erie	37,845	2,866	7.6
Fulton	17,407	112	0.6
Hancock	33,174	161	0.5
Henry	11,963	66	0.6
Huron	25,196	246	1.0
Lorain	127,036	714	0.6
Lucas	202,630	755	0.4
Ottawa	27,909	8,581	30.7
Richland	54,599	405	0.7
Sandusky	26,390	281	1.1
Seneca	24,122	121	0.5
Wood	53,376	329	0.6
Wyandot	9,870	62	0.6
Michigan			
Lenawee	43,452	2,414	5.6
Monroe	62,971	426	0.7
Washtenaw	147,573	1,403	1.0
Wayne	821,693	2,544	0.3
Total	**1,747,373**	**21,576**	**2.9**

[a] These are counties within 50 mi (80 km) of Davis-Besse with at least one block group located within the 50-mi (80-km) radius.

Source: USCB 2012

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 U.S. Others may be permanent residents near the Davis-Besse 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 U.S. Census Bureau (USCB) minority and low-income population counts.

Information on migrant farm and temporary labor was collected in the 2007 Census of Agriculture. Table 2–23 provides information on migrant farm workers and temporary farm labor (less than 150 days) within 50 mi of Davis-Besse. According to the 2007 Census of Agriculture, approximately 11,126 farm workers were hired to work for less than 150 days and were employed on 2,313 farms within 50 mi of Davis-Besse. The county with the largest number of temporary farm workers (1,595) on 122 farms was Huron County (NASS 2009).

Table 2–23. Migrant Farm Workers and Temporary Hired Farm Labor in Counties Located Within 50 Miles of Davis-Besse

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)]
Ohio				
Ashland	213	184	421	5
Crawford	119	107	313	4
Erie	88	68	383	9
Fulton	173	148	686	13
Hancock	146	130	324	6
Henry	128	119	487	9
Huron	145	122	1,595	7
Lorain	195	156	651	14
Lucas	91	78	519	14
Ottawa	92	78	408	10
Richland	146	113	385	4
Sandusky	158	140	699	23
Seneca	179	154	347	12
Wood	170	148	600	11
Wyandot	100	82	350	4
County Subtotal	**1,143**	**1,827**	**8,168**	**145**
Michigan				
Lenawee	262	214	908	22
Monroe	222	193	1,035	27
Washtenaw	250	198	835	12
Wayne	86	65	601	6
County Subtotal	**820**	**670**	**3,379**	**67**
Total	**2,963**	**2,497**	**11,547**	**212**

[(a)] These are counties within 50 mi of Davis-Besse with at least one block group located within the 50-mi radius.
[(b)] Table 7. Hired Farm Labor—Workers and Payroll: 2007

Source: NASS 2011a, 2011b, 2011c

In the 2002 Census of Agriculture, farm operators were asked for the first time whether or not any 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. Within the 50-mi radius of the Davis-Besse, 207 farms reported hiring migrant workers in the 2007 Census of Agriculture. Monroe County in Michigan reported the most farms (27) with hired migrant workers, followed by Sandusky County in Ohio, with 23 farms (NASS 2009).

According to the 2007 Census of Agriculture estimates, 519 temporary farm workers (those working fewer than 150 days per year) were employed on 78 farms in Lucas County, and 408 temporary farm workers were employed on 78 farms in Ottawa County. Sandusky County has 699 temporary farm workers (those working fewer than 150 days per year) employed on 140 farms, and 600 temporary farm workers were employed on 148 farms in Ottawa County (NASS 2009).

2.2.9.6 Economy

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

<u>Employment and Income</u>

A list of some of the major employers in Ottawa County is provided in Table 2–24. As shown in the table, nine major employers are identified in Ottawa County; three of which were Government, two manufacturing, two service, one trade, and one (FENOC) utility.

Table 2–24. Major Employers in Ottawa County, 2009

Employer	Type of Industry
Benton-Carroll-Salem Local Schools	Government
Brush Wellman, Inc.	Manufacturing
FirstEnergy Corp	Utility
Luther Home of Mercy	Service
Magruder Hospital	Service
Ottawa County Government	Government
Port Clinton City Schools	Government
USGS Corp/U.S. Gypsum Co.	Manufacturing
Wal-Mart Stores, Inc.	Trade

Source: http://www.development.ohio.gov/research/files/S0/Ottawa.pdf

According to the 2008 through 2010 American Community Survey 3-year estimates, education services, health care, and social assistance represented the largest sector of employment (26.2 percent) followed by manufacturing (15.7 percent). In Ottawa County, retail services represented the largest sector of employment (22.4 percent) followed by manufacturing (17.0 percent). In Sandusky County, manufacturing represented the largest sector of employment followed by education services, health care, and social assistance. A list of employment by industry in the ROI is presented in Table 2–25.

Table 2–25. Employment by Industry in ROI, 2008-2010 3-Year Estimate

Industry	Lucas	Ottawa	Sandusky	Wood	Total	Percent
Total employed civilian workers	196,651	19,861	28,753	61,250	306,515	100
Agriculture, forestry, fishing and hunting, and mining	570	306	762	609	2,247	0.7
Construction	9,136	1,564	1,681	2,737	15,118	4.9
Manufacturing	27,661	3,162	7,597	9,627	48,047	15.7
Wholesale trade	5,816	386	522	1,735	8,459	2.8
Retail trade	23,758	2,443	3,022	7,165	36,388	11.9
Transportation, warehousing, and utilities	11,750	1,607	1,553	3,231	18,141	5.9
Information	3,102	166	300	1,122	4,690	1.5
Finance, insurance, real estate, rental, and leasing	9,998	927	811	2,947	14,683	4.8
Professional, scientific, management, administrative, and waste management services	16,826	946	1,285	4,662	23,719	7.7
Educational, health, and social services	52,035	4,477	6,503	17,315	80,330	26.2
Arts, entertainment, recreation, accommodation, and food services	20,721	2,232	2,607	5,105	30,665	10.0
Other services (except public administration)	8,946	909	1,359	2,858	14,072	4.6
Public administration	6,332	736	751	2,137	9,956	3.2

Source: USCB 2012

Estimated income information for the Davis-Besse ROI is presented in Table 2–26. According to the U.S. Census Bureau's (USCB's) 2008 through 2010 American Community Survey 3-year estimates, median household income were above the State average in Ottawa, Sandusky, and Wood Counties and lower in Lucas County. Ottawa and Wood Counties per capita income were above the State average, and they were lower in Lucas and Sandusky Counties. An estimated 19.1, 10, 11.6, and 12.2 percent of individuals in Lucas, Ottawa, Sandusky, and Wood Counties were living below the official poverty level, respectively, while Ohio, as a whole, had 14.8 percent of individuals living below the poverty level. The percentage of families living below the poverty level in Lucas, Ottawa, Sandusky, and Wood Counties was 14.9, 6.9, 7.9, and 7.3 percent, respectively. The percentage of families in Ohio as a whole was 10.8 percent (USCB 2012).

Table 2–26. Estimated Income Information for the Davis-Besse Four-County Socioeconomic Region of Influence, 2008–2010 3-Year Estimate

	Lucas	Ottawa	Sandusky	Wood	Ohio
median household income (dollars)[(a)]	40,017	51,712	46,024	52,512	46,563
per capita income (dollars)[(a)]	23,127	27,113	21,748	25,724	24,738
individuals living below the poverty level (percent)	19.1	10.0	11.6	12.2	14.8
families living below the poverty level (percent)	14.9	6.9	7.9	7.3	10.8

[(a)] In 2010 inflation-adjusted dollars

Source: USCB 2012

Unemployment

According to the USCB's 2008 through 2010 American Community Survey 3-year estimates, the unemployment rates in Lucas, Ottawa, Sandusky, and Wood Counties were 8.8, 4.9, 5.0, and 7.7 percent, respectively (USCB 2012). The unemployment rate for the State of Ohio was 6.3 (USCB 2012).

Taxes

The Ohio Tax Reform Act (Amended Substitute House Bill 66, 126th General Assembly) went into effect on July 1, 2005. The Act has made significant changes in the structure of almost all major state and local taxes. Major business tax components of the Ohio Tax Reform Act consist of the phase-out of tangible personal property tax (which excludes electric companies), corporate franchise tax, and the phase-in of the commercial activity tax. It is a privilege tax measured by gross receipts from activities within the State. The fully phased-in 0.26 percent commercial activity tax rate took effect on April 1, 2009 (impacting fiscal year 2010 tax revenues). Table 2–27 shows prior phase-in rates.

Table 2–27. 2005–2009 3-Year Phase-In Rates Percentage Result of the July 2005 Ohio Tax Reform Act and the Fully Phased-In 0.26 Percent Commercial Activity Tax

Tax Period	Base Tax Rate (Percent)	Phase-On Percentage	Effective Rate (Percent)
July–December 2005	0.06	N/A	0.0600
January–March 2006	0.26	23	0.0598
April 2006–March 2007	0.26	40	0.1040
April 2007–March 2008	0.26	60	0.1560
April 2008–March 2009	0.26	80	0.2080
After March 2009	0.26	100	0.2600

Source: FENOC 2010c

Table 2–28 compares property taxes paid by FENOC for Davis-Besse to the annual total operating budgets for Ottawa County, Carroll Township, Benton-Carroll-Salem School District, and the Penta County Joint Vocational School for the years 2004 through 2008. During this 5-year period, Davis-Besse property taxes contributed less than 10 percent to the Ottawa

County total operating budget. The percentage of Davis-Besse property tax to the operating budget in Carroll Township, where Davis-Besse is located, varied widely from about 11 percent to nearly 28 percent. Property taxes paid to the Benton-Carroll-Salem School District and the Penta County Joint Vocational School, on the other hand, were more stable, averaging about 17 percent for the school district and 1.6 percent for the vocational school.

Table 2–28. Davis-Besse Property Tax Distribution and Jurisdictional Operating Budgets, 2004–2008

Year	Property Tax Paid by Davis-Besse (Dollar)	Operating Budget (Dollar)	Percent of Operating Budget (Percent)
Ottawa County			
2004	846,190	13,808,101	6.1
2005	1,171,511	13,909,810	8.4
2006	830,177	15,111,168	5.9
2007	949,380	15,846,381	6.0
2008	897,881	16,053,182	5.6
Carroll Township			
2004	485,644	4,334,322	11.2
2005	675,842	3,510,297	19.3
2006	533,277	1,908,000	27.9
2007	551,766	2,307,692	23.9
2008	558,791	4,829,032	11.6
Benton-Carroll-Salem Local School District			
2004	3,211,588	20,142,955	15.9
2005	4,484,582	21,114,350	21.2
2006	3,495,600	20,953,869	16.7
2007	3,607,888	22,038,419	16.4
2008	3,707,221	23,938,413	15.5
Penta County Joint Vocational School			
2004	372,018	24,832,789	1.5
2005	507,832	25,644,335	2.0
2006	397,738	26,553,076	1.5
2007	412,907	28,015,110	1.5
2008	417,247	29,793,427	1.4

Source: FENOC 2010c

The amount of future property tax payments for Davis-Besse and the proportion of those payments are dependent on future market value of the units, future valuations of other properties in these jurisdictions, and other factors. FENOC assumes that the values presented in Table 2–28 are substantially representative of conditions that would exist in the license renewal term of the unit.

2.2.10 Historic and Archaeological Resources

This section discusses the cultural background and known historic and archaeological resources in and around Davis-Besse.

2.2.10.1 Cultural Background

The area in and around Davis-Besse has a low-to-moderate potential for significant prehistoric and historic resources. Human occupation of the Ohio area is generally characterized based on the following chronologic cultural sequence (Lepper 2005):

- Paleo-Indian Period (14,000+ to 10,000 years before present (BP)),
- Archaic Period (10,000 to 2,500 BP),
- Early Woodland Period (2,800 to 2,000 BP),
- Middle Woodland Period (2,100 to 1,500 BP),
- Late Woodland Period (1,500 to 1,100 BP), and
- Late Prehistoric Period (1,100 to 400 BP).

The Paleo-Indian Period is generally characterized by highly mobile bands of hunters and gatherers. Little information regarding subsistence is available for the Paleo-Indian Period in Ohio, although it is likely that these groups hunted small game and now-extinct megafauna (e.g., mastodon, saber-tooth tiger, and ground sloth) and gathered wild plants. Typical Paleo-Indian sites in Ohio consist of an isolated projectile point (of a style characteristic of the period, notably the fluted Clovis points). Over 1,000 projectile points have been found in the State, especially in the Ohio River drainage south of Davis-Besse (Neusius and Gross 2007). One documented fluted projectile point was discovered at the Peters site in Ottawa County, south of Davis-Besse along the Portage River (Prufer and Shane 1973). In addition to projectile points (both fluted and unfluted lanceolate points), the Paleo-Indian tool kit included gravers, scrapers, knives, and biface blanks used to construct tools. Paleo-Indians prized high-quality stone for making their stone tools, especially the black flint from Coshocton County in Ohio (well to the southeast of the Davis-Besse), which was used for making most of the fluted Paleo-Indian projectile points that have been found in the state (Lepper 2005). However, there are several sites in Ohio that consist of more substantial Paleo-Indian cultural artifacts. At Sheridan Cave, about 45 mi (72 km) south of Davis-Besse, archaeologists found projectile points and stone tools associated with more than 60 species of the aforementioned extinct megafauna (Tankersly 1997). A Paleo-Indian base camp with a concentration of 6,835 stone tools was found at the Nobles Pond site in Stark County, southeast of Davis-Besse near Canton, Ohio (Lepper 2005).

The Archaic Period is generally distinguished from the preceding Paleo-Indian Period by changes in technology, population growth, and a changing environment. Technological changes are evidenced by the manufacture of notched projectile points, as well as tools and ornaments made from both bone and copper, in addition to ground stone tools. Toward the end of the Archaic Period, pottery was also being manufactured. As the Archaic period progressed, groups began adapting to a more stable, drier, and warmer environment, becoming more settled

in their residential patterns. Toward the end of the Archaic Period, groups that resided in the river floodplains began the process of plant domestication and agriculture (Smith 1989). Additionally, as groups became more settled, they engaged in long-distance exchange networks. Their reduced mobility required them to establish connections with other groups that would engage in trade and exchange (Neusius and Gross 2007). Archaic sites in the vicinity of Davis-Besse are unlikely, as the area was a part of the Great Black Swamp. Prior to draining in the 19th and 20th centuries, the Great Black Swamp encompassed an area about 120 mi (190 km) long, and 30 to 40 mi (50 to 60 km) wide. Most of that area would not have been a favorable location for groups to inhabit during this time. However, Archaic sites have been found around the margins of the swamp, as well as fishing camps on the islands in Lake Erie (Lepper 2005). A predictive model for archaeological deposits has been proposed by Murphy (1988), suggesting that sites are most likely to be found on slightly elevated soils, specifically the Nappanee soil type.

During the Early Woodland Period, native groups began a gradual transition to a heavier reliance on domesticated plants, pottery, and established a more elaborate mortuary ritual. Building upon some of the characteristics of the cultures from the Early Woodland Period, the Hopewell Culture occupied large portions of Ohio in the subsequent Middle Woodland Period; however, some of the groups in the northern and eastern parts of Ohio continued the Early Woodland Period lifestyle without adopting the Hopewell lifeways. The Hopewell Culture was characterized by vast trade networks, increasing dependence on agriculture, mound and earthwork construction, as well as elaborate artifacts that were created and often found in vast amounts in burial contexts. These included plain and effigy pipes, pottery effigies, Hopewell series pottery, pottery and copper ear spools, panpipes and celts, and other artifacts fashioned from non-local materials (Neusius and Gross 2007). Most Early and Middle Woodland Period sites are found farther south than the area in and around Davis-Besse, although there are some sites that have been found in northern Ohio that would not be characterized as Hopewell but are from the same period (Lepper 2005).

The Late Woodland Period saw the decline of the Hopewell Culture and the vast trade networks that accompanied it. Consequently, most of the artifacts from this period were crafted from more locally procured materials. Despite the fact that the Hopewell Culture no longer continued to thrive, population continued to grow, and groups continued to congregate in villages and increase their social organization. Settlements were not just located in river valleys (as had been the norm in previous periods) but spread out into the landscape (Lepper 2005). Technological changes included the bow and arrow, which was adopted by 1,200 BP, evidenced by smaller notched and un-notched triangular projectile points. Agriculture played a large role in the subsistence systems of many Late Woodland groups, with increasing focus on domesticated crops; however, groups located near the margin of Lake Erie continued to rely on hunting, gathering, and fishing. In some areas, the Late Woodland Period continued unchanged until contact with European groups, while in other areas, the Late Prehistoric Period (also known as the Mississippian Period in parts of Ohio) began around 1,100 BP. The Late Prehistoric Period groups adopted maize agriculture along with beans and squash but continued a mixed economy in which hunting and gathering still played a prominent role.

Groups in and around Davis-Besse were not direct participants of the Mississippian or Iroquois culture's but likely were influenced by some elements (Lepper 2005). Several sites associated with the Mississippian Culture have been located along the Maumee River and its tributaries (Prahl et al. 1973). Those who resided on the western portion of Lake Erie during the Late Prehistoric Period were a part of the Sandusky Culture. Referred to as the Fire Nation by the Iroquois, the Sandusky Culture was both a trading and war partner of the Iroquois. There is evidence for increasing violence between Late Prehistoric groups, with some villages

surrounded by palisades, and burials with traumatic injury incurred by projectile points (Lepper 2005). Almost 200 years prior to the arrival of Europeans in Ohio, Native American groups came into contact with European trade goods such as glass beads and iron and brass implements, as well as European diseases (Neusius and Gross 2007). At least four sites in close proximity to Davis-Besse have been documented with these European trade goods (the Indian Hills site, the La Salle site, the Petersen site, and the Edwards site). During this Proto-Historic Period, European demand for furs encouraged Native American groups to respond to this need. The Iroquois Tribe, in particular, made trade connections with European groups, forcing out many of the groups along Lake Erie, especially in the fur-rich Great Black Swamp area, in an effort to control the fur trade (Lepper 2005). The area around Davis-Besse, and most of Ohio, saw successive waves of Native American refugees as they were pushed out of their eastern seaboard and southern Appalachian piedmont areas. It is likely that the Wyandot and Ottawa tribes would have used the land in the area of Davis-Besse in this period prior to their forced move west into the area around southern Wisconsin by the Iroquois Confederation (Lepper 2005; Tanner 1987).

During the historic period, Native American groups continued to live in the area around Davis-Besse, trading with Europeans and colonists. The Euro-American presence continued to press into the territory occupied by the Native Americans, constructing trading posts and forts near Lake Erie. The area around present day Sandusky was home to both a French and British fort, as well as a French trading post during the mid-18th century (Tanner 1987). Three Wyandot settlements were also in the Sandusky region at the same time, and other Native American villages were located along the Maumee River to the northwest of Davis-Besse (Tanner 1987). Native American groups continued to fight back against the white settlement for their territory. This conflict came to a head at the Battle of Fallen Timbers along the Maumee River, just outside of Perrysburg, OH, west of Davis-Besse. The infamous General "Mad Anthony" Wayne commanded the American forces and engaged the Native Americans on August 20, 1794. The American forces drove the Native Americans from the battlefield, after which they fled to Fort Miamis and were denied refuge by the British forces. The Treaty of Greenville was signed the following year; it secured the Ohio and the Northwest Territory for the U.S. and allowed additional settlement by American pioneers (Ohio History Central 2005). By the 1830s, white populations had pushed the Native American groups out of the area currently occupied by Davis-Besse. The influx of white settlers was precipitated by the construction of the Erie Canal in 1825, which facilitated settlement of the western portion of the lake (Tanner 1987). The construction of the Maumee and Western Reserve Road, connecting Perrysburg to Fremont, OH, through the Great Black Swamp, also helped settlers migrate to the area. Initially, this road was a trail used by Native Americans, but, after several treaties, the 31-mi (50-km) long road was ceded to the U.S. Government by 1808. The road was used heavily during the War of 1812 and became a part of the "Great Trail" that connected Pittsburgh to Detroit. By 1827, the road had been improved enough so as to make it relatively passable for wagons, but, after a few years, its condition worsened. The road became notorious for its difficult conditions. It was given the nickname "Mud Pike," and, consequently, several taverns were constructed along the route to service the troubled travelers. In the 1840s, the road was improved and made a toll road, after extensive draining of the Great Black Swamp took place (Coleman 2002).

As settlement continued, the area around Davis-Besse was used for agriculture. The early settlers drained the Great Black Swamp, put in several ditches, drain tiles, and removed trees; this turned the area into the fertile farm region that it is today.

In 1907, the U.S. National Guard Camp Perry was established, about 5 mi (8 km) to the southeast of Davis-Besse. The camp is named for Oliver Hazard Perry, a hero of the

War of 1812, and it maintains the largest outdoor firing range in the world. During the First World War, officers and marksmen were trained there, and, during the Second World War, German and Italian prisoners were kept there. Today, the camp is home to the 213th Ordinance Company, the 200th Civil Engineering Squadron, the 372nd Missile Maintenance Company Detachment 1, the U.S. Coast Guard Port Security Unit 309, and the Ohio Naval Reserve. Since 1907, Camp Perry has hosted the "World Series of the Shooting Sports," a marksmanship event that boasts more than 4,000 participants (Ohio History Central 2008). The former Erie Army Depot takes up the rest of the area around Camp Perry, consisting of a privately owned industrial park and the Locust Point Anti-Aircraft Artillery Firing Area (LPAAAFA).

The LPAAAFA was an artillery training area located on the edge of Lake Erie used by the 371st Anti-Aircraft Artillery Group of the U.S. Army Ohio National Guard. In February of 1953, approximately 69 ac (28 ha) that would be used as the LPAAAFA was leased by the U.S. Army from the state of Ohio, and, in August of 1963, the land was transferred to private owners when the LPAAAFA was closed. A portion of the land occupied by the LPAAAFA extended from the coast of Lake Erie inland about 0.5 mi (0.8 km) adjacent to what is now the canal associated with Davis-Besse. The area associated with the LPAAAFA has been assessed for hazards and has been subsequently cleared; however, there is potential for Davis-Besse personnel to encounter remnants of Department of Defense (DoD) activities, including unexploded ordnance, on their property. There were three associated firing points for the LPAAAFA; two points within Davis-Besse property north of the Toussaint River along the shore of Lake Erie and a third point, a short guard tower, on the Camp Perry property, also along the Lake Erie shoreline. Each firing point location consisted of a 50-ft (15.2-m) tall safety tower equipped with a siren and horn, none of which are still in existence. During the 10-year period of use, guardsmen would use remote controlled aerial targets as well as towed targets for training, impacting 93,585 ac (37,873 ha) in the lake (ACE 2010).

On July 31, 1978, Davis-Besse began commercial operation, servicing customers in the Great Lakes region. Consisting of one reactor, the site sits on 954 ac (390 ha), much of which is leased by the FWS for use as the Ottawa National Wildlife Refuge.

2.2.10.2 Historic and Archaeological Resources

Davis-Besse encompasses 954 ac (390 ha) of land. Disturbed areas include the power block area, borrow pits, and quarry. Undisturbed areas include approximately 733 ac (297 ha) of marshland and additional maintained lands within the owner-controlled perimeter on the south side, a portion of the east side (to the south) and along the western side (south of the Davis-Besse railroad). An exact acreage of this land was not available. The Ottawa National Wildlife Refuge encompasses much of the marshland area and is managed by the FWS. Prior to the construction of the site, the area had been cleared, drained, and farmed since the 19th century. The land area adjacent to the Davis-Besse property is still used mainly for agricultural purposes.

The parcel of land on which Davis-Besse is situated has not been surveyed for archaeological resources; however, the Ohio Archaeological Society and the Ohio State Historic Preservation Office (SHPO) had concluded that no archaeological resources would be affected by the plant's construction (AEC 1973). This is likely due to the fact that the area in and around Davis-Besse is a marshy wetland, and, consequently, the potential for significant cultural resources in this area is low. The western portion of Davis-Besse was cleared, drained, and farmed during the 19th century, and during construction of the main power block, the ground surface was graded up to an elevation of 6 to 12 ft (1.8 to 3.7 m) above the original surface grade. Consequently, the potential for significant archaeological resources in this area is also low. However, because no archaeological surveys have been conducted in and around Davis-Besse, the potential for

the presence of unrecorded cultural resources remains. It should be noted that Nappanee soils are present in the southwestern portion of Davis-Besse property, and based on the model proposed by Murphy (1988), there is potential for archaeological materials at those locations. Additionally, the southwest portion of the property is also potentially undisturbed. One known cultural resource is located on Davis-Besse property. The Refuge Site, 33-OT-25, is situated on a small peninsula of dry land in the marshy area of the southeast corner of the property. This is a historic site consisting of nails, glass mason jar fragments, and a kaolin pipe fragment that has been determined to be ineligible for listing in the National Register of Historic Places (NRHP). It was also noted in discussions with the applicant that one pre-plant structure may still be in existence on the Davis-Besse site. It was indicated that a house and barn were originally on the site; the house had been moved at the time of construction, but the barn was kept in place. The barn has subsequently been re-sided. It is located in the undisturbed portion of the site within the owner-controlled area.

A recent query in the Ohio Historic Preservation Office's online mapping system by NRC staff identified 14 archaeological surveys have been conducted within 6 mi (10 km) of Davis-Besse. Additionally, within this 6-mi (10-km) radius, 378 properties (archaeological sites, historic structures, and cemeteries) were identified. Of those properties, 99 archaeological sites were recorded, of which 71 are prehistoric, 15 are historic, and 13 are multicomponent, having both prehistoric and historic elements. Four of the properties have been determined eligible for listing in the NRHP—sites 33-OT-88, 33-OT-91, 33-OT-141, and a historic structure located in Oak Harbor. In addition, there are 32 properties listed in the NRHP in Ottawa County, OH; however, only one, Carroll Township Hall, is located within 6 mi (10 km) of Davis-Besse (NPS 2011). Carroll Township Hall is within view of Davis-Besse.

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 Davis-Besse. There are no Federal projects that would make it necessary for another Federal agency to become a cooperating agency in the preparation of this SEIS. There are no known American Indian lands within 50 mi of Davis-Besse; however, eight tribes were identified to have potential interests in the surrounding area. The tribes identified and contacted during the scoping period are the Delaware Nation, Forest County Potawatomi Community, Hannahville Indian Community Council, Miami Tribe of Oklahoma, Shawnee Tribe, Wyandotte Nation, Peoria Tribe of Indians of Oklahoma, and Ottawa Tribe of Oklahoma.

Federally owned facilities within 50 mi of Davis-Besse are listed below:

- U.S. National Guard Camp Perry—5 mi,
- Ottawa National Wildlife Refuge and Visitors Center—6 mi, and
- Cedar Point National Wildlife Refuge—13 mi.

2.3.1 Coastal Zone Management Act

In the U.S., coastal areas are managed through the Coastal Zone Management Act of 1972 (CZMA). The Act, administered by NOAA's Office of Ocean and Coastal Resource Management, provides for management of the Nation's coastal resources, including the Great Lakes, and balances economic development with environmental conservation. Federal consistency is the CZMA requirement where Federal agency activities that have reasonably foreseeable effects on any land or water use or natural resource of the coastal zone must be consistent to the maximum extent practicable with the enforceable policies of a coastal state's

Federally approved Coastal Management Program. The Federal consistency regulations implemented by the NOAA are contained in 15 CFR Part 930. This law authorizes individual states to develop plans that incorporate the strategies and policies they will employ to manage development and use of coastal land and water areas. NOAA must approve each plan. One of the components of an approved plan is "enforceable policies," by which a state exerts control over coastal uses and resources (NOAA 2011a, 2011b).

NOAA approved the Ohio Coastal Zone Management Program in May 1997. In Ohio, the approved program is the Ohio Coastal Management Program (OCMP), which was authorized by the Ohio General Assembly passage of the Ohio Coastal Management Law in 1988. Davis-Besse, located in Ottawa County, is within the OCMP. Accordingly, FENOC has contacted the Ohio Department of Natural Resources. The applicants ER illustrated the activities considered to have a direct and significant impact on the coastal lands. It reflects 30 of the 41 policies in the OCMP that FENOC has deemed enforceable pursuant to Title 15 of the Ohio Revised Code, "Conservation of Natural Resources" (FENOC 2010c).

2.4 References

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

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

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

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

10 CFR Part 60. *Code of Federal Regulations,* Title 10, *Energy,* Part 60, "Disposal of High-Level Radioactive Wastes in Geologic Repositories."

10 CFR Part 61. *Code of Federal Regulations*, Title 10, *Energy*, Part 61, "Licensing Requirements for Land Disposal of Radioactive Waste."

10 CFR Part 70. *Code of Federal Regulations,* Title 10, *Energy*, Part 70, "Domestic Licensing of Special Nuclear Material."

10 CFR Part 71. *Code of Federal Regulations*, Title 10, *Energy*, Part 71, "Packaging and Transportation of Radioactive Material."

15 CFR Part 930. *Code of Federal Regulations,* Title 15, *Commerce and Foreign Trade,* Part 930, "Federal Consistency with Approved Coastal Management Programs."

40 CFR Part 40. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 40, "Research and Demonstration Grants."

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

40 CFR Part 52. *Code of Federal Regulations,* Title 40, *Protection of Environment*, Part 52, "Approval and Promulgation of Implementation Plans."

40 CFR Part 80. *Code of Federal Regulations,* Title 40, *Protection of Environment*, Part 80, "Designation of Areas for Air Quality Planning Purposes."

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

40 CFR Part 141. *Code of Federal Regulations,* Title 40, *Protection of the Environment,* Part 141, "National Primary Drinking Water Regulations," Subpart G, "National Primary Drinking Water Regulations: Maximum Contaminant Levels and Maximum Residual Disinfectant Levels," §66 "Maximum Contaminant Levels for Radionuclides."

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

40 CFR Part 239, et seq. *Code of Federal Regulations*, Title 40, Protection of Environment, Chapter I, Environmental Protection Agency, Subchapter I, "Solid Wastes."

40 CFR Part 260. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 260, "Hazardous Waste Management System: General."

40 CFR Part 261. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 261, "Identification and Listing of Hazardous Waste."

40 CFR Part 262. *Code of Federal Regulations*. Title 40, *Protection of Environment*, Part 262, "Standards Applicable to Generators of Hazardous Waste."

40 CFR Part 266. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 266, "Storage, Treatment, Transportation, and Disposal of Mixed-Waste."

40 CFR Part 273. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 273, "Standards for Universal Waste Management."

50 CFR Part 10. *Code of Federal Regulations*, Title 50, *Wildlife and Fisheries*, Part 10, "General Provisions."

50 CFR Part 20. *Code of Federal Regulations,* Title 50, *Wildlife and Fisheries,* Part 20, "Eagle Permits."

50 CFR Part 22. *Code of Federal Regulations*, Title 50, *Wildlife and Fisheries*, Part 22, "Eagle Permits."

50 CFR Part 402. Code of Federal Regulations, Title 50, Wildlife and Fisheries, Part 402, "Interagency Cooperation—Endangered Species Act of 1973, As Amended."

32 FR 4001. U.S. Fish and Wildlife Service. Native fish and wildlife; endangered species. *Federal Register* 32(48): 4001. March 11, 1967. Available URL: <http://ecos.fws.gov/docs/federal_register/fr18.pdf> (accessed 10 May 2013).

35 FR 8491. U.S. Fish and Wildlife Service. Conservation of endangered species and other fish or wildlife. *Federal Register* 35(106): 8491-8498. June 2, 1970.

41 FR 41914. U.S. Fish and Wildlife Service. Endangered and threatened wildlife and plants, determination of critical habitat for American crocodile, California condor, Indiana bat, and Florida manatee. *Federal Register* 41(187): 41914–41916. September 24, 1976. Available URL: <http://ecos.fws.gov/docs/federal_register/fr115.pdf> (accessed 8 May 2013).

49 FR 21664. U.S. Fish and Wildlife Service. "Endangered and threatened wildlife and plants; review of invertebrate wildlife for listing as endangered or threatened species." *Federal Register* 49(100): 21664-21675. May 22, 1984. Available URL: <http://ecos.fws.gov/docs/federal_register/fr836.pdf> (accessed 4 January 2011).

63 FR 31268. U.S. Environmental Protection Agency. "Emergency Planning and Community Right-to-Know Programs; Amendments to Hazardous Chemical Reporting Thresholds, Streamlining Requirements." *Federal Register* 63(109): 31268 et seq. June 8, 1998.

66 FR 22938. U.S. Fish and Wildlife Service. Endangered and threatened wildlife and plants; final determination of critical habitat for the Great Lakes breeding population of the piping plover. *Federal Register* 66(88): 22938-22969. May 7, 2001.

73 FR 66964. U.S. Environmental Protection Agency. "National Ambient Air Quality Standards for Lead; Final Rule." *Federal Register* 73(219): 66964 et seq. November 12, 2008.

74 FR 56264. U.S. Environmental Protection Agency. "Mandatory Reporting of Greenhouse Gases; Final Rule." *Federal Register* 74(209): 56264 et seq. October 30, 2009.

75 FR 6474. U.S. Environmental Protection Agency. "Primary National Ambient Air Quality Standards for Nitrogen Dioxide; Final Rule." *Federal Register* 75(26): 6474 et seq. February 9, 2010.

75 FR 9282, U.S. Fish and Wildlife Service, "General Provisions; Revised List of Migratory Birds: Final Rule." *Federal Register* 75(39): 9282 et seq. March 1, 2010.

75 FR 35520. U.S. Environmental Protection Agency. "Primary National Ambient Air Quality Standard for Sulfur Dioxide; Final Rule." *Federal Register* 75 (119): 35520 et seq. June 22, 2010.

75 FR 67551. U.S. Fish and Wildlife Service. "Endangered and Threatened Wildlife and Plants; Listing the Rayed Bean and Snuffbox as Endangered; Proposed Rule," *Federal Register* 75(211): 67551–67583. November 2, 2010.

78 FR 60023. U.S. Fish and Wildlife Service. "Endangered and threatened wildlife and plants; proposed threatened status for red knot (*Calidris canutus rufa*)." *Federal Register* 78(189): 60023-60098. September 30, 2013.

78 FR 61046. U.S. Fish and Wildlife Service. "Endangered and threatened wildlife and plants; 12-month finding on a petition to list the eastern small-footed bat and the northern long-eared bat as endangered or threatened species; listing the northern long-eared bat as an endangered species." *Federal Register* 78(231): 61046-61080. October 2, 2013.

79 FR 73705. U.S. Fish and Wildlife Service. "Endangered and threatened wildlife and plants; listing determination for the rufa red knot (*Calidris canutus rufa*)." *Federal Register* 79(238): 73705-73748. December 11, 2014.

80 FR 17974. U.S. Fish and Wildlife Service. "Endangered and threatened wildlife and plants; threatened species status for the northern long-eared bat with 4(d) rule." *Federal Register* 80(63): 17973–18033. April 2, 2015.

3745-50 OAC. Ohio Administrative Code. Chapter 3745-50, "Hazardous Waste Management System-General."

3745-52 OAC. Ohio Administrative Code. Chapter 3745-52, "Generator Standards."

15 ORC Chapter 1518.02. Ohio Revised Code, Title 15, Conservation of Natural Resources, Chapter 1518.02, "Injuring or Removing Endangered or Threatened Plant."

15 ORC Chapter 1531.25. Ohio Revised Code, Title 15, Conservation of Natural Resources Chapter 1532.25, "Protection of Species Threatened with Statewide Extinction."

[ACE] U.S. Army Corps of Engineers. 2010. *Draft Final Preliminary Assessment Report: Locust Point Anti-Aircraft Artillery Firing Area FUDS Property No. G05OH0996, Formerly Used Defense Sites Military Munitions Response Program. Prepared by Shaw Environmental & Infrastructure, Inc. for the U.S. Army Corps of Engineers*, Buffalo District.

[AEC] U.S. Atomic Energy Commission. 1973. *Final Environmental Statement Related to the Construction of Davis-Besse Nuclear Power Station*, *Docket No, 50-346*. Washington, D.C., March 1973. Agencywide Documents Access and Management System (ADAMS) Accession No. ML 110140258.

[ANSI] American National Standards Institute. 2011. *A300 Standards for Tree Care Operations.* New York, NY: Tree Care Industry Association. 9th Part.

[Audubon] National Audubon Society. 2011. *Important Bird Areas: Lake Erie Western Basin*, Available URL: <http://iba.audubon.org/iba/viewSiteProfile.do?siteId=2044&navSite=state> (accessed 19 March 2011).

Bald and Golden Eagles Protection Act of 1940, as amended, 16 U.S.C. §668–668c.

Bolsenga, S.J. and C.E. Herdendorf, *Lake Erie and Lake St. Clair Handbook,* Wayne State University Press, Detroit, MI, 1993.

Bridgeman T.B., et al., "Recruitment of *Hexagenia* Mayfly Nymphs in Western Lake Erie Linked to Environmental Variability," *Ecological Applications,* 16(2): 601–611, 2006.

[BSBO] Black Swamp Bird Observatory. 2003a. *Migrational Movements and Habitat Usage of Migrant Passerines in the Great Lakes Region: Ottawa National Wildlife Refuge, Ohio—2003*, Available URL: <http://www.bsbo.org/research/pdf/BSBO_2003_PasserineMigration_PR.pdf> (accessed 21 April 2011).

[BSBO] Black Swamp Bird Observatory. 2003b. *Migrational Survey and Habitat Usage of Shorebirds in the Lake Erie Marsh Region*—2003. Available URL: <http://www.bsbo.org/Portals/8/PDFs/Publications/BSBO_2003_Shorebird_PR.pdf> (accessed 6 May 2014).

[BSBO] Black Swamp Bird Observatory. 2004a. *Migrational Movements and Habitat Usage of Migrant Passerines in the Great Lakes Region: Ottawa National Wildlife Refuge, Ohio—2004*, Available URL: <http://www.bsbo.org/research/pdf/BSBO_2004_PasserineMigration_PR.pdf> (accessed 21 April 2011).

[BSBO] Black Swamp Bird Observatory. 2004b. *Migrational Survey And Habitat Usage of Shorebirds in the Lake Erie Marsh Region*—2004. Available URL: <http://www.bsbo.org/Portals/8/PDFs/Publications/BSBO_2004_Shorebird_PR.pdf> (accessed 6 May 2014).

[BSBO] Black Swamp Bird Observatory, 2005. *Migrational Survey and Habitat Usage of Shorebirds in the Lake Erie Marsh Region—2005*, Available URL: <http://www.bsbo.org/Portals/8/PDFs/Publications/BSBO_2004_Shorebird_PR.pdf> (accessed 6 May 2014).

[BSBO] Black Swamp Bird Observatory. 2006a. *Migrational Survey and Habitat Usage of Shorebirds in the Lake Erie Marsh Region*—2006. Available URL: <http://www.bsbo.org/Portals/8/PDFs/Publications/BSBO_2006_Shorebird_PR.pdf> (accessed 6 May 2014).

[BSBO] Black Swamp Bird Observatory. 2006b. *Navarre Marsh Bird Sightings—Spring 2006*, Available URL: <http://www.bsbo.org/passerine/pdf/2006_spring_bird_sightings.pdf> (accessed 7 June 2011).

[BSBO] Black Swamp Bird Observatory. 2006c. *Standardized Surveys of Butterflies on Ottawa National Wildlife Refuge and the Surrounding Western Basin of Lake Erie, Ohio—2006*, Available URL: <http://www.bsbo.org/research/pdf/BSBO_2006_Butterfly_PR.pdf> (accessed 7 June 2011).

[BSBO] Black Swamp Bird Observatory, 2007a. *Migrational Survey and Habitat Usage of Shorebirds in the Lake Erie Marsh Region—2007*, Available URL: <http://www.bsbo.org/Portals/8/PDFs/Publications/BSBO_2007_Shorebird_PR.pdf> (accessed 6 May 2014).

[BSBO] Black Swamp Bird Observatory, 2007b. *Navarre Marsh Bird Sightings—Spring 2007*, Available URL: <http://www.bsbo.org/passerine/pdf/2007_spring_sightings.pdf> (accessed 7 June 2011).

[BSBO] Black Swamp Bird Observatory, 2007c. *Spring Raptor Migration Surveys—2007 in the Lake Erie Region Marsh*, Updated April 4, 2011, Available URL: <http://www.bsbo.org/raptor/2007_raptor_migration_survey.htm> (accessed 7 June 2011).

[BSBO] Black Swamp Bird Observatory, 2007d. *Standardized Surveys of Butterflies on Ottawa National Wildlife Refuge and the Surrounding Western Basin of Lake Erie, Ohio—2007*, Available URL: <http://www.bsbo.org/research/pdf/BSBO_2007_Butterfly_PR.pdf> (accessed 7 June 2011).

[BSBO] Black Swamp Bird Observatory, 2008a. *Migrational Survey and Habitat Usage of Shorebirds in the Lake Erie Marsh Region—2008*, Available URL: <http://www.bsbo.org/Portals/8/PDFs/Publications/BSBO_2008_Shorebird_PR.pdf> (accessed 6 May 2014).

[BSBO] Black Swamp Bird Observatory, 2008b. *Migrational Movements and Habitat Usage of Migrant Passerines in the Great Lakes Region: Ottawa National Wildlife Refuge, Ohio—2008*," Available URL: <http://www.bsbo.org/research/pdf/BSBO_2009_PasserineMigration_PR.pdf> (accessed 7 June 2011).

[BSBO] Black Swamp Bird Observatory, 2008c. *Standardized Surveys of Butterflies on Ottawa National Wildlife Refuge and the Surrounding Western Basin of Lake Erie, Ohio—2008*, Available URL: <http://www.bsbo.org/research/pdf/BSBO_2008_Butterfly_PR.pdf> (accessed 7 June 2011).

[BSBO] Black Swamp Bird Observatory, 2008d. *Navarre Marsh Bird Sightings—Spring 2008, Data for April 13–April 30*. Available URL: <http://www.bsbo.org/passerine/pdf/05012008-0607-2008_spring_bird_survey.pdf> (accessed 7 June 2011).

[BSBO] Black Swamp Bird Observatory, 2008e. *Navarre Marsh Bird Sightings—Spring 2008, Data for May 1–June 7.* Available URL: <http://www.bsbo.org/passerine/pdf/05012008-0607-2008_spring_bird_survey.pdf> (accessed 7 June 2011).

[BSBO] Black Swamp Bird Observatory, 2008f. *17th Spring Raptor Migration Surveys—2008 in the Lake Erie Region Marsh*, Updated April 4, 2011, Available URL: <http://www.bsbo.org/raptor/2008_raptor_migration_survey.htm> (accessed 7 June 2011).

[BSBO] Black Swamp Bird Observatory, 2009a. *Migrational Movements and Habitat Usage of Migrant Passerines in the Great Lakes Region: Ottawa National Wildlife Refuge, Ohio—2009*, Available URL: <http://www.bsbo.org/research/pdf/BSBO_2009_PasserineMigration_PR.pdf> (accessed 15 April 2011).

[BSBO] Black Swamp Bird Observatory, 2009b. *Migrational Survey and Habitat Usage of Shorebirds in the Lake Erie Marsh Region—2009,* Available URL: <http://www.bsbo.org/Portals/8/PDFs/Publications/BSBO_2009_Shorebird_PR.pdf> (accessed 6 May 2014).

[BSBO] Black Swamp Bird Observatory, 2009c. *Spring Raptor Migration in Ottawa National Wildlife Refuge and Surrounding Lake Erie Marshes, Ohio—2009*, Available URL: <http://www.bsbo.org/research/pdf/BSBO_2009_Raptor_PR.pdf> (accessed 15 April 2011).

[BSBO] Black Swamp Bird Observatory, 2009d. *Standardized Surveys of Butterflies on Ottawa National Wildlife Refuge and the Surrounding Western Basin of Lake Erie, Ohio—2009*, Available URL: <http://www.bsbo.org/research/pdf/BSBO_2009_Butterfly_PR.pdf> (accessed 7 June 2011).

[BSBO] Black Swamp Bird Observatory, 2009e. *Navarre Marsh Bird Sightings—Spring 2009*, Available URL: <http://www.bsbo.org/passerine/pdf/Navarre_Spring_Survey_2009.pdf> (accessed 7 June 2011).

[BSBO] Black Swamp Bird Observatory, 2009f. *18th Spring Raptor Migration Surveys—2009 in the Lake Erie Region Marsh*, Updated April 4, 2011, Available URL: <http://www.bsbo.org/raptor/current_year_raptor_migration_survey.htm> (accessed 31 May 2011).

[BSBO] Black Swamp Bird Observatory. 2010a. *Migrational Survey and Habitat Usage of Shorebirds in the Lake Erie Marsh Region*. Available URL: <http://www.bsbo.org/Portals/8/PDFs/Publications/BSBO_2010_Shorebird_PR.pdf> (accessed 6 May 2014).

[BSBO] Black Swamp Bird Observatory. 2010b. *Navarre Marsh Bird Sightings—Spring 2010*, Data for April 1–May 31. Available URL: <http://www.bsbo.org/passerine/pdf/navarre_spring_survey_2010.pdf> (accessed 7 June 2011).

[BSBO] Black Swamp Bird Observatory, 2011a. *Navarre Marsh Bird Sightings—Spring 2011*, Data for April 12–May 31. Available URL: <http://www.bsbo.org/passerine/pdf/navarre_spring_survey_2011.pdf> (accessed 7 June 2011).

[BSBO] Black Swamp Bird Observatory, 2011b. *Loggerhead Shrike: Fist Ever Captured at the Navarre Banding Station, May 5, 2007,* Available URL: <http://www.bsbo.org/passerine/losh_05052007_navarre.htm> (accessed 21 April 2011).

[CAPS] University of Missouri Circular Area Profiling System, 2012. Census population in a 20- and 50-mile radius around the Davis-Besse Station (41.596944 Lat., -83.087778 Long.). Available URL: <http://mcdc.missouri.edu/websas/caps10c.html> (accessed 17 September 2012).

Carter TC, Feldhamer GA. 2005. Roost tree use by maternity colonies of Indiana bats and northern long-eared bats in southern Illinois. Forest and Ecology Management 219:259–268.

Centerior Energy. 1994. Letter from Stortz, L.F., Vice President, to Hic, T.O., Division of Emergency and Remedial Response, OEPA, Subject: Submittal of Information Regarding Spill of Gasoline, Identification Number 01-62-0180. February 22, 1994.

Clean Air Act of 1963, as amended. 42 U.S.C. §7401 et seq.

Coastal Zone Management Act of 1972. 16 U.S.C. §1451–1464.

Coleman, K.B. 2002. “The Maumee & Western Reserve Road or ‘Mud Pike’: U.S. Route 20 Between Perrysburg and Fremont, Northwest Ohio.” Available URL: <http://www.horizonview.net/~ihs/Transportation/Transp-Story-M&WRrd.html> (accessed 22 April 2011)

Conroy J.D. and Culver D.A., 2005. Do Dreissenid Mussels Affect Lake Erie Ecosystem Stability Processes? *American Midland Naturalist*, 153(1): 20–32, 2005.

Crail TD, Krebs RA, Zanatta DT. 2011. Unionid Mussels from Nearshore Zones of Lake Erie. Journal of Great Lakes Research 37(2011): 199–202, 2011, Available URL: <http://www.cst.cmich.edu/users/zanat1d/Crail%20JGLR%202011.pdf> (accessed 31 May 2011).

Davis-Besse Nuclear Power Station (Davis-Besse), Undated. *In 2004–05 Spent Fuel Pool Leakage to Onsite Groundwater.* Condition Report #04-01719, Discovery date 5 May 2004.

Davis-Besse, 2004a. *National Pollutant Discharge Elimination System (NPDES) Program, Administrative Procedure DB-CN-00030*. Prepared by S. Chimo, June 21, 2004.

Davis-Besse, 2004b. *Periodic Test Procedure DB-CN-04032, Wastewater Treatment Sludge Holding Tank Analysis*. Revision 01, Prepared by R. Edwards, October 28, 2004.

Davis-Besse, 2009. *Business Practice DBBP-CHEM-2009: Storm Water Pollution Prevention Plan*. Revision 00.

Emergency Planning and Community Right-to-Know Act of 1986. 42 U.S.C. §116 et seq.

Emery, L. 1985. *Review of Fish Species Introduced into the Great Lakes, 1819–1974*. Great Lakes Fishery Commission, Technical Report No. 45, April 1985, Available URL: <http://www.glfc.org/pubs/TechReports/Tr45.pdf> (accessed 14 January 2011).

Endangered Species Act of 1973, as amended. 16 U.S.C. §1531 et seq.

[EPA] U.S. Environmental Protection Agency, 1974. “Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety,” Report 550/9-74-004, Washington, D.C., March 1974, Available URL: <http://www.nonoise.org/library/levels74/levels74.htm> (See also “EPA Identifies Noise Levels Affecting Health and Welfare,” September 21, 2007, Available URL: <http://www.epa.gov/history/topics/noise/01.htm> (accessed April 2011)).

[EPA] U.S. Environmental Protection Agency. 1987. “Project Summary: Characterization of PCB Transformer/Capacitor Fluids and Correlation with PCDDs and PCDFs in Soot. EPA/600/S2-87/004. Hazardous Waste Engineering Research Laboratory,” Cincinnati, Ohio. April.

[EPA] U.S. Environmental Protection Agency. 2004. “2004 Lake Erie Lakewide Management Plan,” Available URL: <http://www.epa.gov/lakeerie/2004update/index.html> (accessed 12 January 2011).

[EPA] U.S. Environmental Protection Agency. 2008. “2008 Lake Erie Lakewide Management Plan,” Available URL: <http://www.epa.gov/glnpo/lamp/le_2008/le_2008.pdf> (accessed 12 January 2011).

[EPA] U.S. Environmental Protection Agency. 2009. “Ecoregions of Indiana and Ohio.” Available URL: <http://www.epa.gov/wed/pages/ecoregions/ohin_eco.htm#Ecoregionsdenote> (accessed 15 April 2011).

[EPA] U.S. Environmental Protection Agency. 2010a. “Office of Solid Waste.” Available URL: <http://www.epa.gov/osw> (accessed December 2010).

[EPA] U.S. Environmental Protection Agency. 2010b. "Waste Environmental Management Systems." Available URL: <http://www.epa.gov/osw/inforesources/ems/index.htm> (accessed December 2010).

[EPA] U.S. Environmental Protection Agency. 2010c. "Office of Solid Waste," Available URL: http://www.epa.gov/osw (accessed December 2010).

[EPA] U.S. Environmental Protection Agency. 2010d. "Waste Environmental Management Systems," Available URL: <http://www.epa.gov/osw/inforesources/ems/index.htm> (accessed December 2010).

[EPA] U.S. Environmental Protection Agency. 2010e. "Safe Drinking Water Information System (SDWIS)," County Search—Lucas, Sandusky, Ottawa, and Wood Counties, OH. Available URL: <http://iaspub.epa.gov/enviro/sdw_form_v2.create_page?state_abbr=OH> (accessed April 2011).

[EPA] U.S. Environmental Protection Agency. 2011a. "Enforcement & Compliance History Online (ECHO), Water Program Search Results." Available URL: <http://www.epa-echo.gov/echo/compliance_report_water_icp.html> (accessed 4 March 2011).

[EPA] U.S. Environmental Protection Agency. 2011b. "Enforcement & Compliance History Online (ECHO), Detailed Facility Report." Available URL: <http://www.epa-echo.gov/cgi-bin/get1cReport.cgi?tool=echo&IDNumber=OH0003786> (accessed 4 March 2011).

[EPA] U.S. Environmental Protection Agency. 2011c. "Envirofacts Warehouse Water Discharge Permit Detailed Reports." Available URL: <http://oaspub.epa.gov/enviro/pcs_det_reports.detail_report?npdesid=OH0003786> (accessed 4 March 2011).

[EPA] U.S. Environmental Protection Agency. 2011d. "Clean Energy, eGRID," eGRID2010 Version 1.0. Available URL: <http://www.epa.gov/cleanenergy/energy-resources/egrid/index.html> (accessed 16 May 2011).

[EPA] U.S. Environmental Protection Agency. 2011e. "Energy CO_2 Emissions by State, 1990–2008." Available URL: <http://www.epa.gov/statelocalclimate/documents/pdf/CO2FFC_2008.pdf> (accessed 15 May 2011).

[EPA] U.S. Environmental Protection Agency. 2011f. "Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2009," EPA 430-R-11-005. April 15. Available URL: <http://www.epa.gov/climatechange/emissions/usinventoryreport.html> (accessed 15 May 2011).

[EPA] U.S. Environmental Protection Agency. 2011g. *AirData: Access to Air Pollution Data.* Available URL: <http://www.epa.gov/oar/data/> (accessed 14 May 2011).

[EPA] U.S. Environmental Protection Agency. 2013. *National Ambient Air Quality Standards (NAAQS).* Updated on December 14, 2012. Available URL: <http://epa.gov/air/criteria.html> (accessed 29 March 2013).

[EPA] U.S. Environmental Protection Agency. 2014. The Green Book Non-attainment Areas for Criteria Pollutants. Updated on July 2, 2014. Available URL: <http://www.epa.gov/airquality/greenbook/index.html> (accessed 12 August 2014).

[ERM] Environmental Resources Management, 2007. *Groundwater Flow Characteristics Report, Davis-Besse Nuclear Power Station,* Prepared for FENOC, Oak Harbor, OH, January 16.

[ERM] Environmental Resources Management, 2008. *Groundwater Monitoring Well Installation & Monitoring Report, Davis-Besse Nuclear Power Station*. Prepared for FENOC, Oak Harbor, OH, March 18.

[ESA] *Endangered Species Act of 1973, as amended.* 16 U.S.C. §1531, et seq.

Ewert DN, Hall KR, Wunderle JM Jr., Currie D, Rockwell SM, Johnson SB, White JD. 2012. Duration and rate of spring migration of Kirtland's Warblers. Wilson Journal of Ornithology 124:9-14.

[FENOC] FirstEnergy Nuclear Operating Company, 1998. Letter from Lash, J.H., Plant Manager, Davis-Besse, to C. Zipp, State Fire Marshall Office. Subject: *Underground Storage Tank Overfill Release Report, Incident Number 6281145-00,* September 18.

[FENOC] FirstEnergy Nuclear Operating Company. 2005. *System Description for Meteorological Monitoring System for the Toledo Edison Company, Davis-Besse Nuclear Power Station, Unit 1,* Oak Harbor, Ohio. SD-032C, Rev. 2.

[FENOC] FirstEnergy Nuclear Operating Company. 2007. Letter from Kaminskas, V.A., FENOC, Director of Site Operations, to A. Gall, Division of Surface Water, OEPA Subject: *Submittal of 2006 Annual Sludge Disposal Report for the Davis-Besse Nuclear Power Station,* January 29.

[FENOC] FirstEnergy Nuclear Operating Company. 2008. Letter from Kaminskas, V.A., FENOC, Director of Site Operations, to R. Zuzik, Division of Surface Water, OEPA, Subject: *Submittal of the 2007 Annual Sludge Disposal Report for the Davis-Besse Nuclear Power Station*, January 18.

[FENOC] FirstEnergy Nuclear Operating Company. 2009. Letter from Allen, B., FENOC, Vice President-Nuclear, to A. Gall, Sewage Sludge Coordinator, OEPA. Subject: *Submittal of the 2008 Annual Sludge Disposal Report for the Davis-Besse Nuclear Power Station,* January 23.

[FENOC] FirstEnergy Nuclear Operating Company, 2010a. Letter from Boissoneault, PM, FENOC, Manager, Site Chemistry, to A. Gall, Sewage Sludge Coordinator, OEPA. Subject: *Submittal of the 2009 Annual Sludge Disposal Report for the Davis-Besse Nuclear Power Station*, January 21.

[FENOC], FirstEnergy Nuclear Operating Company. 2010b. *Updated Safety Analysis Report (USAR), Davis-Besse Nuclear Power Station No. 1, Docket No. 50-346, License No: NPF-3, Revision 27*, June 2010.

[FENOC] FirstEnergy Nuclear Operating Company. 2010c. "Davis-Besse Nuclear Power Station License Renewal Application," Toledo, OH, August 2010, ADAMS Accession No. ML102450572.

[FENOC] FirstEnergy Nuclear Operating Company, 2010d. Letter from Brown, S.F., FENOC, Senior Engineer, to R. Zuzik, Division of Surface Water, OEPA. Subject: *National Pollutant Discharge Elimination System Permit Renewal Application, Davis-Besse Nuclear Power Station, EPA ID No. OH0003786, Permit No. 2IB00011*ID,* October 21.

[FENOC] FirstEnergy Nuclear Operating Company. 2011a. Letter from Boissoneault, PM, FENOC, Manager, Site Chemistry, to A. Gall, Sewage Sludge Coordinator, OEPA. Subject: "Submittal of the 2010 Annual Sludge Disposal Report for the Davis-Besse Nuclear Power Station," January 25.

[FENOC] FirstEnergy Nuclear Operating Company. 2011b. Enclosure C-Binder 2 of 2, Davis-Besse Nuclear Power Station, Unit No. 1 (DBNPS) References." May 27, 2011. ADAMS Accession No. ML11193A104.

[FENOC] FirstEnergy Nuclear Operating Company. 2011c. Letter from Barry S. Allen, to Document Control Desk, NRC. Subject: Davis-Besse Nuclear Power Station, Unit No. 1, Docket No. 50-346, License Number NPF-3, Reply to Requests for Additional Information for the Review of the Davis-Besse Nuclear Power Station. Unit No. 1. License Renewal Application (TAC No. ME4613) Environmental Report. May 27.

[FENOC] FirstEnergy Nuclear Operating Company. 2012. *Combined Annual Radiological Environmental Operating Report and Radiological Effluent Release Report for the Davis-Besse Nuclear Power Station–2011*, May 2012. ADAMS Accession No. ML12174A090.

[FENOC] FirstEnergy Nuclear Operating Company. 2013a. E-mail from S. Dort to E. Keegan. Subject: Answer to staff question about synthetic minor permit from Ohio Environmental Protection Agency. February 27, 2013. ADAMS Accession No. ML13280A272.

[FENOC] FirstEnergy Nuclear Operating Company. 2013b. Davis-Besse, Unit 1. *2012 Annual Radiological Environmental Operating Report Including the Radiological Effluent Release Report. Oak Harbor, Ohio*. May 2013. ADAMS Accession No. ML13169A109.

[FENOC] FirstEnergy Nuclear Operating Company. 2014a. Letter from R. Lieb to Document Control Desk. Subject: FENOC Comments on Davis-Besse Draft Supplemental Environmental Impact Statement. April 21, 2014. ADAMS Accession No. ML14113A214.

[FENOC] FirstEnergy Nuclear Operating Company. 2014b. *Davis-Besse, Unit 1. 2013 Annual Radiological Environmental Operating Report Including the Radiological Effluent Release Report. Oak Harbor, Ohio*. May 2014. ADAMS Accession No. ML14140A215.

[FWS] U.S. Fish and Wildlife Service. 1984. "Endangered and Threatened Wildlife and Plants; Review of Invertebrate Wildlife for Listing as Endangered or Threatened Species*,"* *Federal Register,* Volume 49, No. 100, pp. 21664–21675, May 22. Available URL: <http://ecos.fws.gov/docs/federal_register/fr836.pdf> (accessed 4 January 2011).

[FWS] U.S. Fish and Wildlife Service. 1985. *Kirtland's Warbler Recovery Plan*. Prepared by the Kirtland's Warbler Recovery Team. 83 p. Available URL: <http://ecos.fws.gov/docs/recovery_plan/850930.pdf> (accessed 16 June 2014).

[FWS] U.S. Fish and Wildlife Service. 2001. "Ottawa National Wildlife Refuge Complex Comprehensive Conservation Plan." Available URL: <http://www.fws.gov/midwest/planning/ottawa/index.html> (accessed 20 April 2011).

[FWS] U.S. Fish and Wildlife Service. 2002. "*Status Assessment Report for the Rayed Bean*, Villosa fabalis, *Occurring in the Mississippi River and Great Lake Systems (U.S. Fish and Wildlife Service Regions 3, 4, and 5, and Canada),"* Prepared by the Ohio River Valley Ecosystem Team Mollusk Subgroup, September. Available URL: <http://www.fws.gov/midwest/endangered/clams/pdf/rayed-bean-sa.pdf> (accessed 4 January 2011).

[FWS] U.S. Fish and Wildlife Service. 2003. "Lake Erie Watersnake Recovery Plan," FWS Great Lakes-Big Rivers Region, September. Available URL: <http://www.fws.gov/midwest/endangered/reptiles/pdf/lews-fnl-rpla-sm.pdf> (accessed 20 March 2011).

[FWS] U.S. Fish and Wildlife Service. 2003. "Recovery Plan for the Great Lakes Piping Plover (Charadrius melodus)." FWS Region 3. September 2003. 151 p. Available URL: <http://ecos.fws.gov/docs/recovery_plan/030916a.pdf> (accessed 8 May 2013).

[FWS] U.S. Fish and Wildlife Services, 2009a. Letter from Knapp, M., FWS, Field Supervisor, to B. Allen, FENOC. Subject: Comments on the Proposed Davis-Besse License Renewal. December 16. ADAMS Accession No. ML102450568.

[FWS] U.S. Fish and Wildlife Service. 2009b. Piping Plover (Charadrius melodus) 5-Year Review: Summary and Evaluation. Hadley, MA and Lansing, MI: FWS. September 2009. 214 p. Available URL: <http://www.fws.gov/midwest/endangered/recovery/5yr_rev/pdf/PipingPlover5yr2009.pdf> (accessed 8 May 2013).

[FWS] U.S. Fish and Wildlife Service. 2009c. *Spotlight Species Action Plan: Kirtland's Warbler*. Region 3, East Lansing Field Office. Available URL: <http://ecos.fws.gov/docs/action_plans/doc3036.pdf> (accessed 16 June 2014).

[FWS] U.S. Fish and Wildlife Service. 2010a. "Rayed Bean (freshwater mussel) *Villosa fabalis*)," October. Available URL: <http://www.fws.gov/cookeville/pdfs/Rayed%20Bean%20Fact%20Sheet.pdf> (accessed 4 January 2011).

[FWS] U.S. Fish and Wildlife Service. 2010b. E-mail from Seymour, M., FWS, Wildlife Biologist, to R. Bulavinetz, NRC, Subject: Federally Listed Species along Davis-Besse Transmission Line Corridors. September 24. ADAMS Accession No. ML110730328.

[FWS] U.S. Fish and Wildlife Services, 2010c. Letter from Knapp, M., FWS, Field Supervisor, to C. Bladey, NRC. Subject: Scoping Comments on the Davis-Besse License Renewal Application Review. December 16. ADAMS Accession No. ML110060289.

[FWS] U.S. Fish and Wildlife Service. 2011a. "West Sister Island National Wildlife Refuge: Wildlife and Habitat," Available URL: <http://www.fws.gov/refuges/profiles/index.cfm?id=31542> (accessed 20 March 2011).

[FWS] U.S. Fish and Wildlife Service. 2011b. "Rayed Bean (*Villosa fabalis*)," January 4. Available URL: <http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=F01A> (accessed 20 March 2011).

[FWS] U.S. Fish and Wildlife Service. 2011c. "Eastern Prairie Fringed Orchid (*Platanthera leucophaea*) Fact Sheet," March 9. Available URL: <http://www.fws.gov/Midwest/Endangered/plants/epfo.html> (accessed 20 March 2011).

[FWS] U.S. Fish and Wildlife Service. 2011d. "Karner Blue Butterfly (*Lycaeides Melissa samuelis*)," June 1. Available URL: <http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=I00F> (accessed 1 June 2011).

[FWS] U.S. Fish and Wildlife Service. 2011e. "Kirtland's Warbler (*Dendroica kirtlandii*)." June 1. Available URL: <http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=B03I> (accessed 1 June 2011).

[FWS] U.S. Fish and Wildlife Service. 2011f. "Find Endangered Species: Species By County Report for Lucas, Ottawa, Sandusky, and Wood Counties, Ohio," Available URL: <http://www.fws.gov/endangered/> (accessed 8 February 2011).

[FWS] U.S. Fish and Wildlife Service. 2011g. "National Wetlands Inventory Wetland Mapper." Available URL: <http://www.fws.gov/wetlands/Data/Mapper.html> (accessed 20 March 2011).

[FWS] U.S. Fish and Wildlife Service. 2012a. *Kirtland's Warbler (Dendroica kirtlandii) 5-Year Review: Summary and Evaluation*. Available URL: <http://ecos.fws.gov/docs/five_year_review/doc4045.pdf> (accessed 16 June 2014).

[FWS] U.S. Fish and Wildlife Service. 2012b. Letter from FWS Columbus, Ohio Ecological Services Field Office, to 1st Lt. Roger Nienberg, Department of the Air Force. Subject: Final Environmental Assessment, Phase IV Renewable Energy Wind Demonstration at 200th RHS Camp Perry Air National Guard Station, Ohio. September 25, 2012. Available URL: <http://www.bsbobird.org/Portals/8/PDFs/Conservation/USFWS%20Comments%20on%20EA_Part%20I.pdf> (accessed 16 June 2014).

[FWS] U.S. Fish and Wildlife Service. 2013. "County Distribution of Ohio's Federally Threatened, Endangered, Proposed, and Candidate Species," January. Available URL: <http://www.fws.gov/midwest/endangered/lists/ohio-cty.html> (accessed 26 February 2013).

[FWS] U.S. Fish and Wildlife Service. 2014. *Northern Long-eared Bat Interim Conference and Planning Guidance*. FWS Regions 2, 3, 4, 5, and 6. January 6, 2014. Available URL: <http://www.fws.gov/northeast/virginiafield/pdf/NLEBinterimGuidance6Jan2014.pdf> (accessed 5 May 2014).

[GLFC] Great Lakes Fishery Commission, 2000. *Sea Lamprey: A Great Lakes Invader*, Available URL: <http://www.seagrant.umn.edu/downloads/x106.pdf> (accessed 20 March 2011).

[GLFC] Great Lakes Fishery Commission. 2003. *Fish Community Goals and Objectives for Lake Erie*. Special Publication 03-02, March 2003, Available URL: <http://www.glfc.org/pubs/SpecialPubs/Sp03_2.pdf> (accessed 20 March 2011).

Greger, L.R., NRC, Reactor Projects Branch Chief, letter to D. Shelton, Vice President-Nuclear, Davis-Besse, "Re: Safety Inspection," Docket No. 50-346, February 25, 1991.

Haig SM. 1992. "Piping Plover (Charadrius melodus)." In: Poole A, Stettenheim P, Gill F, (eds.). The Birds of North America, No. 2, Philadelphia, PA: The Academy of Natural Sciences; Washington, DC: The American Ornithologists Union. 18 p.

Harrington BA. 2001. Red knot (Calidris canutus). In Poole A, Gill F, eds. The Birds of North America, No. 563, Philadelphia, PA: The Birds of North America, Inc.

Henderson LE, Farrow LJ, Broders HG. 2008. Intra-specific effects of forest loss on the distribution of the forest-dependent northern long-eared bat (Myotis septentrionalis). Biological Conservation 141:1819–1828.

Herdendorf, C.E. 1987. *The Ecology of Coastal Marshes of Western Lake Erie: A Community Profile.* U.S. Fish and Wildlife Service Biological Report 85(7.9), February 1987, Available URL: <http://www.nwrc.usgs.gov/techrpt/85-7-9.pdf> (accessed 20 March 2011).

[IES] Institute of Educational Science. 2010. U.S. Department of Education, National Center for Educational Statistics, "College Opportunities Online Locator," Zip Code 43112, August 4, Available URL: <http://nces.ed.gov/ipeds/cool/RefineSearch.aspx> (accessed June 2011).

[IJC] International Joint Commission. 2004. *Twelfth Biennial Report on Great Lakes Water Quality*. U.S. and Canada, September 2004, Available URL: <http://www.ijc.org/php/publications/html/12br/english/report/index.html> (accessed 20 March 2011).

Krynak TJ. 2010. Bat habitat use and roost tree selection for northern long-eared myotis (*Myotis septentrionalis*) in north-central Ohio. Thesis submitted to the College of Arts and Sciences, John Carroll University. Available URL: <https://etd.ohiolink.edu/rws_etd/document/get/jcu1283341332/inline> (accessed 6 May 2014).

Lacki MJ, Schwierjohann JH. 2001. Day-roost characteristics of northern bats in a mixed mesophytic forest. Journal of Wildlife Management 65:482–488.

Lepper, B. 2005. *Ohio Archaeology: An Illustrated Chronicle of Ohio's Ancient American Indian Cultures.* Orange Frazer Press. Wilmington, OH.

Lucas 2011. Ohio Department of Development, Lucas County Profile. Available URL: <http://development.ohio.gov/research/files/s0/Lucas.pdf> (accessed September 2012).

Ludsin, S.A., Kershner MW, Blocksom, KA, Knight RL, Stein RA. 2001. *Life after Death in Lake Erie: Nutrient Controls Drive Fish Species Richness, Rehabilitation*, *Ecological Applications*, 11(3):731–746, 2001.

Magnuson–Stevens Fishery Conservation and Management Act, as amended. 16 U.S.C. §1801 et seq.

Marine Mammal protection Act of 1972, as amended. 16 U.S.C. §1361.

Migratory Bird Treaty Act of 1981, as amended. 16 U.S.C. §§703–712.

[MDNR] Minnesota Department of Natural Resources. 2008. "In Search of Blue Pike in Minnesota Conservation." July–August 2008. Available URL: <http://www.dnr.state.mn.us/volunteer/julaug08/blue_pike.html> (accessed 20 March 2011).

Menzel, J.M., Ford WM, Menzel MA, Carter TC, Gardner JE, Gardner JD, Hofmann JE. 2005. *Summer Habitat Use and Home-Range Analysis of the Endangered Indiana Bat*, *Journal of Wildlife Management*, 69(1):430–436, 2005, Available URL: <http://www.fs.fed.us/ne/newtown_square/publications/other_publishers/OCR/ne_2005_Menzel001.pdf> (accessed 20 March 2011).

Miller MP, Haig SM, Gratto Trevor CL, Mullins TD. 2009. Molecular population genetic structure in the piping plover. U.S. Geological Survey Open File Report 2009–1032. 30 p. Available URL: <http://pubs.usgs.gov/of/2009/1032/pdf/OFR20091032.pdf> (accessed 12 April 2013).

Murphy, H. 1988. *State Route 2 Black Swamp Survey*. Journal of the Steward Anthropological Society. Vol. 18, nos. 1 & 2, pp. 22–36.

[NASS] U.S. Department of Agriculture, National Agricultural Statistics Service. 2007. "2007 Census of Agriculture," Volume 1, Chapter 2, Table 1 and Table 7. Available URL: <http://www.agcensus.usda.gov/Publications/2007/Full_Report/Volume_1,_Chapter_2_County_Level/Ohio/index.asp> (accessed April 2011).

[NCDC] National Climatic Data Center. 1994. *1993 Local Climatological Data Annual Summary with Comparative Data, Toledo,* Ohio. National Oceanic and Atmospheric Administration, Satellite and Information Service. Available URL: <http://www7.ncdc.noaa.gov/IPS/lcd/lcd.html> (accessed 15 May 2011).

[NCDC] National Climatic Data Center. 2011a. *Climates of the States (CLIM60): Climate of Ohio.* National Oceanic and Atmospheric Administration, Satellite and Information Service. Available URL: <http://cdo.ncdc.noaa.gov/cgi-bin/climatenormals/climatenormals.pl> (accessed 11 May 2011).

[NCDC] National Climatic Data Center. 2011b. *Integrated Surface Data (ISD), DS3505 format. Database,* Asheville, N.C. Available URL: <ftp://ftp3.ncdc.noaa.gov/pub/data/noaa> (accessed 13 May 2011).

[NCDC] National Climatic Data Center 2013a. *2012 Local Climatological Data Annual Summary with Comparative Data.* Toledo, Ohio (KTOL). National Oceanic and Atmospheric Administration, Satellite and Information Service. Available URL: <http://cdo.ncdc.noaa.gov/qclcd/QCLCD> (accessed 22 March 2013).

[NCDC] National Climatic Data Center. 2013b. Storm Events for Ohio. National Oceanic and Atmospheric Administration, Satellite and Information Service. Available URL: <http://www.ncdc.noaa.gov/stormevents/choosedates.jsp?statefips=39%2COHIO> (accessed 5 March 2013).

[NCDC] National Climatic Data Center. 2013c. Ohio Temperature and Precipitation. National Oceanic and Atmospheric Administration. Available URL: <http://www.ncdc.noaa.gov/temp-and-precip/timeseries/index.php?parameter=tmp&month=1&year=1955&filter=ytd&state=33&div=0> (accessed 25 March 2013).

[NCES] National Center for Education Statistics. 2010. "Search for Public School Districts," U.S. Department of Education, 2010, Available URL: <http://www.nces.ed.gov/ccd/districtsearch/> (accessed June 2011).

[NEPA] *National Environmental Policy Act of 1969, as amended.* 42 U.S.C. §4321 et seq.

Neusius, S.W., and G.T. Gross. 2007. *Seeking Our Past: An Introduction to North American Archaeology.* Oxford University Press. New York, New York.

Niles LJ, Sitters HP, Dey AD, Atkinson PW, Baker AJ, Bennet KA, Carmoa R, Clark KE, Clark NA, Espoza C. 2008. Status of the red knot (Calidris canutus rufa) in the Western Hemisphere. Studies in Avian Biology 36:1-185.

[NMFS] National Marine Fisheries Service. 2010. Letter from Colligan, M.A., NMFS, Northeast Assistant Regional Administrator, to D. Wrona, Branch Chief, NRC. Subject: *Reply to Request for Species List at Davis-Besse*. December 21. ADAMS Accession No. ML110140230.

[NOAA] National Oceanic and Atmospheric Administration. 2009. E-mail from J. Kosarik (NOAA) to J.H. Snooks (AREVA). March 3, 2009.

[NOAA] National Oceanic and Atmospheric Administration. 2011a. "Coastal Zone Management Act – Congressional Action to Help Manage Our Nation's Coasts." Available URL: <http://coastalmanagement.noaa.gov/czm/czm_act.html> (accessed 16 August 2011).

[NOAA] National Oceanic and Atmospheric Administration. 2011b. "Federal Consistency Overview." Available URL: <http://coastalmanagement.noaa.gov/consistency/welcome.html> (accessed 16 August 2011).

[NOAA] National Oceanic and Atmospheric Administration. 2013. *Regional Climate Trends and Scenarios for the U.S. National Climate Assessment, Part 3. Climate of the Midwest*. NOAA Technical Report NESDIS 142-3. January 2013. Available URL: <http://www.nesdis.noaa.gov/technical_reports/NOAA_NESDIS_Tech_Report_142-3-Climate_of_the_Midwest_U.S.pdf>.

[NPS] National Park Service. 2011. "National Register of Historic Places; NPS Focus." Available URL: <http://nrhp.focus.nps.gov/natreghome.do?searchtype=natreghome> (accessed 22 April 2011).

[NRC] U.S. Nuclear Regulatory Commission. 1975. "Final Environmental Statement Related to the Operation of Davis-Besse Nuclear Power Station," Washington, D.C., October. ADAMS Accession No. ML110140258.

[NRC] U.S. Nuclear Regulatory Commission. 1976. "Regulatory Guide 1.27—Ultimate Heat Sink for Nuclear Power Plants," Washington D.C., Revision 2, March.

[NRC] U.S. Nuclear Regulatory Commission. 1988. "Information Notice 88-22: Disposal of Sludge from Onsite Sewage Treatment Facilities at Nuclear Power Stations," Prepared by C.E. Rossi, Division of Operational Events Assessment, Office of Nuclear Regulation, May 12.

[NRC] U.S. Nuclear Regulatory Commission. 1996. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*, NUREG-1437, Washington, D.C., May. ADAMS Accession Nos. ML040690705 and ML040690738.

[NRC] U.S. Nuclear Regulatory Commission. 1999a. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Main Report*, NUREG-1437, Section 6.3, Table 9.1, Volume 1, Addendum 1, Washington, D.C.

[NRC] U.S. Nuclear Regulatory Commission. 1999b. Letter from C. Carpenter, NRC, to W. McCollum, Jr., Duke Energy Corporation. Subject: Determination of the scope of transmission line impact assessment for Oconee License Renewal. May 10, 1999. ADAMS Accession No. ML070790567.

[NRC] U.S. Nuclear Regulatory Commission. 2007. "Regulatory Guide 1.23—Meteorological Monitoring Programs for Nuclear Power Plants," Washington D.C., Revision 1, March.

[NRC] U.S. Nuclear Regulatory Commission. 2010. "Final significance determination for a White finding; Notification of follow-up assessment; and Notice of Violation; NRC Inspection Report No. 05000346/2010502." Davis-Besse Nuclear Power Station. February 25. ADAMS Accession No. ML1005605920.

[NRC] U.S. Nuclear Regulatory Commission. 2011. "Summary of Site Audit Related to Review of the Davis-Besse License Renewal Application," June 3. ADAMS Accession No. ML110820276.

[NRC] U.S. Nuclear Regulatory Commission. 2013. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*. Washington, DC: Office of Nuclear Reactor Regulation. NUREG-1437, Revision 1, Volumes 1, 2, and 3. June 2013. ADAMS Accession Nos. ML13106A241, ML13106A242, and ML13106A244.

[NRCS] Natural Resources Conservation Service. 2011. *Web Soil Survey, U.S. Department of Agriculture, National Cooperative Soil Survey*. Available URL: <http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx> (accessed 16 May 2011).

[OAS] Ohio Audubon Society. 2007. "Common Birds in Decline: A State of the Birds Report," Available URL: <http://oh.audubon.org/PDFs/Ohio%20State%20of%20the%20Birds%20Fact%20Sheet.pdf> (accessed 19 March 2011).

[OAS] Ohio Audubon Society. 2009. "State of the Birds," Available URL: <http://oh.audubon.org/bsc/SOTB.html> (accessed 19 March 2011).

[ODD] Ohio Department of Development, Office of Strategic Research. 2003. "Projected population: County Totals," March 2003, Available URL: <http://www.development.ohio.gov/research/FILES/P200/countytotals.pdf> (accessed July 25, 2011.

[ODD] Ohio Department of Development. 2011. “Senate Bill 221—Alternative Energy Portfolio Standard and Energy Efficiency Portfolio Standard.” Available URL: <http://www.development.ohio.gov/Energy/Tools/Policy.htm> (accessed 18 May 2011).

[ODNR] Ohio Department of Natural Resources. 2008. Earthquake Epicenters in Ohio and adjacent areas: Ohio Division of Geologic Survey Map EG-2, Internet Mapping Service. Available URL: <http://www.dnr.state.oh.us/website/geosurvey/earthquakes/viewer.htm> (accessed 6 June 2011).

[ODNR] Ohio Department of Natural Resources. 2009a. *Ohio’s Lake Erie Fisheries 2008.* Prepared March 2009 by the Lake Erie Fisheries Units. Available URL: <http://www.dnr.state.oh.us/Portals/9/pdf/estatus2008.pdf> (accessed 20 March 2010).

[ODNR] Ohio Department of Natural Resources. 2009b. Letter from Navarro, J., ODNR, Program Administrator, to B.S. Allen, FENOC. Subject: Reply to Request for Information on Threatened or Endangered Species at the Davis-Besse Station. December 22, 2009. ADAMS Accession No. ML102450568.

[ODNR] Ohio Department of Natural Resources. 2009c. “Lake Erie Water Snake,” 2009. Available URL: <http://www.dnr.state.oh.us/Home/wild_resourcessubhomepage/ResearchandSurveys/WildlifePopulationStatusLandingPage/LakeErieWaterSnake/tabid/19298/Default.aspx> (accessed 20 March 2011).

[ODNR] Ohio Department of Natural Resources. 2010. Letter from Mitch, B., ODNR, Environmental Review Manager, to C.I. Custer, FENOC. Subject: Reply to Request for Information on Threatened or Endangered Species at the Davis-Besse Station. January 4, 2010. ADAMS Accession No. ML102450568.

[ODNR] Ohio Department of Natural Resources. 2010a. “Ohio Biodiversity Database Rare Species List for Lucas County as of 10/1/2010.” Available URL: <http://www.dnr.state.oh.us/LinkClick.aspx?fileticket=TqE9HB4d1Rk%3d&tabid=20404> (accessed 20 March 2011).

[ODNR] Ohio Department of Natural Resources. 2010b. “Ohio Biodiversity Database Rare Species List for Ottawa County as of 10/1/2010.” Available URL: <http://www.dnr.state.oh.us/LinkClick.aspx?fileticket=OgZRPyIpIg8%3d&tabid=20404> (accessed 20 March 2011).

[ODNR] Ohio Department of Natural Resources. 2010c. “Ohio Biodiversity Database Rare Species List for Sandusky County as of 10/1/2010.” Available URL: <http://www.dnr.state.oh.us/LinkClick.aspx?fileticket=1E76Np%2b8VT4%3d&tabid=20404> (accessed 20 March 2011).

[ODNR] Ohio Department of Natural Resources. 2010d. “Ohio Biodiversity Database Rare Species List for Wood County as of 10/1/2010.” Available URL: <http://www.dnr.state.oh.us/LinkClick.aspx?fileticket=WwRAk3NBYKQ%3d&tabid=20404> (accessed 20 March 2011).

[ODNR] Ohio Department of Natural Resources. 2011a, “American Badger.” Available URL: <http://www.dnr.state.oh.us/Home/species_a_to_z/SpeciesGuideIndex/badger/tabid/6807/Default.aspx> (accessed 20 March 2011).

[ODNR] Ohio Department of Natural Resources. 2011b. “Eastern Massasauga.” Available URL: <http://www.dnr.state.oh.us/Home/species_a_to_z/SpeciesGuideIndex/easternmassasauga/tabid/6610/Default.aspx> (accessed 20 March 2011).

[ODNR] Ohio Department of Natural Resources. 2011c. "Indiana Bat." Available URL: <http://www.dnr.state.oh.us/Home/species_a_to_z/SpeciesGuideIndex/indianabat/tabid/6662/Default.aspx> (accessed 20 March 2011).

[ODNR] Ohio Department of Natural Resources. 2011d. "Piping Plover." Available URL: <http://www.dnr.state.oh.us/Home/species_a_to_z/SpeciesGuideIndex/pipingplover/tabid/6902/Default.aspx> (accessed 20 March 2011).

[ODNR] Ohio Department of Natural Resources. 2011e. "Ohio's Five Physiographic Regions." Available URL: <http://www.ohiodnr.com/Home/Nature/FivePhysiographicRegions/tabid/871/Default.aspx> (accessed 15 April 2011).

[ODNR] Ohio Department of Natural Resources. 2011f. "Lakeside Daisy (*Hymenoxy acaulis* var. *glabra*)." Available URL: <http://www.fws.gov/Midwest/Endangered/plants/lakeside.html> (accessed 20 March 2011).

[ODNR and OEPA] Ohio Department of Natural Resource and Ohio Environmental Protection Agency. 1999. "Ohio Wetland Restoration and Mitigation Strategy Blueprint." September 1999, Available URL: <http://www.ohiodnr.com/Portals/3/wetlands/pdf/owrmsb.pdf> (accessed 15 April 2011).

[OEPA] Ohio Environmental Protection Agency. 2006a. Letter from Smith, P.L., OEPA, Permit Processing Unit, Division of Surface Water, to FENOC. Subject: Ohio EPA Permit No. 2IB00011*ID, Facility Name Davis-Besse Nuclear Power Station. August 14.

[OEPA] Ohio Environmental Protection Agency. 2006b. Letter from Smith, P.L., OEPA, Permit Processing Unit, Division of Surface Water, to FENOC. Subject: Ohio EPA Permit No. 2IB00011*ID, Facility Name Davis-Besse Nuclear Power Station. September 8.

[OEPA] Ohio Environmental Protection Agency. 2010a. Letter from Swindall, E., OEPA, Division of Water, to FENOC—Davis-Besse. Subject: Preliminary Compliance Review of Discharge Monitoring Report. September 21.

[OEPA] Ohio Environmental Protection Agency. 2010b. Letter from Swindall, E., OEPA, Division of Water, to FENOC—Davis-Besse. Subject: Preliminary Compliance Review of Discharge Monitoring Report. November 20.

[OEPA] Ohio Environmental Protection Agency. 2011. "Sole Source Aquifers in Ohio," 2011, Available URL: <http://www.epa.state.oh.us/ddagw/swap_ssa.aspx> (accessed 16 May 2011).

[OEPA] Ohio Environmental Protection Agency. 2011a. "Ohio EPA Oversite of the Nuclear Plants." Available URL: <http://www.epa.state.oh.us/derr/ersis/er/docs/RAD/Oversite%20of%20the%20Nuclear%20Plants.pdf> (accessed 9 March 2011).

[OEPA] Ohio Environmental Protection Agency. 2011b. "Ohio Administrative Code (OAC) Chapter 3745-25-02 Ambient Air Quality Standards. Division of Air Pollution Control Air Pollution Regulations." Available URL: <http://www.epa.ohio.gov/portals/27/regs/3745-25/3745-25-02.pdf> (accessed 14 May 2011).

[OHDOT] Ohio Department of Transportation. 2010. "Traffic Survey Report—AADT Data." Available URL: <http://www.odotonline.org/techservapps/traffmonit/countinformation/default.htm> (accessed June 2011).

Ohio History Central. 2005. "Battle of Fallen Timbers." Available URL: <http://www.ohiohistorycentral.org/entry.php?rec=473> (accessed 22 April 2011).

Ohio History Central. 2008. “Camp Perry.” Available URL: http://www.ohiohistorycentral.org/index.php> (accessed 25 February 2011).

[ONWRA] Ottawa National Wildlife Refuge Association. 2011. “Our Refuge,” Available URL: <http://www.onwra.com/our-refuge.html> (accessed 15 April 2011).

Ottawa 2011. Ohio Department of Development, Ottawa County Profile. Available URL: <http://development.ohio.gov/research/files/s0/Ottawa.pdf>. Accessed September 2012.

Owen SF, Menzel MA, Ford WM, Chapman BR, Miller KV, Edwards JW, Wood PB. 2003. Home-range size and habitat used by the northern myotis (Myotis septentrionalis). American Midland Naturalist 150:352–359.

[OWL] Ohio Wilderness League. 2011. “West Sister Island Wilderness,” Available URL: <http://www.ohiowilderness.org/WestSisterIslandWilderness.aspx> (accessed 19 March 2011).

[PCS] Partners for Clean Streams. Activities and Accomplishments in the Maumee Area of Concern: Document Summary. Available URL: <http://www.partnersforcleanstreams.org/Maumee10YearDocSummary.pdf> (accessed 2 June 2014).

Petrucha ME, Sykes PW Jr., Huber PW, Duncan WW. Spring and fall migrations of Kirtland’s warbler (Setophaga kirtlandii). North American Birds 66(3):382-427.

Prahl, E.J., D.S. Brose, and D.S. Stothers. 1973. “A Preliminary Synthesis of Late Prehistoric Phenomena in the Western Basin of Lake Erie.” In The Late Prehistory of the Lake Erie Drainage Basin; A 1972 Symposium Revised. David S. Brose ed. Cleveland Museum of Natural History, 1976.

Prufer, O.H. and O.C. Shane. 1973. “The Portage-Sandusky-Vermilion River Region in Ohio.” In The Late Prehistory of the Lake Erie Drainage Basin; A 1972 Symposium Revised. David S. Brose ed. Cleveland Museum of Natural History, 1976.

[PUCO] Ohio Public Utility Commission. 2011. “Where Does Ohio’s Electricity Come From?,” Updated January 3. Available URL: <http://www.puco.ohio.gov/emplibrary/files/media/Publications/Fact_Sheets/where%20does%20ohio’s%20electricity%20come%20from.pdf> (accessed 15 May 2011).

[RCRA] Resource Conservation and Recovery Act of 1976. 42 U.S.C. §6901.

Reutter, J.M., 1981a. *Fish Egg and Larvae Entrainment at the Davis-Besse Nuclear Power Station During 1980*, Columbus, OH. Ohio State University Center for Lake Erie Area Research, CLEAR Technical Report No. 211. ADAMS Accession No. ML11227A197.

Reutter, J.M., 1981b. *Fish Impingement at the Davis-Besse Nuclear Power Station During 1980,* Columbus, OH. Ohio State University Center for Lake Erie Area Research, CLEAR Technical Report No. 212. ADAMS Accession No. ML11227A197.

Reutter, JM, Herdendorf CE, Barnes MD, Carey WE. 1980. *Environmental Evaluation of a Nuclear Power Plant on Lake Erie,* Columbus, OH. Ohio State University Center for Lake Erie Area Research, CLEAR Technical Report No. 181. ADAMS Accession No. ML11227A196.

Sandusky 2011. Ohio Department of Development, Sandusky County Profile. Available URL: <http://development.ohio.gov/research/files/s0/Sandusky.pdf>. Accessed September 2012.

Smith, B.D. 1989. *Origins of Agriculture in Eastern North America.* Science, New Series. Vol. 246, No. 4937, pp. 1566–1571.

Sovacool, B.K., "Valuing the Greenhouse Gas Emissions from Nuclear Power: A Critical Survey," *Energy Policy*, 36:2940–2953, 2008.

Tankersly, K.B. 1997. *Sheriden: A Clovis Cave Site in Eastern North America*. Geoarchaeology: An International Journal. Vol. 12, No. 6, pp. 713–724.

Tanner, H.H., ed. 1987. *Atlas of Great Lakes Indian History*. University of Oklahoma Press. Norman, OK.

Toledo Edison. 1990. State of Ohio Water Withdrawal Facility Registration, letter and form sent from Toledo Edison to R.L. Goettemoeller, ODNR, Chief, Registration No. 00598, 1990.

Tyson JT, Stein RA, Dettmers JM, Ed. 2009. "The State of Lake Erie in 2004," Great Lakes Fishery Commission, Special Publication 09-02, June 2009, Available URL: <http://www.glfc.org/pubs/SpecialPubs/Sp09_2.pdf> (accessed 14 January 2011).

[USCB] U.S. Census Bureau. 2012. "American FactFinder, Census 2010 and 2009–2011, 3-Year Estimate, American Community Survey, State and County QuickFacts on Lucas, Ottawa, Sandusky, and Wood Counties, Ohio, and Housing Characteristics for 2010 and 2009–2011, 3-Year Estimate," Available URL: <http://factfinder.census.gov> and <http://quickfacts.census.gov> (accessed July and November 2012).

[USGCRP] U.S. Global Change Research Program. 2009. "Global Climate Change Impacts in the United States." Available URL: <http://www.globalchange.gov/publications/reports/scientific-assessments/us-impacts/download-the-report> (accessed 3 June 2011).

[USGCRP] U.S. Global Change Research Program. 2014. *Climate Change Impacts in the United States*. Melillo JM, Richmond TC, Yohe GW (eds). May. ADAMS Accession No. ML14129A233.

[USGS] U.S. Geological Survey. 2008. "Geologic Hazards Team Interactive Map Server, National Seismic Hazard Maps—2008," Earthquake Hazards Program. Available URL: <http://gldims.cr.usgs.gov/> (accessed 17 May 2011).

[USGS] U.S. Geological Survey. 2011. "Physiographic Regions." Available URL: <http://tapestry.usgs.gov/physiogr/physio.html> (accessed 16 May 2011).

Wood 2011. Ohio Department of Development, Wood County Profile. Available URL: <http://development.ohio.gov/research/files/s0/Wood.pdf>. Accessed September 2012.

3.0 ENVIRONMENTAL IMPACTS OF REFURBISHMENT

Facility owners or operators may need to undertake, for economic or safety reasons, or 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 that 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 recirculation piping in boiling-water reactors or replacement of steam generators in pressurized-water reactors. These actions may have an impact on the environment beyond those that occur during normal operations and may require evaluation, depending on the type of action and the plant-specific design. As described in Chapter 1, in June 2013 the NRC published a final rule (78 FR 37282) revising its environmental protection regulations in 10 CFR Part 51 and issued a revised GEIS. However, the environmental impacts of refurbishment activities for Davis-Besse were reviewed in accordance with the 1996 rule and GEIS (NRC 1996, 1999). Table 3–1 lists the environmental issues associated with refurbishment that the U.S. Nuclear Regulatory Commission (NRC) staff (the staff) determined to be Category 1 issues in the GEIS.

Table 3–1. Category 1 Issues Related to Refurbishment

Issue	GEIS Section(s)
Surface water quality, hydrology, and use (for all plants)	
Impacts of refurbishment on surface water quality	3.4.1
Impacts of refurbishment on surface water use	3.4.1
Aquatic ecology (for all plants)	
Refurbishment	3.5
Groundwater use and quality	
Impacts of refurbishment on groundwater use and quality	3.4.2
Land use	
Onsite land use	3.2
Human health	
Radiation exposures to the public during refurbishment	3.8.1
Occupational radiation exposures during refurbishment	3.8.2
Socioeconomics	
Public services: public safety, social services, and tourism and recreation	3.7.4; 3.7.4.3; 3.7.4.4; 3.7.4.6
Aesthetic impacts (refurbishment)	3.7.8
Source: 61 FR 28467, June 5, 1996	

Table 3–2 lists environmental issues related to refurbishment that the NRC staff determined to be plant-specific or inconclusive in the GEIS. These issues are Category 2 issues. The definitions of Category 1 and 2 issues can be found in Section 1.4 of this SEIS.

Table 3–2. Category 2 Issues Related to Refurbishment

Issue	GEIS Section(s)	10 CFR 51.53 (c)(3)(ii) Subparagraph
Terrestrial resources		
Refurbishment impacts	3.6	E
Threatened or endangered species (for all plants)		
Threatened or endangered species	3.9	E
Air quality		
Air quality during refurbishment (non-attainment and maintenance areas)	3.3	F
Socioeconomics		
Housing impacts	3.7.2	I
Public services: public utilities	3.7.4.5	I
Public services: education (refurbishment)	3.7.4.1	I
Public services: transportation	3.7.4.2	J
Offsite land use (refurbishment)	3.7.5	I
Historic and archaeological resources	3.7.7	K
Environmental justice		
Environmental justice[a]	Not addressed	Not addressed

[a] Guidance related to environmental justice was not in place at the time the NRC prepared the 1996 GEIS and the associated revision to 10 CFR Part 51. If an applicant plans to undertake refurbishment activities for license renewal, the applicant's Environmental Report (ER) and the staff's environmental impact statement must address environmental justice.

Source: 61 FR 28467, June 5, 1996

Table B.2 of the GEIS identifies systems, structures, and components (SSCs) that are subject to aging and might require refurbishment to support continued operation during the license renewal period of a nuclear facility. In preparation for its license renewal application, FirstEnergy Nuclear Operating Company (FENOC) performed an evaluation of these SSCs pursuant to 10 CFR 54.21 in order to identify the need to undertake any major refurbishment activities that would be necessary to support the continued operation of Davis-Besse during the proposed 20-year period of extended operation. FENOC addressed refurbishment activities in Section 3.2 of its Environmental Report (ER), "Refurbishment Activities," which is included as Appendix E of the license renewal application (FENOC 2010).

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

3.1 Refurbishment Activities at Davis-Besse

The NRC regulations for implementing the National Environmental Policy Act (NEPA) require ERs to describe in detail and assess the environmental impacts of refurbishment activities, such as planned modifications to SSCs or plant effluents, as stated in 10 CFR 51.53. When FENOC submitted the Davis-Besse license renewal application and ER in August 2010, replacement of the reactor vessel head, steam generators, and other large irradiated plant equipment were identified as refurbishment activities that would be performed in the future.

Based on the information in the ER, FENOC planned to replace the reactor vessel head in 2011, and the two original steam generators in 2014. Other planned refurbishment activities included building a new permanent storage facility to store the replaced vessel head and steam generators and other irradiated equipment (e.g., the reactor coolant system hot leg piping). Refurbishment plans also included building a permanent multi-story office building and a new warehouse to store the new steam generators. FENOC also planned to construct various temporary structures, including tents and trailers for fabrication and assembly activities, mock-up activities, weld testing, decontamination, warehouse storage and lay down areas.

FENOC completed the reactor vessel head replacement in 2011. In 2011, the Old Steam Generator Storage Facility was built as a permanent structure to house the replaced vessel head, the original steam generators, and the reactor coolant system hot leg piping. Also in 2011, FENOC built a permanent multi-story office building to house personnel supporting activities related to replacing the vessel head and steam generators.

During the refueling outage that began on February 1, 2014, the two original steam generators, along with the reactor coolant system hot leg piping, were replaced. The temporary structures were removed following completion of the steam generator replacement project (FENOC 2014).

In June 2014, FENOC submitted the annual update to the LRA and provided the revised pages to the ER documenting that refurbishment activities had been completed (FENOC 2014).

3.2 Environmental Impacts of Refurbishment

The following sections discuss the Category 2 issues associated with refurbishment activities at Davis-Besse. Any environmental impacts from refurbishment will be in addition to those associated with continued operation of Davis-Besse for the period of license renewal. Chapter 4 of this report discusses those issues.

3.2.1 Terrestrial Resources—Refurbishment Impacts

FENOC's planned refurbishment activities (discussed in Section 3.1) required FENOC to construct several new buildings and designate areas for decontamination and building material and lay down areas for supplies. The descriptions of terrestrial resources in Section 2.2.6 and protected species and habitats in Section 2.2.7 serve as the basis for the assessment of refurbishment impacts to terrestrial resources contained in this section. The information concerning refurbishment activity timing and logistics was drawn from FENOC's ER (2010). Changes to FENOC's refurbishment plan were submitted with the annual update to its license renewal application (FENOC 2014).

Onsite Impacts. FENOC completed all refurbishment activities during an extended refueling outage that began on February 1, 2014, and lasted until May 8, 2014. As part of refurbishment, FENOC constructed temporary and permanent buildings, moved heavy equipment and machinery, and created lay down areas on previously disturbed areas within the

owner-controlled area of the Davis-Besse site. FENOC estimates that total land disturbance was less than 10 acres (ac) (4 hectares (ha)).

FENOC constructed the following buildings and facilities:

- an 18,000-square foot (ft^2) (1,670-square meter (m^2)) permanent storage facility to store the current RV head, the original steam generators, and the reactor coolant system (RCS) hot legs;
- an 18,000-ft^2 (1,670-square meter (m^2)) permanent structure that housed the replacement steam generators until they were installed in the plant;
- a permanent multi-story office building to support the extra personnel required for refurbishment activities; and
- various temporary facilities totaling 68,000 ft^2 (6320 m^2) including tents and portable trailers for fabrication and assembly activities, mock-up activities, weld testing, decontamination, warehouse storage, and lay down areas.

FENOC constructed concrete pads as a base for the temporary buildings described above; however, the pads will remain on the site as permanent structures.

All land that was disturbed for construction and other refurbishment-related activities is previously disturbed and currently maintained as parking lots or other paved surface or as landscaped areas that are regularly mowed. Because of this, no terrestrial habitat was affected by refurbishment activities. Some sediment transport or erosion may have occurred during construction. Some wildlife in neighboring marsh and grassland habitat might have avoided habitat margins during the refurbishment period due to increased noise and lighting, which would reduce the available habitat for those species. Edges species would have been affected more than interior species. Construction activities that occurred during the spring 2014 refueling outage may have affected the nesting behavior of certain bird species. However, these impacts were short-term because the refurbishment activities only lasted for about 90 days during the refueling outage. Additionally, all nesting birds would benefit from the protective measures that FENOC follows regarding the bald eagle (*Haliaeetus leucocephalus*) and its nesting season (discussed below under "Protected Species and Habitats").

Onsite impacts to terrestrial resources would be SMALL. The protective measures in place for bald eagles (discussed below) would benefit all wildlife in the immediate area. Increased noise and lighting might have reduced habitat usage for a short time, but no undisturbed land had been immediately impacted; therefore, refurbishment did not result in the long-term conversion or loss of habitat or noticeably alter the behavior of any wildlife populations.

Offsite Impacts. Babcock and Wilcox Canada, Ltd., transported the steam generators to the Davis-Besse site via railroad and ship. Physical modifications to the rail lines were necessary to safely transport the new steam generators to the site. Babcock and Wilcox Canada, Ltd., was responsible for ensuring all the Federal, State and local requirements were met for transporting the steam generators to the Davis-Besse site. Depending on the surrounding habitat, construction activities could have led to a loss of habitat, erosion, and altered wildlife behavior. Edge species and nesting birds may have been affected more than interior species. Because the exact extent of offsite impacts due to rail line modifications is unknown, the impacts could range from SMALL to MODERATE.

Protected Species and Habitats. As discussed in Section 2.2.7, the U.S. Fish and Wildlife Service (FWS) identified two bald eagle nests that are located on the Davis-Besse site—one within Navarre Marsh and one northwest of the cooling tower near the site boundary (FWS 2010). FENOC's (2011) environmental best management practices specify that no

ground disturbing activity, tree clearing, or habitat modification occur within 660 feet (ft) (200 meters (m)) of any bald eagle nest from January 1 through July 31. FENOC's procedures require coordination with the FWS prior to taking action (FENOC 2011). Additionally, the Bald and Golden Eagle Protection Act of 1940, as amended (16 U.S.C. §668-668c), prohibits the taking of eagles without a FWS-issued eagle permit. Taking includes any action or activity that decreases an eagle's productivity by interfering with breeding, feeding, or sheltering behavior or any activity that results in an eagle abandoning its nest (50 CFR 22.3). If any refurbishment activities would have occurred within a 660 ft (200 m) radius of one or more bald eagle nests, FENOC would have had to consult with the FWS prior to beginning refurbishment activities to ensure that the appropriate mitigation measures were taken to minimize adverse impacts to bald eagles during the 70-day refurbishment period. However, no refurbishment activities were performed within the 660 ft (200 m) radius of the eagle nests.

FENOC also maintains procedures concerning the Indiana bat (*Myotis sodalis*) (discussed in Section 2.2.7). If any Indiana bats inhabit natural areas on the Davis-Besse site, these individuals may have avoided the area for a short period during refurbishment activities due to increased noise and lighting. However, because FENOC did not remove trees as part of the refurbishment activities, no measurable impacts to the Indiana bat would have occurred.

None of the refurbishment activities were expected to impact any other federally listed species, migratory birds, or State-listed species. Many State-listed plant species are known to occur on the Davis-Besse site (discussed in Section 2.2.7), but, because only previously disturbed lands were involved in refurbishment activities, no State-protected plants were affected. State-listed animals that are known to occur on the site would likely avoid the immediate area and neighboring habitat edges due to construction noise and lighting. No critical habitat is designated in the vicinity of Davis-Besse.

Impacts to protected species and habitats would be SMALL because FENOC has procedures in place to protect the bald eagle, which is the protected species most likely to be affected by refurbishment activities. These protective measures would, in turn, benefit all migratory birds and other protected wildlife in the immediate area. Federally and State-listed plant species would not be impacted because all refurbishment activities took place on previously disturbed land.

Conclusion. The NRC staff concludes that impacts on terrestrial resources from refurbishment would be SMALL to MODERATE. Some animals, especially nesting birds, might have avoided habitats neighboring refurbishment activities due to increased noise and lighting during the 90-day refurbishment period. This impact would reduce the available habitat for a short time for certain animal populations. No refurbishment activities occurred within a 660 ft (200 m) radius of any bald eagle nest; therefore, FENOC did not have to consult with the FWS regarding impacts to bald eagles. Offsite impacts varied depending on the amount of work to improve rail lines to transport the steam generators to the Davis-Besse site.

In its comments on the DSEIS, the EPA (2014) provided several recommendations for mitigation that could further reduce the potential SMALL to MODERATE impact on terrestrial resources that may result from refurbishment activities. The EPA recommendations are summarized as follows.

- FENOC could minimize impacts to surrounding habitats from refurbishment-related construction by not constructing unnecessary permanent, impervious surfaces, such as the permanent concrete pad base for temporary buildings.

- FENOC could stagger construction schedules of new facilities so that no additional habitat is directly disturbed by the need for multiple laydown areas.
- Any new buildings could be designed to Leadership in Energy and Environmental Design (LEED) standards.

All new buildings constructed as part of refurbishment were built in the industrial areas of the site on previously disturbed land and in accordance with local and state building codes. All building activities related to refurbishment activities related to license renewal were completed during the 2014 refueling outage.

3.2.2 Threatened and Endangered Species

Section 3.1.1 discusses FENOC's planned refurbishment activities. The description of protected species and habitats in Section 2.2.7 serves as the basis for the assessment of refurbishment impacts to protected species and habitats contained in this section. The information concerning refurbishment activity timing and logistics was drawn from FENOC's ER (2010).

Terrestrial Species and Habitats. Section 3.2.1 discusses terrestrial protected species and habitats and concludes that the impacts to these species were SMALL because refurbishment activities took place on previously disturbed areas of the site and occurred for only a short time (approximately 90 days). Additionally, impacts to the bald eagle, which is the most likely protected species to be affected by refurbishment activities, would be mitigated by the protective measures identified in FENOC's (2011) environmental best management practices and by the bald eagle permit regulations (50 CFR Part 22) implementing the Bald and Golden Eagles Protection Act.

Aquatic Species and Habitats. Aquatic protected species and habitats, identified in Section 2.2.7, would not be affected by any refurbishment activities on the Davis-Besse site because FENOC did not perform any in-water work as part of refurbishment.

Conclusion. The NRC staff concludes that the impacts to protected species and habitats from refurbishment were SMALL. Refurbishment activities would most likely have affected the bald eagles. No refurbishment activities occurred within 660 ft (200 m) radius of any bald eagle nest, and therefore FENOC did not have to consult with the FWS regarding impacts to bald eagles.

3.2.3 Housing Impacts—Refurbishment

Employment-Related Housing Impacts. Housing impacts is a Category 2 refurbishment issue. Table B-1 of Appendix B to 10 CFR Part 51, Subpart A (61 FR 28467, June 5, 1996), notes the following:

> 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.

The steam generator replacement required a one-time increase in the number of temporary workers for up to 90 days at Davis-Besse. Approximately 1,400 additional workers were needed to perform steam generator replacement activities, in addition to the 900 temporary workers supporting the refueling outage activities.(FENOC 2010, 2014).

Conclusion. The number of additional workers may have caused a short-term increase in the demand for temporary (rental) housing units in the vicinity of Davis-Besse, beyond what is normally experienced during refueling outages. Since Davis-Besse is located in a high-population area, and the number of available housing units has kept pace or exceeded changes in county populations (see Section 2.2.8.5), the additional number of workers would have no noticeable effect on the availability of rental housing. Due to the short duration of the replacement activity and the availability of housing in the region, employment-related housing impacts would be SMALL.

3.2.4 Public Services: Public Utilities—Refurbishment

Water Supply. Public utilities are a Category 2 refurbishment issue. Table B-1 of Appendix B to 10 CFR Part 51, Subpart A (61 FR 28467, June 5, 1996), notes that, "[a]n increased problem with water shortages at some sites may lead to impacts of moderate significance on public water supply availability."

Davis-Besse acquires potable water from the Carroll Township Water System, which has an excess capacity of 700,000 gallons per day (FENOC 2010). Hydro-demolition, required up to approximately 230,000 gallons of water per day, which is approximately one-third of the excess capacity of the Carroll Township Water Supply System. Coordination between Davis-Besse and Carroll Township Water Supply personnel during hydro-demolition minimized the impact of this potential increased demand in water use at Davis-Besse (FENOC 2010, 2014).

As discussed in Section 3.2.4, steam generator replacement at Davis-Besse required a one-time increase in the number of temporary workers for up to 90 days. The additional number of temporary workers needed to replace the steam generator might have caused a short-term increase in the amount of public water and sewer services used in the immediate vicinity of Davis-Besse.

Conclusion. Since there is no water shortage in the region, and the public water systems located in the four counties have excess capacity, any changes in demand for public water from the additional number of workers at Davis-Besse would have no noticeable effect on water supply availability in the four counties. As a result, the impacts to public utilities were SMALL.

3.2.5 Public Services: Education—Refurbishment

Educational Services. Education is a Category 2 refurbishment issue. Table B-1 of Appendix B to 10 CFR Part 51, Subpart A (61 FR 28467, June 5, 1996), notes that, "[m]ost sites would experience impacts of small significance but larger impacts are possible depending on site- and project-specific factors."

Conclusion. As discussed in Section 3.2.4, the steam generator replacement at Davis-Besse required a one-time increase in the number of workers at the station during the refueling outage for up to 90 days. Because of the short duration of the replacement activity, families and school age children probably would not accompany the workers; therefore, there would be no impact on educational services during the extended refueling outage.

3.2.6 Offsite Land Use—Refurbishment

Land Assessment. Offsite land use is a Category 2 refurbishment issue. Table B-1 of Appendix B to 10 CFR Part 51, Subpart A (61 FR 28467, June 5, 1996), notes that "[i]mpacts may be of moderate significance at plants in low population areas."

Since Davis-Besse is in a high-population area, any changes in employment would have no noticeable effect on offsite land use in the region. Because of the short duration of the replacement activity, the additional number of temporary workers was not expected to cause any permanent changes in population and tax-revenue-related offsite land use in the immediate vicinity of Davis-Besse. Nevertheless, the replacement of the existing steam generators could increase the assessed value of Davis-Besse, and property tax payments to Ottawa County, Carroll Township could increase. However, it is expected that any increase in assessed property value would be small because the station improvement is replacing existing equipment.

Conclusion. Since FENOC's tax payments to Ottawa County are a small percentage (around 6 percent per year) of the total annual county operating budget, the incremental contribution and resulting impact to the county's tax revenue—even with an increased assessment—would have no noticeable effect on offsite land use.

3.2.7 Public Services: Transportation—Refurbishment

Traffic Flow. Transportation is a Category 2 refurbishment issue. Table B-1 of Appendix B to 10 CFR Part 51, Subpart A (61 FR 28467, June 5, 1996), notes the following:

> 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 additional workers and the local road and traffic control conditions may lead to impacts of moderate or large significance at some sites.

As previously discussed in Section 2.2.8.2, commuting routes to Davis-Besse via State Highway 2 are in rural and uncongested areas. According to FENOC, increased traffic volumes entering and leaving the Davis-Besse site during refueling outages, which occur at intervals of approximately 24 months, has not degraded the level of service capacity on local roads. Portable flashing caution and warning signs on State Route 2 are needed to slow traffic during outages to allow site traffic exiting the station to merge safely into traffic flow on State Route 2 (FENOC 2010).

Conclusion. Due to the information presented in the ER, the short duration of the replacement activity (up to 90 days), and given that the steam generator replacement occurred during an extended refueling outage, transportation (level of service) impacts would be SMALL.

3.2.8 Historic and Archaeological Resources

National Register-Eligible Historic or Archeological Resources. Historic and archeological resources are a Category 2 refurbishment issue. Table B-1 of Appendix B to 10 CFR Part 51, Subpart A (61 FR 28467, June 5, 1996), notes the following:

> 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.

FENOC has not proposed any new facilities, service roads, or transmission lines to support continued operations at Davis-Besse. However, as discussed in Section 3.1, FENOC replaced Davis-Besse's two steam generators in 2014. Ground disturbances were limited to the construction of temporary and permanent concrete pads, temporary buildings to support construction activities, a permanent storage facility to house the retired steam generators, and a permanent multi-story office building. Construction of the steam generator storage facility and

office building occurred in 2011. All construction activities have occurred on land that was previously disturbed during the construction of Davis-Besse. In addition, existing onsite rail lines were modified for the transport of new steam generators (FENOC 2010, 2014).

The transport of the new steam generators to Davis-Besse would make use of existing infrastructure with little or no additional offsite land disturbance. The replacement generators traveled by rail and barge and, after delivery, were transported over an existing service road by a heavy-duty, self-propelled modular transporter. A load-haul path, consisting of fill and gravel, was constructed on site to haul the old steam generators to the permanent storage facility (FENOC 2010).

Conclusion. Steam generator replacement did not adversely impact any known historic or archeological resources on or in the vicinity of Davis-Besse as all activities are taking place on land that was previously disturbed during the construction of Davis-Besse. Furthermore, FENOC has formal guidelines in its *Environmental Evaluations* procedure (NOP-OP-2010 Revision 5) for protecting historic and archaeological resources prior to ground-disturbing activities. Therefore, impacts from this activity on National Register-eligible historic or archeological resources are SMALL.

3.2.9 Environmental Justice—Refurbishment

Environmental Justice. Environmental justice is a Category 2 refurbishment issue. Table B-1 of Appendix B to 10 CFR Part 51, Subpart A (61 FR 28467, June 5, 1996), notes that, "[t]he need for and the content of an analysis of environmental justice will be addressed in plant specific reviews."

Potential impacts to minority and low-income populations from refurbishment-related plant modifications (steam generator replacement) at Davis-Besse mostly consisted of environmental and socioeconomic effects (e.g., noise, dust, traffic, employment, and housing impacts). Radiation doses from plant operations after steam generator replacement remained at current levels and well within regulatory limits.

Noise and dust impacts during steam generator replacement were short-term and limited to onsite activities at Davis-Besse. Construction activities associated with steam generator removal may have increased noise levels at the station (primarily from hydro-demolition, or other mechanical means of concrete removal) greater than those associated with normal reactor operations at Davis-Besse. The loudest noise from construction activities, however, were intermittent and relatively brief, and noise levels decreased as the distance from the noise source increases.

Minority and low-income populations residing along site access roads experienced increased commuter vehicle traffic during refueling outage shift changes. In addition, increased demand for rental housing in the vicinity of Davis-Besse during the refueling outage and steam generator replacement could disproportionately affect low-income populations. However, due to the short duration of this refurbishment activity and the availability of rental housing in the four-county region of interest (ROI), any impact experienced by low-income populations was short-term and limited. According to the American Community 3-year Estimate Survey 2007–2009, there were over 40,000 vacant housing units in Ottawa, Lucas, Wood, and Sandusky Counties (USCB 2010).

Conclusion. Due to the short duration of the replacement activity, and based on the analysis of impacts for the other resource areas discussed in Section 3.2, impacts to minority and low-income populations living near Davis-Besse were temporary and not disproportionately high and adverse.

3.2.10 Air Quality

Air quality during refurbishment (non-attainment and maintenance areas) is a Category 2 issue,[1] Table B-1 of Appendix A to Subpart B, "Environmental Effect of Renewing the Operating License of a Nuclear Power Plant," of 10 CFR Part 51 (61 FR 28467, June 5, 1996), "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions," notes the following:

> 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 statutes of each site and the numbers of workers expected to be employed during the outage.

Specifically, 10 CFR 51.53(c)(3)(ii)(F) requires the following:

> If the applicant's plant is located in or near a nonattainment or maintenance area, an assessment of vehicle exhaust emissions anticipated at the time of peak refurbishment work force must be provided in accordance with the Clean Air Act (CAA) as amended.

The 1996 GEIS states the following:

> The 1990 CAA amendments include a provision that no federal agency shall support any activity that does not conform to a state implementation plan designed to achieve the National Ambient Air Quality Standards (NAAQS) for criteria pollutants (sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, lead, and particulate matter less than 10 μm in diameter). On November 30, 1993, the U.S. Environmental Protection Agency (EPA) issued a final rule (58 FR 63214) implementing the new statutory requirements, effective January 31, 1994. The final rule requires that federal agencies prepare a written conformity analysis and determination for each pollutant where the total of direct and indirect emissions caused by proposed federal action would exceed established threshold emission levels in a nonattainment or maintenance area. An area is designated "nonattainment" for a criteria pollutant if it does not meet the NAAQS for the pollutant. A maintenance area has been redesignated by a State from nonattainment to attainment; the State must submit to EPA a plan for maintaining the NAAQS as a revision to its State Implementation Plan.

Activities associated with refurbishment at Davis-Besse are discussed in Section 3.1. Minor and short-duration air quality impacts occurred during the steam generator replacement project activities. As described in the ER (FENOC 2010), the applicant identified the need to construct a new steam generator storage facility to support site refurbishment activities. Construction of this new, permanent facility was completed in 2011. The main contributors to air quality impacts associated with completed refurbishment activities were fugitive dust generation from facility construction activities, refurbishment work to open the shield building and containment vessel to replace the steam generators and related equipment, and exhaust emissions from motorized equipment and vehicles of temporary workers. Best management practices in accordance with FENOC and site procedures were implemented to minimize the amount of fugitive dust

[1] As described in Section 1.4 of this SEIS, the NRC has approved a revision to its environmental protection regulation, 10 CFR Part 51, "Environmental protection regulations for domestic licensing and related regulatory functions" (NRC 2012). With respect to air quality, the final rule amends Table B-1 in Appendix B, Subpart A, to 10 CFR Part 51 by changing "Air Quality during refurbishment (non-attainment and maintenance areas)" issue from, a Category 2 to a Category 1 issue and renamed, "Air Quality impacts (all plants)." This Category 1 issue, "Air Quality impacts (all plants)," has an impact level of SMALL. There was no change to the Category 1, "Air Quality effects of transmission lines" issue. The NRC staff performed its review of air quality issues in accordance with the 1996 GEIS (NUREG-1437) and rule for this issue.

(FENOC 2010). Additionally, fugitive emissions and exhaust emission from motorized equipment were temporary and short term.

As discussed in Section 2.2.2.1, Davis-Besse is located in Ottawa County, which is part of the Sandusky Intrastate Air Quality Control Region (AQCR) (40 CFR 81.203). Ottawa County is designated in attainment for CO, Pb, NO_2, PM_{10}, $PM_{2.5}$ and is not designated for SO_2 (OEPA 2013). Lucas and Wood Counties abutting Ottawa County to the north and west, respectively, are designated as maintenance areas for 1997 8-hour ozone NAAQS (EPA 2013). Monroe County, Michigan, is designated a maintenance area for $PM_{2.5}$ NAAQS and 1997 8-hour ozone NAAQS (EPA 2013, 2014). The nearest nonattainment area is Wayne County, Michigan, for SO_2 NAAQS(EPA 2014). Wood County is about 17 miles from Davis-Besse (distance can range from 17 to 51 miles), Lucas County is about 5 miles from Davis-Besse (distance can range from 5 to 43 miles), Monroe County is about 21 miles from Davis-Besse (distance can range from 21 to 49 miles), and Wayne County is about 30 miles from Davis-Besse (distance can range from 30 to 60 miles.) Refurbishment activities required an estimated additional 1,400 workers (FENOC 2010, 2014). As noted in the ER, 74 percent of Davis-Besse employees reside in Ottawa County (37.2 percent), Lucas County (19.8 percent), Wood County (15.5 percent), and Monroe County (1.4 percent) (FENOC 2010). Therefore, it can be expected that the additional workforce would reside in these counties, which are within the 50-mile radius of Davis-Besse (see distances above).

Consequently, it is assumed that the additional workforce needed would travel from areas within the 50-mile radius of Davis-Besse and that each of the 1,400 workers would travel 100 miles daily commuting to and from Davis-Besse. This would result in an additional 1,400 vehicles and 140,000 vehicle miles per day within the region. In 2011, the average number of vehicle miles traveled within Lucas, Wood, and Monroe counties was 6,940,080, 4,807,420 and 3,172,149 per day, respectively (MDOT 2013; ODOT 2013). The additional number of vehicle miles that would be traveled in the region per day during refurbishment represents approximately 2.0, 3.4, and 4.4 percent of the total miles traveled daily in Lucas, Wood and Monroe Counties, respectively. Because the additional workforce could travel from all over the 50-mile region and not necessarily have a 100-mile roundtrip commute, this projected increase in miles traveled daily for each county is conservative. As noted above, Lucas, Wood, and Monroe counties are designated maintenance areas for 1997 8-hour ozone NAAQS. Monroe County is designated a maintenance area for $PM_{2.5}$ NAAQS, and Wayne County is designated a nonattainment area for SO_2 NAAQS.

The increase in emissions for each of these pollutants resulting from the additional workforce was estimated to determine if emissions would be likely to exceed established threshold emission levels in a nonattainment or maintenance area. Ozone is formed when NO_x and VOCs combine in the presence of heat and sunlight; hence, VOCs and NO_x are precursors that contribute to the formation of ozone. $PM_{2.5}$ can be emitted directly as well as indirectly as a result of chemical reactions of gases (NO_x, SO_2, VOCs, and ammonia) that form $PM_{2.5}$. The Michigan Department of Environmental Quality (MDEQ) has determined that SO_2 and NO_x are the main precursors of $PM_{2.5}$; therefore, only direct $PM_{2.5}$, NO_x, and SO_2 from vehicle emissions are analyzed in the assessment below (MDEQ 2008). Replacement of Davis-Besse's steam generators began in February 2014 and was completed in approximately 90 days. Therefore, the total vehicle miles during the steam generator replacement and refueling outage would be 13.0 million miles (assuming a daily 100-mile roundtrip commute as discussed above). It is estimated that the additional 13.0 million miles would result in an additional 25 tons of VOCs, 49 tons of NO_x, 1.0 tons of SO_2, and 1.5 tons of $PM_{2.5}$ (direct emissions) being emitted, which do not exceed the de minimis levels of 100 tons per year of NO_x, 50 tons per year of VOCs for ozone maintenance areas, 100 tons per year of direct emissions of $PM_{2.5}$, 100 tons per year of

SO_2, 100 tons per year for $PM_{2.5}$ maintenance areas and 100 tons per year for SO_2 nonattainment areas as set forth in 40 CFR 93.153(b). Since the estimated emissions do not exceed the de minimis levels, a conformity determination is not required, and it is unlikely that emissions from refurbishment activities affected a nonattainment or maintenance area or caused or contributed to any new violation of NAAQS.

Additionally, a screening analysis in the 1996 GEIS determined that emissions from 2,300 vehicles over a 9 month refurbishment period may exceed the thresholds for carbon monoxide, oxides of nitrogen, and VOCs in non-attainment and maintenance areas and that the amount of road dust generated by the vehicles traveling to and from the work site would exceed the threshold for PM_{10} in serious non-attainment areas. Consequently, vehicular emissions that will result from the additional 1,400 workers for 90 days will not be significant. On this basis, the NRC staff concludes that the impact of vehicle exhaust emissions associated with steam generator replacement activities was SMALL.

3.3 Evaluation of New and Potentially Significant Information on Impacts of Refurbishment

The NRC staff reviewed the information presented in the Davis-Besse ER, supporting documentation, and information gathered during the site audits and interviews. During the review, the staff did not identify any new and significant information that would affect the conclusion presented in the ER. Therefore, the NRC staff adopts the findings in the GEIS for Category 1 issues associated with refurbishment and concludes that there were no environmental impacts beyond those discussed in the GEIS for these issues.

3.4 Summary Impacts of Refurbishment

For all but one of the eight Category 2 issues and environmental justice, the impacts of refurbishment at Davis-Besse ranged from unnoticeable impacts to a SMALL impact. The NRC staff concludes that there was a SMALL impact for the following refurbishment issues:

- Threatened or Endangered Species,
- Offsite Land Use,
- Historic and Archeological Resources, and
- Air Quality.

The NRC staff concludes that the potential environmental effects were unnoticeable to SMALL for the following refurbishment issues:

- Housing Impacts,
- Public Services: Education,
- Public Services: Public Utilities, and
- Public Services: Transportation.

The NRC staff concludes that the potential environmental impacts to terrestrial resources were SMALL to MODERATE.

3.5 References

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

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

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

50 CFR Part 22. *Code of Federal Regulations*, Title 50, *Wildlife and Fisheries*, Part 22, "Eagle Permits."

61 FR 28467. U.S. Nuclear Regulatory Commission. "Environmental Review for Renewal of Nuclear Power Plant Operating Licenses." *Federal Register* 61(109): 28467-28497. June 5, 1996.

Bald and Golden Eagles Protection Act of 1940, as amended, 16 U.S.C. § 668–668c.

[EPA] U.S. Environmental Protection Agency. 2013. The Green Book Nonattainment Areas for Criteria Pollutants. Updated on December 14, 2012. Available URL: <http://www.epa.gov/oaqps001/greenbk/> (accessed 4 March 2013).

[EPA] U.S. Environmental Protection Agency. 2014. Letter from K.A. Westlake, NEPA Implementation Section, EPA, to C. Bladey, NRC. Subject: Draft Plant-Specific Supplement 52 to the Generic Environmental Impact Statement for the License Renewal of Davis-Besse Nuclear Power Station, Unit 1, Oak Harbor, Ottawa County, Ohio. NUREG-1437. April 10, 2014. Agencywide Documents Access and Management System (ADAMS) Accession No. ML14113A425.

[FENOC] FirstEnergy Nuclear Operating Company. 2010. "Davis-Besse Nuclear Power Station License Renewal Application," Toledo, OH, August 2010, ADAMS Accession Nos. ML102450572

[FENOC] FirstEnergy Nuclear Operating Company. 2011. Letter from Barry S. Allen, to Document Control Desk, NRC. Subject: Davis-Besse Nuclear Power Station, Unit No. 1, Docket No. 50-346, License Number NPF-3, "Reply to Requests for Additional Information for the Review of the Davis-Besse Nuclear Power Station. Unit No. 1. License Renewal Application (TAC No. ME4613) Environmental Report." May 27, 2011. ADAMS Accession No. ML111930294.

[FENOC] FirstEnergy Nuclear Operating Company. 2014. Letter from Raymond A. Lieb to Document Control Desk, NRC. Subject: Davis-Besse Nuclear Power Station, Unit No. 1, Docket No. 50-346, License Number NPF-3, License Renewal Application Amendment No. 50—Annual Update (TAC Nos. ME4640 and ME4613). June 23, 2014. ADAMS Accession No. ML14175B381.

[FWS] U.S. Fish and Wildlife Service. 2010. E-mail from Seymour M, Wildlife Biologist, to Bulavinetz R, NRC. Subject: Federally listed species along Davis-Besse transmission line corridors. September 24, 2010. ADAMS Accession No. ML110730328.

[MDEQ] Michigan Department of Environmental Quality. 2008. State Implementation Plan Submittal. Available URL: <http://www.michigan.gov/documents/deq/deq-aqd-air-aqe-PM25-SIP-Final-2008_238092_7.pdf>.

[MDOT] Michigan Department of Transportation. 2013. Traffic Monitoring Information System (TMIS), 2011 Traffic Estimates. Available URL: <http://mdotnetpublic.state.mi.us/tmispublic/ReportLinks.aspx>.

[NRC] U.S. Nuclear Regulatory Commission. 1996. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*, NUREG-1437, Washington, D.C., May. ADAMS Accession Nos. ML040690705 and ML040690738.

[NRC] U.S. Nuclear Regulatory Commission. 1999. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Main Report*, NUREG-1437, Section 6.3, Table 9.1, Volume 1, Addendum 1, Washington, D.C.

[ODOT] Ohio Department of Transportation. 2013. Division of Planning, Office of Technical Services, Daily Vehicle Miles Traveled Report (DVMT). Available URL: <http://www.dot.state.oh.us/Divisions/Planning/TechServ/TIM/Pages/DVMT.aspx>.

[OEPA] Ohio Environmental Protection Agency. 2013. National Ambient Air Quality Standards—Attainment Status. Available URL: <http://www.epa.state.oh.us/dapc/general/naaqs.aspx> (accessed 4 June 2013).

[USCB] U.S. Census Bureau. 2010. "American FactFinder, Census 2000 and 2006–2008, 3-Year Estimate, American Community Survey, State and County QuickFacts on Lucas, Sandusky, Ottawa and Wood Counties, Ohio, and Housing Characteristics for 2000 and 2006–2008, 3-Year Estimate." Available URLs: <http://factfinder.census.gov> and <http://quickfacts.census.gov> (accessed April 2011).

4.0 ENVIRONMENTAL IMPACTS OF OPERATION

This chapter addresses potential environmental impacts related to the period of extended operation of Davis-Besse Nuclear Power Station, Unit No. 1, (Davis-Besse). These impacts are grouped and presented according to resource. Generic issues (Category 1) issues rely on the analysis provided in the generic environmental impact statement (GEIS) (NRC 1996, 1999a, 2013a) and are generally discussed briefly. Site-specific issues (Category 2) have been analyzed for Davis-Besse and assigned a significance level of SMALL, MODERATE, or LARGE, accordingly. Some remaining issues are not applicable to Davis-Besse because of site characteristics or plant features. For an explanation of the criteria for Category 1 and Category 2 issues, as well as the definitions of SMALL, MODERATE, and LARGE, refer to Section 1.4 of this supplemental environmental impact statement (SEIS). As also described in Section 1.4, the U.S. Nuclear Regulatory Commission (NRC) has published a final rule (78 FR 37282, June 20, 2013) revising its environmental protection regulation, Title 10 of the *Code of Federal Regulations* (10 CFR) Part 51, "Environmental protection regulations for domestic licensing and related regulatory functions." The final rule consolidates similar Category 1 and 2 issues, changes some Category 2 issues into Category 1 issues, and consolidates some of those issues with existing Category 1 issues. The final rule also adds new Category 1 and 2 issues.

As described in Section 1.5 of this SEIS, FENOC submitted its Environmental Report (ER) under NRC's 1996 rule governing license renewal environmental reviews (61 FR 28467, June 5, 1996, as amended), as codified in NRC's environmental protection regulation, 10 CFR Part 51. The 1996 GEIS (NRC 1996) and Addendum 1 to the GEIS (NRC 1999a) provided the technical basis for the list of NEPA issues and associated environmental impact findings for license renewal contained in Table B–1 in Appendix B to Subpart A of 10 CFR Part 51. For Davis-Besse, the NRC staff initiated its environmental review in accordance with the 1996 rule and GEIS (NRC 1996, 1999a) and documented its findings in this chapter of the SEIS. General references within this SEIS that refer to the "GEIS" without stipulation are inclusive of the 1996 and 1999 GEIS (NRC 1996, 1999a). Information and findings specific to the June 2013, final rule (78 FR 37282) and/or the June 2013 GEIS (NRC 2013a) are appropriately referenced as such.

4.1 Land Use

Onsite land use issues that could be affected by license renewal are listed in Table 4–1. As discussed in the GEIS, onsite land use and powerline right-of-way (ROW) conditions are expected to remain unchanged during the license renewal term at all nuclear plants; thus, impacts would be SMALL. These issues were, therefore, classified as Category 1 issues. Section 2.2.1 of this SEIS describes the land use conditions at Davis-Besse.

Table 4–1. Land Use Issues

Issues	GEIS Section	Category
Onsite land use	4.5.3	1
Powerline ROW	4.5.3	1

Source: 61 FR 28467, June 5, 1996

Davis-Besse's Environmental Report (ER) (FENOC 2010a), scoping comments, and other available data records for Davis-Besse were reviewed and evaluated for new and significant information. The review included a data gathering site visit to Davis-Besse. No new and significant information was identified during this review that would change the conclusions presented in the GEIS. Therefore, for these Category 1 issues, impacts during the renewal term are not expected to exceed those discussed in the GEIS and are SMALL.

4.2 Air Quality

As described in Section 1.4 of this SEIS, the NRC approved a revision to its environmental protection regulation, 10 CFR Part 51, "Environmental protection regulations for domestic licensing and related regulatory functions." With respect to air quality, the final rule amends Table B-1 in Appendix B, Subpart A, to 10 CFR Part 51 by changing "Air quality during refurbishment (non-attainment and maintenance areas)" issue from a Category 2 to a Category 1 issue and renamed "Air quality impact (all plants)." This Category 1 issue, "Air quality impacts (all plants)," has an impact level of SMALL. There was no change to the Category 1, "Air quality effects of transmission lines" issue. The NRC staff performed its review, as discussed below, of air quality issues in accordance with the 1996 GEIS.

The air quality issues applicable to Davis-Besse are listed in Table 4–2. In evaluating the potential impacts on air quality associated with license renewal, the NRC staff uses as its baseline the existing air quality conditions described in Section 2.2.2.1 of this SEIS. These baseline conditions encompass the existing air quality conditions (EPA's National Ambient Air Quality Standards county designations) potentially affected by air emissions from license renewal. Davis-Besse is located in Ottawa County, which is part of the Sandusky Intrastate Air Quality Control Region (AQCR) (40 CFR 81.203). Ottawa County is designated in attainment for CO, Pb, NO_2, PM_{10}, $PM_{2.5}$ and is not designated for SO_2 (OEPA 2013).

Table 4–2. Air Quality Issues

Issue	GEIS Section	Category
Air quality during refurbishment (non-attainment & maintenance areas)	3.3	2
Air quality effects of transmission lines	4.5.2	1

Source: 61 FR 28467, June 5, 1996

Air quality impacts from planned refurbishment activities associated with license renewal is a Category 2 issue. As discussed in Section 3.2.10, refurbishment activities will require an estimated additional 900 workers for 70 days. Exhaust emissions from vehicles of temporary workers can contribute to air quality impacts. Vehicular emissions that will result from the additional 900 workers for 70 days will be temporary and will not be significant. As discussed in Section 3.2.10, the NRC staff concludes that the impact of vehicle exhaust emissions associated with refurbishment activities would be SMALL.

For the Category 1 issue of air quality effects of transmission lines, the NRC found that "production of ozone and oxides of nitrogen is insignificant and does not contribute measurably to ambient levels of these gases." The NRC staff did not identify any new and significant information based on review of the ER (FENOC 2010a), the public scoping process, or as a result of the environmental site audit that would change the conclusions presented in the GEIS (NRC 1996), and therefore, the NRC staff concludes the impacts are SMALL.

4.3 Geologic Environment

The geologic environment issue related to the Davis-Besse license renewal is listed in Table 4–3 (also see Table B-1 of Appendix B of 10 CFR Part 51 (78 FR 37282)). This is a new Category 1 issue that was identified in the 2013 GEIS.

Table 4–3. Geologic Environment Issue

Issue	GEIS Section	Category
Geology and Soils	4.4	1

Source: Table B-1 in Appendix B, Subpart A, to 10 CFR Part 51 (78 FR 37282; NRC 2013a)

4.3.1 Geology and Soils

As described in Section 1.4 of this SEIS, the NRC has approved a revision to its environmental protection regulation, 10 CFR Part 51. With respect to the geologic environment of a plant site, the final rule amends Table B-1 in Appendix B, Subpart A, to 10 CFR Part 51 by adding a new Category 1 issue, "Geology and soils." This new issue has an impact level of SMALL. This new Category 1 issue considers geology and soils from the perspective of those resource conditions or attributes that can be affected by continued operations during the renewal term. An understanding of geologic and soil conditions has been well established at all nuclear power plants and associated transmission lines during the current licensing term, and these conditions are expected to remain unchanged during the 20-year license renewal term for each plant. The impact of these conditions on plant operations and the impact of continued power plant operations and refurbishment activities on geology and soils are SMALL for all nuclear power plants and not expected to change appreciably during the license renewal term. Operating experience shows that any impacts to geologic and soil strata would be limited to soil disturbance from construction activities associated with routine infrastructure renovation and maintenance projects during continued plant operations. Implementing best management practices would reduce soil erosion and subsequent impacts on surface water quality. Information in plant-specific SEISs prepared to date and reference documents have not identified these impacts as being significant.

Section 2.2.3 of this SEIS describes the local and regional geologic environment relevant to Davis-Besse. The NRC staff did not identify any new and significant information with regard to this Category 1 (generic) issue based on review of the ER (FENOC 2010a), the public scoping process, or as a result of the environmental site audit. As discussed in Chapter 3 of this SEIS and as identified in the ER (FENOC 2010a), FENOC plans to construct new facilities in support of associated refurbishment activities that could affect up to 10 ac (4 ha) of land (see Section 3.2.1). Such activities would require site clearing, grading, ground excavation, and placement of backfill. However, ground-disturbing activities would be confined to previously disturbed areas that currently exist as impervious surface (e.g., parking lots), or are currently maintained as landscaped areas. This work would be performed in accordance with Davis-Besse's stormwater pollution prevention plan (see Section 2.2.4) and associated best management practices to control runoff from disturbed areas and to prevent or significantly mitigate soil erosion and loss. It is also anticipated that plant operation and maintenance activities would be confined to previously disturbed areas or existing ROWs during the license renewal term. Based on this information, it is expected that any incremental impacts on geology and soils during the license renewal term would be SMALL (NRC 2013a).

4.4 Surface Water Resources

The surface water issues applicable to Davis-Besse are listed in Table 4–4 (also see Table B-1 of Appendix B of 10 CFR Part 51). Surface water use and water quality relative to Davis-Besse are described in Sections 2.1.7.1 and 2.2.4 of this SEIS, respectively.

Table 4–4. Surface Water Use and Quality Issues

Issue	GEIS Section	Category
Altered current patterns at intake & discharge structures	4.2.1.2.1	1
Altered thermal stratification of lakes	4.2.1.2.3	1
Temperature effects on sediment transport capacity	4.2.1.2.3	1
Scouring caused by discharged cooling water	4.2.1.2.3	1
Eutrophication	4.2.1.2.3	1
Discharge of chlorine or other biocides	4.2.1.2.4	1
Discharge of sanitary wastes & minor chemical spills	4.2.1.2.4	1
Discharge of other metals in wastewater	4.2.1.2.4	1

Source: 61 FR 28467, June 5, 1996

4.4.1 Generic Surface Water Issues

The NRC staff did not identify any new and significant information based on review of the ER (FENOC 2010a), the public scoping process, or the environmental site audit. The NRC staff also reviewed other sources of information such as various permits, assorted applicant files, and data reports. As a result, no information or impacts related to these issues was identified that would change the conclusions presented in the GEIS (NRC 1996). Therefore, it is expected that there would be no impacts related to these Category 1 issues during the period of extended operation beyond those discussed in the GEIS. For these surface water issues, the GEIS concludes that the impacts are SMALL.

4.4.2 Surface Water Use Conflicts

No Category 2 surface water issues were found to be applicable to the continued operation of the facility, and no further evaluation was performed for Davis-Besse.

4.5 Groundwater Resources

The groundwater issues applicable to Davis-Besse are listed in Table 4–5 (also see Table B-1 of Appendix B of 10 CFR Part 51). Groundwater use and water quality relative to Davis-Besse are described in Sections 2.1.7.2 and 2.2.5 of this SEIS, respectively.

Table 4–5. Groundwater Use and Quality Issues

Issue	GEIS Section	Category
Groundwater use conflicts (potable & service water; plants that use <100 gallons per minute (gpm))	4.8.1.1	1
Radionuclides released to groundwater	4.5.1.2[a]	2

[a] NRC 2013a; 78 FR 37282

Source: 61 FR 28467, June 5, 1996

4.5.1 Groundwater Use Conflicts

Groundwater is not used at the Davis-Besse plant, and groundwater withdrawal has not taken place since construction phase dewatering. The NRC staff did not identify any new and significant information based on review of the ER (FENOC 2010a), the public scoping process, or the environmental site audit that would change the conclusions presented in the GEIS. Therefore, it is expected that were would be no impacts related to this Category 1 issue during the period of extended operation beyond those discussed in the GEIS (NRC 1996). For the single Category 1 (generic) groundwater issue applicable to Davis-Besse, the GEIS concludes that the impact is SMALL.

4.5.2 Radionuclides Released to Groundwater

As described in Section 1.4 of this SEIS, in 2013, the NRC has approved a revision to its environmental protection regulation, 10 CFR Part 51. With respect to groundwater quality, the final rule amends Table B-1 in Appendix B, Subpart A, to 10 CFR Part 51 by adding a new Category 2 issue, “Radionuclides released to groundwater,” with an impact level range of SMALL to MODERATE, to evaluate the potential impact of discharges of radionuclides from plant systems into groundwater. This new Category 2 issue has been added to evaluate the potential impact to groundwater quality from the discharge of radionuclides from plant systems, piping, and tanks. This issue was added because, within the past several years, there have been events at nuclear power reactor sites that involved unknown, uncontrolled, and unmonitored releases of radioactive liquids into the groundwater.

Davis-Besse has had leaks of tritium to onsite groundwater, as described in Section 2.2.5. Tritium-contaminated groundwater has not moved offsite. Identified sources of groundwater leaks were repaired. The highest tritium concentrations reported are well below the U.S. EPA drinking water standard of 20,000 pCi/l (40 CFR 141.66). The impact of radionuclides released to groundwater is determined to be SMALL and is expected to remain SMALL during the license renewal term.

4.6 Aquatic Resources

Table 4–6 lists the issues related to aquatic resources applicable to Davis-Besse. No Category 2 issues are related to aquatic resources. The NRC staff did not find any new and significant information during the review of the applicant’s ER (FirstEnergy Nuclear Operating Company (FENOC) 2010), the site audit, the scoping process, or the evaluation of other available information. As a result, no information or impacts related to these issues was identified that would change the conclusions presented in the GEIS (NRC 1996). Therefore, the

NRC staff concludes that there would be no impacts related to these issues beyond those discussed in the GEIS. The GEIS concludes that the impacts are SMALL.

Table 4–6. Aquatic Resources Issues

Issue	GEIS Section	Category
For all plants		
Accumulation of contaminants in sediments or biota	4.2.1.2.4	1
Entrainment of phytoplankton & 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, & disease among organisms exposed to sublethal stresses	4.2.2.1.10	1
Stimulation of nuisance organisms	4.2.2.1.11	1
Exposure of aquatic organisms to radionuclides	4.6.1.2[a]	1
For plants with cooling tower-based heat-dissipation systems		
Entrainment of fish & shellfish in early life stages	4.3.3	1
Impingement of fish & shellfish	4.3.3	1
Heat shock	4.3.3	1

[a] NRC 2013a; 78 FR 37282

Source: 61 FR 28467, June 5, 1996

4.6.1 Exposure of Aquatic Organisms to Radionuclides

As described in Section 1.4 of this SEIS, in 2013, the NRC approved a revision to its environmental protection regulation, 10 CFR Part 51, governing environmental impact reviews of nuclear power plant operating renewed licenses. With respect to the aquatic organisms, the final rule amends Table B-1 in Appendix B, Subpart A, to 10 CFR Part 51 by adding a new Category 1 issue, “Exposure of aquatic organisms to radionuclides,” among other changes. This new Category 1 issue considers the impacts to aquatic organisms from exposure to radioactive effluents discharged from a nuclear power plant during the license renewal term. An understanding of the radiological conditions in the aquatic environment from the discharge of radioactive effluents within NRC regulations has been well established at nuclear power plants during their current licensing term. Based on this information, the NRC concluded that the doses to aquatic organisms are expected to be well below exposure guidelines developed to protect these organisms and assigned an impact level of SMALL.

The NRC staff has not identified any new and significant information related to the exposure of aquatic organisms to radionuclides during its independent review of the applicant’s ER

(FENOC 2010a) , the site audit, and the scoping process. Section 2.1.2 of this SEIS describes the applicant's Radioactive Waste Management Program to control radioactive effluent discharges to ensure that they comply with NRC regulations in 10 CFR Part 20. Section 4.9.1 of this SEIS contains the NRC staff's evaluation of Davis-Besse's radioactive effluent and radiological environmental monitoring programs. Based on its evaluation of Davis-Besse's radioactive effluent and radiological environmental monitoring programs, the NRC staff concludes that the impacts from radioactive effluents to aquatic organisms are SMALL. The NRC staff concludes that there would be no impacts to aquatic organisms from radionuclides beyond those impacts contained in the GEIS (NRC 2013a) and therefore, the impacts to aquatic organisms from radionuclides are SMALL.

4.7 Terrestrial Resources

The issues related to terrestrial resources applicable to Davis-Besse are discussed in the following sections and listed in Table 4–7.

Table 4–7. Terrestrial Resources Issues

Issue	GEIS Section	Category
Cooling tower impacts on crops & ornamental vegetation	4.3.4	1
Cooling tower impacts on native plants	4.3.5.1	1
Bird collisions with cooling towers	4.3.5.2	1
Powerline right-of-way management (cutting herbicide application)	4.5.6.1	1
Bird collisions with powerlines	4.5.6.1	1
Impacts of electromagnetic fields on flora & fauna (plants, agricultural crops, honeybees, wildlife, livestock)	4.5.6.3	1
Floodplains & wetland on powerline right-of-ways	4.5.7	1
Exposure of terrestrial organisms to radionuclides	4.6.1.1 [a]	1
Effects on terrestrial resources (non-cooling system impacts)	4.6.1.1 [a]	2

[a] NRC 2013a; 78 FR 37282

Source: 61 FR 28467, June 5, 1996

4.7.1 Generic Terrestrial Resources Issues

The NRC did not identify any new and significant information during the review of the applicant's ER (FENOC 2010a), the NRC staff's site audit, the scoping process, or the evaluation of other available information that would change the conclusions presented in the GEIS. Therefore, it is expected that there would be no impacts related to these the Category 1 issues beyond those discussed in the GEIS (NRC 1996). For these issues, the GEIS concludes that the impacts are SMALL.

4.7.2 Exposure of Terrestrial Organisms to Radionuclides

As described in Section 1.4 of this draft SEIS, in 2013, the NRC approved a revision to its environmental protection regulation, 10 CFR Part 51. With respect to the terrestrial organisms, the final rule amends Table B-1 in Appendix B, Subpart A, to 10 CFR Part 51 by adding a new

Category 1 issue, “Exposure of terrestrial organisms to radionuclides,” among other changes. This new issue has an impact level of SMALL. This new Category 1 issue considers the impacts to terrestrial organisms from exposure to radioactive effluents discharged from a nuclear power plant during the license renewal term. An understanding of the radiological conditions in the terrestrial environment from the discharge of radioactive effluents within NRC regulations has been well established at nuclear power plants during their current licensing term. Based on this information, the NRC concluded that the doses to terrestrial organisms are expected to be well below exposure guidelines developed to protect these organisms and assigned an impact level of SMALL.

The NRC staff has not identified any new and significant information related to the exposure of terrestrial organisms to radionuclides during its independent review of Davis-Besse’s ER (FENOC 2010a), the site audit, and the scoping process. Chapter 2 of this SEIS describes the applicant’s radioactive waste management program to control radioactive effluent discharges to ensure that they comply with NRC regulations. Section 4.9.1 of this SEIS contains the NRC staff’s evaluation of the applicant’s radioactive effluent and radiological environmental monitoring programs. Based on its review of Davis-Besse’s radioactive effluent and radiological environmental monitoring programs, the NRC staff concludes that the impacts from radioactive effluents to terrestrial organisms would be SMALL. The NRC staff concludes that there would be no impact to terrestrial organisms to radionuclides beyond those impacts described in the GEIS (NRC 2013a), and therefore, the impacts to terrestrial organisms from radionuclides would be SMALL.

4.7.3 Effects on Terrestrial Resources (Non-cooling System Impacts)

As described in Section 1.4 of this SEIS, in 2013, the NRC approved a revision to its environmental protection regulation, 10 CFR Part 51. With respect to the terrestrial organisms, the final rule amends Table B-1 in Appendix B, Subpart A, to 10 CFR Part 51 by expanding the Category 2 issue, “Refurbishment impacts,” among others, to include normal operations, refurbishment, and other supporting activities during the license renewal term. This issue remains a Category 2 issue with an impact level range of SMALL to LARGE; however, the final rule renames this issue, “Effects on terrestrial resources (non-cooling system impacts).”

Section 2.2.7 describes the terrestrial resources on and in the vicinity of the plant site, and Section 2.2.8 describes protected species and habitats. As discussed in Chapter 3 of this SEIS and described in Section 4.3.1 above, FENOC plans to construct new facilities in support of associated refurbishment activities that could affect up to 10 ac (4 ha) of land. However, ground-disturbing activities would be confined to previously disturbed areas. FENOC (2010) anticipates no new impacts on terrestrial resources because of refurbishment or as a result of operation and maintenance on the plant site or along the in-scope transmission line corridors during the license renewal term. Based on the NRC staff’s independent review, the NRC staff concurs that refurbishment activities and operation and maintenance activities that FENOC might undertake during the renewal term, such as maintenance and repair of plant infrastructure (e.g., roadways, piping installations, onsite transmission lines, fencing, and other security infrastructure), likely would be confined to previously disturbed areas of the Davis-Besse site. Therefore, the NRC staff expects non-cooling system impacts on terrestrial resources during the license renewal term to be SMALL.

4.8 Protected Species and Habitats

Section 2.2.7 of this SEIS describes protected species and habitats in the vicinity of the Davis-Besse site. Table 4–8 lists the one Category 2 issue related to protected species and habitats that is applicable to Davis-Besse.

Table 4–8. Protected Species Issue

Issue	GEIS Section	Category
Threatened or endangered species	4.1	2

Source: 61 FR 28467, June 5, 1996

This site-specific, or Category 2 issue, requires consultation with the appropriate agencies to determine whether threatened or endangered species are present and whether they would be affected by continued operation of Davis-Besse during the license renewal term. In the case of Davis-Besse, the U.S. Fish and Wildlife Service (FWS) is responsible for terrestrial and freshwater species listed under the Endangered Species Act (ESA), the Bald and Golden Eagles Act, and the Migratory Bird Treaty Act (MBTA). The National Marine Fisheries Service (NMFS) is responsible for marine and anadromous species listed under the ESA. The Ohio Department of Natural Resources (ODNR) is responsible for species protected by the State of Ohio. Descriptions of protected species and habitats appear in Section 2.2.8 of this SEIS.

4.8.1 Species Protected Under the Endangered Species Act

4.8.1.1 Chronology of Endangered Species Act Section 7 Consultation

The NRC staff corresponded with both the FWS and NMFS to determine impacts to Federally listed species and to decide whether to initiate section 7 consultation as a result of the proposed Davis-Besse license renewal. No species under the NMFS's jurisdiction are present on the Davis-Besse site or within Lake Erie (NMFS 2010). Thus, NRC has no obligations under section 7 of the ESA for species under NMFS's jurisdiction.

For species under FWS's jurisdiction, the FWS provided information to FENOC on protected species in 2009 (FWS 2009) and confirmed that the information contained in their 2009 letter to FENOC remained current in a letter to the NRC in 2010 (FWS 2010). The NRC developed a list of Federally listed species potentially on or in the vicinity of the Davis-Besse site and requested concurrence on this list in a June 1, 2011, letter (NRC 2011a). Since that time, the NRC has defined the action area (see Section 2.2.8.1) and reviewed available information on the FWS's Endangered Species Program Web site to ensure that it considers any newly listed species or updated information concerning species that could be affected by the proposed license renewal.

Following the publication of the draft SEIS, and in accordance with the ESA regulations at 50 CFR 402.13(a), the NRC (2014a) sent FWS a letter dated February 27, 2014, that requests the FWS's concurrence with the NRC's effect determinations for the species discussed below that may be affected by the proposed license renewal of Davis-Besse. During consultation, the NRC prepared additional assessments to determine potential impacts to the Kirtland's warbler (*Setophaga kirtlandii*), red knot (*Calidris canutus rufa*), and northern long-eared bat (*Myotis septentrionalis*) (NRC 2014b, 2014c). The NRC transmitted these assessments to the FWS on May 6, 2014, and June 17, 2014. On July 18, 2014, NRC staff, FWS staff, and representatives of FENOC held a teleconference to discuss several outstanding questions that FWS had concerning potential impacts to the Kirtland's warbler. The NRC (2014) documented the

teleconference in an August 21, 2014, memorandum. On September 30, 2014, the FWS (2014) provided its concurrence with the NRC's effect determinations for ESA species under its jurisdiction. This letter documents the conclusion of consultation pursuant to ESA section 7 for Davis-Besse license renewal.

4.8.1.2 Species and Habitats Under NMFS's Jurisdiction

No Federally listed or proposed species or proposed or designated critical habitat under the NMFS's jurisdiction occur in the action area.

4.8.1.3 Species and Habitats Under FWS's Jurisdiction

Section 2.2.8.1 discusses species and habitats protected under the ESA and within FWS's jurisdiction that occur in Ottawa County and have the potential to occur in the action area. Of the four Federally listed species identified in Table 2.2-8 as occurring in Ottawa County, the NRC staff determined that three of these species—piping plover (*Charadrius melodus*), eastern prairie fringed orchid (*Platanthera leucophaea*), and lakeside daisy (*Tetraneuris herbacea*)—are very unlikely to occur in the action area based on habitat requirements or occurrence data. The NRC concludes that the proposed license renewal would have no effect on these species based on the lack of suitable habitat and unlikelihood of occurrence in the vicinity of the Davis-Besse site (see Table 4–9). The remaining species, the Indiana bat (*Sodalis myotis*), may occur in the action area.

During section 7 consultation with the FWS, the NRC and FWS staff identified three additional species that may be affected by the proposed Davis-Besse license renewal: the endangered Kirtland's warbler (*Setophaga kirtlandii*), the threatened red knot (*Calidris canutus rufa*), and the proposed-endangered northern long-eared bat (*Myotis septentrionalis*), which the FWS has since listed as threatened. The FWS (2014) concurred with the NRC's effect determinations for all species that have the potential to occur in the action area in a letter dated September 30, 2014. This letter concluded ESA section 7 consultation between the NRC and FWS for the Davis-Besse license renewal.

Table 4–9 lists the six Federally listed species and one proposed species and summarizes the habitat, the likelihood of occurrence in the action area, and the NRC's ESA effect determinations for each species.

Table 4–9. Summary of Impacts to Federally Listed Species

Scientific Name	Common Name	Habitat	Suitable Habitat Present?[a]	Effect Determination[b]
Birds				
Setophaga kirtlandii	Kirtland's warbler	breeding and nesting: N/A for Lake Erie stopover habitat: shrub/scrub along Lake Erie shores	Yes	May affect, but not likely to adversely affect
Charadrius melodus	piping plover	nesting: N/A for Lake Erie foraging: sandy beaches; mudflats	Yes	May affect, but not likely to adversely affect
Calidris canutus rufa	red knot	breeding and nesting: N/A for Lake Erie stopover habitat: muddy or sandy coastal areas near mouths of bays and estuaries	Yes	May affect, but not likely to adversely affect
Mammals				
Myotis sodalis	Indiana bat	hibernating: cool, humid caves; abandoned mines roosting: dead trees with loose tree bark foraging: forest edges; riparian zones	Yes	May affect, but not likely to adversely affect
Myotis septentrionalis	northern long-eared bat	hibernating: cool, humid caves; abandoned mines roosting: dead trees with loose tree bark in intact, older forests foraging: forest edges; riparian zones	Yes	May affect, but not likely to adversely affect
Plants				
Platanthera leucophaea	eastern prairie fringed orchid	mesic prairie; sage meadows; marsh edges; bogs	Yes	No effect
Hymenoxy acaulis var. glabra	lakeside daisy	dry, rocky prairie with full sun and limestone deposits	No	No effect

[a] This column indicates whether suitable habitat occurs in the action area as defined in Section 2.2.8.1.

[b] Conclusions presented are consistent with effect determinations under the ESA: (1) no effect, (2) may affect, (3) may affect, but not likely to adversely affect, or (4) may affect and likely to adversely affect.

Kirtland's Warbler. Within the action area, the Kirtland's warbler is most likely to use shrub and scrub or forested habitat near the Lake Erie shoreline. This habitat occurs within Navarre Marsh, which is leased to the FWS for management as part of the Ottawa National Wildlife Refuge and would continue to be leased to FWS during the proposed license renewal term. Continued protection of this habitat would result in beneficial effects to the species.

One potential impact of the proposed license renewal is the direct mortality of individuals from collision with the cooling tower, other plant structures, or transmission lines. Although the NRC generically determined this impact to be small for birds at all nuclear plants during the license renewal term (NRC 2013a), this impact could uniquely affect the Kirtland's warbler because of its status as Federally endangered.

To assess this potential impact of station operation, bird mortality surveys were conducted on the Davis-Besse site in the 1970s, and the NRC (2013a) describes the surveys as follows.

> At Davis-Besse, extensive surveys for dead birds were conducted from fall 1972 to fall 1979. Early morning surveys at the 152-m-tall (499-ft-tall) cooling tower were made almost daily from mid-April to mid-June and from the first of September to late October. After the tower began operating in the fall of 1976, some dead birds were lost through the water outlets of the tower basin. A total of 1,561 dead birds were found, an average of 195 per year. The dead birds included 1,229 at the cooling tower, 224 around Unit 1 structures, and 108 at the meteorological tower. Most were night-migrating songbirds, particularly wood-warblers (family Parulidae), vireos (Vireo spp.), and kinglets (Regulus spp.). Waterfowl that were abundant in nearby marshes and ponds suffered little collision mortality. Most collision mortalities at the cooling tower occurred during years when the cooling tower was not well illuminated (1974 to spring 1978). After the completion of Unit 1 structures and installation of many safety lights around the buildings in the fall of 1978, collision mortality was significantly reduced (average of 236 per year from 1974 through 1977, 135 in 1978, and 51 in 1979). This reduction was accomplished by installing low-intensity light sources (1.0 ft-candle or less) to illuminate the cooling tower, which allowed birds to see and avoid it. It appears that the lights at nuclear plants do not confuse birds to the extent that lights on radio or TV towers sometimes do.

The NRC's (1975) final environmental statement for the operation of Davis-Besse (FES-O) provides more detailed information on the first 3 years of these surveys (1972–1974). The FES-O states the following:

> The cooling tower is within [a] major flyway of migratory song birds and waterfowl and some hazard of bird mortality due to impaction on the tower exists. The staff assessment of this possibility in the [Final Environmental Statement for construction of Davis-Besse] concluded that birds were not likely to be killed in large numbers but that a few mortalities at varying intervals were likely. Since that assessment, the applicant has submitted data on impactions (Table 6.3). These results are consistent with the original assessment. A total of 157 birds, mostly warblers and kinglets, were killed on station structures during the migratory periods of 1972-1973. During the 9-week autumn migratory season in 1974, 342 dead birds were recovered. Eighty-two percent were recovered from the cooling tower, 15.5% from Unit 1 structures and 2.8% from the meteorological tower. Warblers and kinglets were again the most frequently affected. The increase in bird numbers may not be due to increased numbers of collisions since the applicant increased the frequency of collection in 1974. Studies based on small samples show that scavengers (raccoons, skunks, foxes, etc.) may take up to 88% of the fallen birds if they are not collected quickly after they fall. All counts to date are, therefore, probably underestimates of true collision frequency.

Table 4–10 (recreated from FES-O, Table 6.3) provides the results of the species recovered during the bird mortality surveys from 1972–1974. Although about 20 warbler species were collected during the surveys in these years, Kirtland's warbler was not among those collected. The FES-O does not indicate the dates, the duration, or the effort involved in these surveys, and no surveys were completed during spring migrations. The NRC staff was unable to locate the results of the 1975–1979 bird mortality surveys, and no further surveys have been conducted since that time.

The NRC (1975) concluded that there would be no impact to the Kirtland's warbler resulting from Davis-Besse operation. However, this conclusion was based on the premises that the Kirtland's warbler does not "normally inhabit the area of the Davis-Besse site" and that the species had not been sighted in the Ottawa National Wildlife Refuge during the period, 1969–1972. While it remains true that the species does not normally inhabit the site, known occurrences of the species in the Ottawa National Wildlife Refuge and along the shores of Lake Erie indicate that this species occasionally occurs in the action area for short periods of time during spring and fall migration. Therefore, the NRC's previous conclusion of "no effect" is no longer appropriate for this species because, as indicated by FWS (2003) guidance, "no effect means literally no effect, not a small effect or an effect that is unlikely to occur."

Based on the available information on bird mortality, the NRC staff finds that it is possible that Kirtland's warbler individuals could experience injury or mortality resulting from collisions with plant structures during the proposed license renewal term. If a Kirtland's warbler were to collide with plant structures or transmission lines during the proposed license renewal term, such a collision could result in a take, as defined by the ESA. However, the NRC staff believes that the likelihood of this happening is discountable, or extremely unlikely to occur, because the Kirtland's warbler is relatively rare, is only in the action area for a short period of time each year, and is not likely to inhabit the developed portions of the site that contain collision hazards. Additionally, because the species has been listed under the ESA since Davis-Besse began operating in 1978, the ESA has obligated the NRC and the applicant to consult with the FWS if new information reveals effects of the action that may affect listed species in a manner or to an extent not previously considered (50 CFR 402.16(b)). No such information has been identified for which the NRC has determined reinitiation of consultation appropriate. Because no such collisions are known to have occurred to date, the NRC staff finds it reasonable to assume that the likelihood of collision would be extremely low in the future.

In addition to collision hazards, the NRC staff also considered the likelihood of direct mortality, loss of habitat or food resources, or behavioral changes resulting from construction or refurbishment activities, regular site maintenance, and infrastructure repairs during the proposed license renewal term. Applicable infrastructure includes roadways, piping installations, onsite transmission lines, fencing, and other security infrastructure.

Construction activities would not result in any impacts to the Kirtland's warbler because the applicant (FENOC) does not plan to perform any construction, ground-disturbing activities, or changes to existing land uses in either natural or developed areas. The refurbishment activities discussed in Chapter 3 of this SEIS were completed in spring 2014; therefore, they will not be a factor during the proposed license renewal term.

As indicated in Section 4.7.3, maintenance and infrastructure repairs would be confined to previously disturbed areas of the site, and Navarre Marsh and the shores of Lake Erie would be unaffected by such activities. Some maintenance activities, such as refueling outages, would require additional workers, which would create additional traffic and noise on the site for short periods of time. The NRC staff does not believe that these would result in measurable or detectable effects on the Kirtland's warbler because the Kirtland's warbler is in the action area for short durations of time each year, and the species is not likely to occur in the developed portions of the site. Additionally, such maintenance activities have been ongoing since the plant began operating in 1978, and Kirtland's warblers continue to use the adjacent marsh and lake shore as stopover habitat, which indicates that these activities are not affecting the species' habitat use, food resources, or behavior.

Table 4–10. Davis-Besse Bird Mortality Survey Results During Three Consecutive Fall Seasons, 1972-1974

		Individuals Collected[3]												
		Fall 1972				Fall 1973				Fall 1974				
Species[1]	**Common Name[2]**	**CT**	**ST**	**MT**	**Total**	**CT**	**ST**	**MT**	**Total**	**CT**	**ST**	**MT**	**Total**	Total
Cardellina canadensis	Canada warbler	-	-	-	-	-	-	-	-	2	-	-	2	2
Cardellina pusilla	Wilson's warbler	-	-	-	-	1	-	-	1	5	-	-	5	6
Catharus fuscescens	veery	-	-	-	-	-	-	-	-	1	-	-	1	1
Catharus guttatus	hermit thrush	-	-	-	-	-	-	-	-	1	-	-	1	1
Certhia americana	brown creeper	-	-	-	-	1	-	-	1	1	1	-	2	3
Cistothorus palustris	marsh wren[3]	-	1	-	1	-	1	-	1	-	-	-	-	2
Columba livia domestica	domestic pigeon	-	-	-	-	-	-	-	-	1	-	1	2	2
Dumetella carolinensis	gray catbird	-	-	-	-	-	1	-	1	-	-	-	-	1
Empidonax flaviventris	yellow-bellied flycatcher	-	-	-	-	-	1	-	1	5	2	-	7	8
Empidonax minimus	least flycatcher	-	-	-	-	-	-	-	-	2	-	-	2	2
Empidonax virescens	Acadian flycatcher	-	-	-	-	-	-	-	-	1	-	-	1	1
Gallinula galeata	common gallinule	-	-	-	-	-	-	-	-	-	1	-	1	1
Geothlypis formosa	Kentucky warbler	-	-	-	-	-	-	-	-	2	-	-	2	2
Geothlypis spp.	yellowthroat[4]	1	1	-	2	2	1	-	3	18	5	-	23	28

Species[1]	Common Name[2]	Individuals Collected[3]												
		Fall 1972				Fall 1973				Fall 1974				
		CT	ST	MT	Total	CT	ST	MT	Total	CT	ST	MT	Total	Total
Larus delawarensis	ring-billed gull	-	-	-	-	-	1	-	1	-	-	-	-	1
Melospiza melodia	song sparrow	-	-	-	-	-	-	-	-	1	-	-	1	1
Mniotilta varia	black-and-white warbler	-	-	-	-	-	-	-	-	3	-	-	3	3
Parulidae spp.	redstart[5]	-	-	-	-	-	4	-	4	5	-	-	5	9
Oporornis agilis	Connecticut warbler	-	-	-	-	1	-	-	1	1	1	-	2	3
Oreothlypis peregrina	Tennessee warbler	-	-	-	-	-	2	-	2	3	-	-	3	5
Oreothlypis ruficapilla	Nashville warbler	-	-	-	-	-	3	-	3	7	2	-	9	12
Parulidae spp.	unidentified warbler	1	-	-	1	1	-	-	1	-	-	-	-	2
Passer domesticus	house sparrow	-	-	-	-	-	-	-	-	-	-	2	2	2
Passerculus sandwichensis	Savannah sparrow	-	-	-	-	-	-	-	-	1	-	1	2	2
Porzana carolina	sora rail	-	-	-	-	-	1	-	1	-	-	-	-	1
Rallus limicola	Virginia rail	-	-	-	-	-	-	-	-	1	-	-	1	1
Regulus calendula	ruby-crowned kinglet	1	-	-	1	16	7	-	23	36	2	-	38	62
Regulus satrapa	golden-crowned kinglet	-	-	-	-	15	2	-	17	44	9	-	53	70
Seiurus aurocapilla	ovenbird	-	-	-	-	1	1	-	2	6	1	1	8	10

		Individuals Collected[3]												
		Fall 1972				Fall 1973				Fall 1974				
Species[1]	**Common Name[2]**	**CT**	**ST**	**MT**	**Total**	**CT**	**ST**	**MT**	**Total**	**CT**	**ST**	**MT**	**Total**	Total
Setophaga americana	northern parula[6]	-	-	-	-	-	-	-	-	1	-	-	1	1
Setophaga caerulescens	black-throated blue warbler	-	-	-	-	-	-	-	-	5	3	-	8	8
Setophaga castanea	bay-breasted warbler	-	-	-	-	-	-	-	-	10	1	1	12	12
Setophaga coronata coronata	myrtle warbler	-	1	-	1	-	1	-	1	2	1	-	3	5
Setophaga fusca	blackburnian warbler	-	-	-	-	-	1	-	1	11	1	-	12	13
Setophaga magnolia	magnolia warbler	-	-	-	-	3	7	-	10	31	7	1	39	49
Setophaga pensylvanica	chestnut-sided warbler	-	-	-	-	1	-	-	1	8	-	-	8	9
Setophaga petechia	yellow warbler	1	-	1	2	-	-	-	-	1	-	-	1	3
Setophaga pinus	pine warbler	-	-	-	-	1	3	-	4	3	-	-	3	7
Setophaga striata	blackpoll warbler	-	-	-	-	-	2	-	2	5	3	1	9	11
Setophaga tigrina	Cape May warbler	-	-	-	-	-	-	-	-	1	-	-	1	1
Setophaga virens	black-throated green warbler	-	1	-	1	1	1	-	2	16	3	-	19	22
Sitta canadensis	red-breasted nuthatch	-	-	-	-	-	-	-	-	1	-	-	1	1
Thryothorus ludovicianus	Carolina wren	-	-	-	-	-	-	-	-	2	-	-	2	2

		Individuals Collected[3]												
		Fall 1972				Fall 1973				Fall 1974				
Species[1]	**Common Name[2]**	**CT**	**ST**	**MT**	**Total**	**CT**	**ST**	**MT**	**Total**	**CT**	**ST**	**MT**	**Total**	Total
Troglodytes aedon	house wren	-	-	-	-	-	-	-	-	1	-	-	1	1
Troglodytes hiemalis	winter wren	-	-	-	-	-	-	-	-	2	-	-	2	2
unidentified bird	unidentified bird	-	-	-	-	10	6	-	16	13*	-	-	13	29
Vireo gilvus	warbling vireo	-	-	-	-	-	1	-	1	-	-	-	-	1
Vireo griseus	white-eyed vireo	-	-	-	-	-	-	-	-	-	1	-	1	1
Vireo olivaceus	red-eyed vireo	-	-	-	-	-	-	-	-	15	4	-	19	19
Vireo philadelphicus	Philadelphia vireo	-	1	-	1	-	-	-	-	2	1	-	3	4
Vireo spp.	solitary vireo[7]	-	-	-	-	-	-	-	-	-	1	-	1	1
Zonotrichia albicollis	white-throated sparrow	-	-	-	-	-	-	-	-	1	2	-	3	3
Zonotrichia leucophrys	white-crowned sparrow	-	-	-	-	1	-	-	1	1	-	-	1	2
Total Birds		**4**	**5**	**1**	**10**	**55**	**47**	**-**	**102**	**279**	**52**	**8**	**339**	**451**

		Individuals Collected[3]												
		Fall 1972				Fall 1973				Fall 1974				
Species[1]	**Common Name[2]**	**CT**	**ST**	**MT**	**Total**	**CT**	**ST**	**MT**	**Total**	**CT**	**ST**	**MT**	**Total**	Total
Eptesicus fuscus	big brown bat	-	-	-	-	-	1	-	1	-	-	-	-	1
Lasiurus borealis	red bat	-	-	-	-	-	-	-	-	2	-	-	2	2
Perimyotis subflavus	tri-colored bat[8]	-	-	-	-	-	-	-	-	-	1	-	1	1
Total Bats		**-**	**-**	**-**	**-**	**-**	**1**	**-**	**1**	**2**	**1**	**-**	**3**	**4**
Total Birds and Bats		**4**	**5**	**1**	**10**	**55**	**48**	**-**	**103**	**281**	**53**	**8**	**342**	**455**

1 The source table does not provide Latin species names. Species names are provided for those that can clearly be distinguished by the common name. Ambiguities are noted in the succeeding footnotes.

2 Common names have been updated, as appropriate, from those listed in the source table to reflect the most widely accepted name.

3 CT = cooling tower; ST = Unit 1 structures (including shield, turbine, and auxiliary buildings); MT = meteorological tower

3 The source table refers to this species as “long-billed marsh wren.”

4 The source table does not specify which species of yellowthroat, which may refer to a number of species in the genus *Geothlypis*.

5 “Redstart” may refer to any of the species in the New World warbler family (Parulidae) in either of the genera *Setophaga* or *Myioborus*.

6 The source table refers to this species as parula warbler.

7 It is unclear what species was collected during the surveys as “solitary vireo” may refer to one of three species: Cassin’s vireo (*Vireo cassinii*), plumbeous vireo (*Vireo plumbeus*), or blue-headed Vireo (*Vireo solitarius*).

8 The source table refers to this species as eastern pipistrelle. The species has since been reclassified and named the tri-colored bat.

* The source table indicates the following: “12 remains were found at CT Oct 15 after a major kill on Oct 13; access to CT was denied on Oct 13–14, and an unknown number of specimens was lost to scavengers.”

Source: Table recreated from FES-O (NRC 1975) Table 6.3

In a letter dated September 30, 2014, the FWS (2014) concurred with the NRC's determination of "may affect, but not likely to adversely affect" for Kirtland's warbler.

Piping Plover *(Charadrius melodus)*. The Davis-Besse site may provide marginal habitat for migrating piping plovers, but the occurrence of this species within the action area would be rare. The Black Swamp Bird Observatory (BSBO) has recorded this species as occurring within Lake Erie marsh region, which includes the Navarre Marsh on the Davis-Besse site. This habitat is leased to FWS for management as part of the Ottawa National Wildlife Refuge and would continue to be leased to FWS during the proposed license renewal term. Continued preservation of this habitat during the proposed license renewal term would result in beneficial effects to the species.

Continued operation and maintenance of the Davis-Besse site during the proposed license renewal term would not affect existing land use conditions in Navarre Marsh or any other natural areas on the site. Thus, continued operation of Davis-Besse would not affect habitat or prey availability. Noise levels and human activity would remain similar to current operations and would not cause any additional disturbances that would cause piping plovers to avoid or abandon habitat within the action area. The NRC staff did not identify any direct or indirect adverse effects to piping plovers that would result from continued operation during the proposed license renewal term. The piping plover was not recorded during the previously discussed 1972–1979 bird mortality surveys. As with the Kirtland's warbler, the NRC staff believes that the likelihood of this happening is discountable, or extremely unlikely to occur, because the piping plover is rarely in the vicinity of the action area and is not likely to inhabit the developed portions of the site that contain collision hazards. Additionally, because the species has been listed under the ESA since 1985, the ESA has obligated the NRC and the applicant to consult with FWS if new information reveals effects of the action that may affect listed species in a manner or to an extent not previously considered (50 CFR 402.16(b)). No such information has been identified for which the NRC staff has determined reinitiation of consultation appropriate. Because no such collisions are known to have occurred to date, the NRC staff finds it reasonable to assume that the likelihood of collision would be extremely low in the future.

The NRC staff concludes that the proposed license renewal may affect, but is not likely to adversely affect, the piping plover. In a September 30, 2014, letter, FWS (2014) concurred with this conclusion.

Red *Knot (Calidris canutus rufa)*. Within the action area, the red knot is most likely to use Lake Erie shoreline habitat within Navarre Marsh. This habitat is leased to FWS for management as part of the Ottawa National Wildlife Refuge and would continue to be leased to FWS during the proposed license renewal term. Continued protection of this habitat would result in beneficial effects to the species.

As with the Kirtland's warbler, it is possible that the red knot could collide with plant structures or transmission lines. This impact, and a summary of previous bird mortality surveys conducted at Davis-Besse, are discussed above in the assessment of effects on the Kirtland's warbler. The red knot was not collected in mortality surveys during the available years (1972–1974). The occurrence of this species in the 1975–1979 surveys is unknown because these survey results are unavailable. However, because the red knot is relatively rare in the action area, the likelihood of red knot individuals colliding with plant structures or transmission lines is also likely low. Nonetheless, if an individual were to collide with plant structures or transmission lines during the proposed license renewal term, such a collision could result in a take as defined by the ESA. Such an effect could be considered discountable if, based on best judgment, the effect is not expected to occur (FWS and NMFS 1998). Because this species was recently listed in December 2014 (79 FR 60023), the ESA has not afforded this species protection for the

majority of the operation of Davis-Besse. Accordingly, until now, the ESA has not necessitated the NRC and the applicant to consult with FWS in the event that an individual was found injured or dead as a result of collision with Davis-Besse plant structures. Although the NRC has no records indicating that such an event happened, the NRC staff cannot rely on the absence of records to predict the likelihood of future collisions because the ESA has not necessitated action following such an event until recently. Thus, the NRC staff conservatively assumes that there is a potential for red knots to collide with plant structures or transmission lines during the proposed license renewal term, and such collisions could result in a take.

In addition to collision hazards, the NRC staff also considered the likelihood of direct mortality, loss of habitat or food resources, or behavioral changes resulting from construction or refurbishment activities, regular site maintenance, and infrastructure repairs during the proposed license renewal term. The nature of these effects is discussed above in the assessment of effects on the Kirtland's warbler. Impacts from construction would not occur because no construction is planned. The NRC staff finds no information that would indicate that regular site maintenance or infrastructure repairs during the proposed license renewal term would result in measurable or detectable effects on red knots.

The NRC staff concludes that the proposed license renewal may affect, but is not likely to adversely affect, the red knot. This determination is the result of the unlikely, but possible, collision of red knot individuals with plant structures or transmission lines during the proposed license renewal term. In a September 30, 2014, letter, FWS (2014) concurred with this conclusion.

Indiana Bat *(Sodalis myotis)*. The Indiana bat may occur within areas of suitable roosting and foraging habitat in the action area, such as riparian areas, grasslands, and meadows. Continued preservation of this habitat during the proposed license renewal term would result in beneficial effects to the species.

The proposed license renewal could affect the Indiana bat by causing direct mortality through collision with plant structures. License renewal activities could also result in direct mortality, loss of habitat or food resources, or behavioral changes resulting from construction or refurbishment activities, regular site maintenance, and infrastructure repairs during the proposed license renewal term.

During the 1972–1979 bird mortality surveys conducted at Davis-Besse and discussed previously in this section, information from the available years (1972–1974) indicates that four dead bats were collected that had collided with plant structures (see Table 2). Two red bats (*Lasiurus borealis*) were collected at the cooling tower in 1974, and one big brown bat (*Eptesicus fuscus*) and one tri-colored bat (*Perimyotis subflavus*) were collected near other plant structures in 1973 and 1974, respectively. No Indiana bats were collected. Given the marginal habitat that the Davis-Besse site provides and the small number of bats collected in the 1972–1974 bird mortality surveys, the NRC staff considers it to be extremely unlikely that Indiana bats would collide with plant structures during the license renewal term. Additionally, because the species has been listed under the ESA since Davis-Besse began operating in 1978, the ESA has obligated the NRC and the applicant to consult with FWS if new information reveals effects of the action that may affect listed species in a manner or to an extent not previously considered (50 CFR 402.16(b)). No such information has been identified for which the NRC has determined reinitiation of consultation appropriate. Because no such collisions are known to have occurred to date, the NRC staff finds it reasonable to assume that the likelihood of collision would be extremely low in the future. Therefore, the NRC staff finds this potential impact to be discountable.

As part of regular site maintenance, FENOC may need to remove trees that pose a safety concern. Although it is unlikely that FENOC would need to remove trees in the small forested tracts on the site where the Indiana bat may roost, the NRC staff conservatively assumes that any tree removal could potentially affect the species if the trees have not been assessed for bat presence or use. FENOC's (2011) Environmental Best Management Practices require FENOC staff to conduct all tree removal or disturbance from September 30 through April 1 when bats would not be in the region. If trees need to be removed during the summer months, FENOC's procedure specifies that FENOC must conduct a net survey for those tree species that are likely to provide Indiana bat roosting habitat. FENOC must complete such surveys before disturbing any trees to ensure that the Indiana bat is not adversely affected. FENOC could also perform such maintenance in the fall or winter months when the Indiana bat has migrated to hibernation sites. Thus, this potential adverse impact would be insignificant because it is unlikely to result in a take.

The NRC staff concludes that the proposed license renewal may affect, but is not likely to adversely affect, the Indiana bat. In a September 30, 2014, letter, the FWS (2014) concurred with this conclusion.

Northern Long-Eared Bat (*Myotis septentrionalis*). Within the action area, the northern long-eared bat is most likely to use the small forested tracts of land for roosting or foraging, although these areas would only provide marginal habitat as the species prefers larger, intact forests. Nonetheless, this habitat would continue to be available to the northern long-eared bat during the proposed license renewal term, and continued preservation of this habitat would result in beneficial effects to the species.

The proposed license renewal could affect the northern long-eared bat by causing direct mortality through collision with plant structures. License renewal activities could also result in direct mortality, loss of habitat or food resources, or behavioral changes resulting from construction or refurbishment activities, regular site maintenance, and infrastructure repairs during the proposed license renewal term.

During the 1972–1979 bird mortality surveys discussed previously in this section, none of the four bats collected were northern long-eared bats. Given the marginal habitat that the Davis-Besse site provides and the small number of bats collected in the 1972–1974 bird mortality surveys, the NRC staff considers it to be extremely unlikely that northern long-eared bats would collide with plant structures during the license renewal term. Therefore, the NRC staff finds this potential impact to be discountable.

As part of regular site maintenance, FENOC may need to remove trees that pose a safety concern. Although it is unlikely that FENOC would need to remove trees in the small forested tracts on the site where northern long-eared bats may roost, the NRC staff conservatively assumes that any tree removal could potentially affect the species if the trees have not been assessed for bat presence or use.

As discussed for the Indiana bat, FENOC maintains Environmental Best Management Practices that include measures to ensure that FENOC staff consider and appropriately mitigate impacts to the Indiana bat before tree removal. Because of the similar life history of northern long-eared bats and Indiana bats, the NRC staff assumes that these measures would be protective for both species. Accordingly, the potential adverse impact created by future tree removals during the proposed license renewal term would be insignificant because the action is unlikely to result in a take.

The NRC staff concludes that the proposed license renewal may affect, but is not likely to adversely affect, the northern long-eared bat. This determination is the result of the potential for

tree removal to affect northern long-eared bat roosts. However, FENOC's continued adherence to its Environmental Best Management Practices during the proposed license renewal term would ensure that tree removal does not result in a take of this species. In a September 30, 2014, letter, FWS (2014) concurred with this conclusion.

Eastern Prairie Fringed Orchid *(Platanthera leucophaea)*. The eastern prairie fringed orchid may occur in areas of suitable habitat within the action area, such as mesic prairie, sage meadows, marsh edges, bogs, and other wetland habitats within Navarre Marsh. Though suitable habitat exists in the action area, during the NRC's site audit (NRC 2011b), the FWS noted that it was unable to find any eastern prairie fringed orchid populations during a 2010 survey within the Ottawa National Wildlife Refuge. Nonetheless, FWS's continued management of the Navarre Marsh as part of the Ottawa National Wildlife Refuge would ensure that, if present, the eastern prairie fringed orchid would not be adversely affected. The NRC staff did not identify any direct or indirect adverse effects to this species that would result from continued operation during the proposed license renewal term.

The NRC staff concludes that the proposed license renewal would have no effect on the eastern prairie fringed orchid. In a September 30, 2014, letter, FWS (2014) concurred with this conclusion.

Lakeside Daisy (*Tetraneuris herbacea*). Suitable habitat for the lakeside daisy does not occur within the action area. Thus, the NRC staff concludes that the proposed license renewal would have no effect on the lakeside daisy. In a September 30, 2014, letter, FWS (2014) concurred with this conclusion.

Critical Habitat. As noted in Section 2.2.7 of this SEIS, no critical habitat occurs in the action area. Therefore, the proposed license renewal would have no effect on proposed or designated critical habitat.

Reporting Requirements. If an ESA-protected species is observed on the Davis-Besse site by plant personnel, the NRC has measures in place to ensure that it would be notified so that the NRC staff could determine the appropriate course of action, such as possibly reinitiating section 7 consultation under the ESA with FWS at that time. The NRC's regulations containing notification requirements that necessitate operating nuclear power reactors to report to the NRC within 4 hours "any event or situation, related to…protection of the environment, for which a news release is planned or notification to other government agencies has been or will be made" (10 CFR 50.72(b)(2)(xi)). Such notifications include reports regarding Federally listed species, as described in Section 3.2.12 of NUREG-1022, *Event Reporting Guidelines for 10 CFR 50.72 and 50.73* (NRC 2013b). If listed in the future, this reporting requirement would apply to observations of northern long-eared bats and red knots.

Mitigation Measures. During section 7 consultation, FWS identified several measures that could further reduce the potential impacts to Federally listed species described above. The measures are as follows.

For northern long-eared bats, trees exhibiting cavities, peeling or exfoliating bark, a split tree trunk or branches or both, as well as any wooded areas or tree lined corridors should be saved wherever possible. If the trees must be cut, cutting should occur between October 1 and March 31 to avoid impacts to northern long-eared bats. If implementation of the seasonal tree cutting timeframe is not possible, summer surveys could be conducted to document the presence or probable absence of the northern long-eared bat within the project area during the summer. Because of the potential for the surveyor to capture Federally listed endangered Indiana bats, such a survey should be conducted by an approved surveyor and be designed

and conducted in coordination with the Endangered Species Coordinator at the FWS's Ohio Ecological Services Field Office.

For Kirtland's warbler, FWS (2014) recommended that FENOC consider conducting mortality surveys to monitor the potential for Kirtland's warblers to collide with tall plant buildings and structures. Although FWS does not believe that license renewal would result in a take, as defined by the ESA, of any individuals, FWS believes that monitoring provides valuable information because of the significant increase in the Kirtland's warbler population in recent years and the lack of current mortality information for the Davis-Besse site. Such a survey could provide information that FENOC could use to reduce any already-insignificant and discountable adverse impacts to the species. FWS recommends that such monitoring take place during spring migration (April 1 through May 31) and fall migration (August 1 through September 30) for a period of at least 3 years to account for seasonal variation. Surveys should occur around the perimeter of any structures lit at night and greater than 100 ft (30 m) in height (i.e., the cooling tower and meteorological tower). Surveys should include at least one searcher detection trial to determine baseline information on search efficiency. If performed, the applicant should develop the surveys in coordination with FWS. Prior to receiving the FWS letter (FWS 2014), FWS staff discussed these recommendations with the applicant and NRC staff in a teleconference (NRC 2014d).

4.8.2 Species Protected Under the Bald and Golden Eagles Protection Act

Bald eagles (*Haliaeetus leucocephalus*) are relatively common in the vicinity of the Davis-Besse site. Several bald eagle nests are located on the Davis-Besse site. Two bald eagle nests are specifically located on the Davis-Besse site—one within Navarre Marsh and one northwest of the cooling tower near the site boundary (FWS 2010).

No activities on the Davis-Besse site would disturb bald eagles during the proposed license renewal term. Ground disturbing activities, increased noise and lighting, and other refurbishment impacts to bald eagles are discussed in Sections 3.2.1 and 3.2.2. Transmission line corridor maintenance has the potential to disturb eagles if trees with nests need to be trimmed or cut down. However, FENOC's (2011) *Environmental Best Management Practices* (discussed in Section 2.2.7) require that activities within 660 ft (200 m) of eagle nests that could disturb those nests be limited to August 1 through December 31, when eagles are least likely to be in the area. Additionally, the procedure requires FENOC to coordinate with the FWS to discuss potential mitigation options that could reduce or minimize impacts to eagles if activities must take place from January 1 through July 31. These specifications apply to the Davis-Besse site as well as the in-scope transmission line corridors. Additionally, the Bald and Golden Eagle Protection Act prohibits the taking of eagles without an FWS-issued eagle permit. Therefore, any activities that would require coordination per the procedures in FENOC's *Environmental Best Management Practices* may also require an eagle permit under the Bald and Golden Eagle Act implementing regulations (50 CFR Part 22). As a result of these two processes, impacts to the bald eagle as a result of transmission line maintenance during the proposed renewal term would be minimal.

4.8.3 Species Protected Under the Migratory Bird Treaty Act

No activities associated with the proposed license renewal would directly impact migratory birds. Transmission line corridor maintenance has the potential to disturb migratory bird nests if trees or shrubs containing nests are trimmed or cut down. However, the MBTA only pertains to direct impacts to migratory birds and does not protect migratory bird habitat (as described in Section 2.2.7.3).

During ESA section 7 consultation with FWS, FWS (2014) expressed concerns regarding the potential for tall buildings and structures to present a collision hazard to migratory birds. Collision hazard is greatest at night and during periods of low cloud ceiling or fog. Tower height and lighting also affects the potential for birds to collide with plant buildings and structures. In the GEIS, the NRC generally concluded that the potential for bird collision with cooling towers, power lines, and other structures is SMALL for all plants (see Section 4.7). In the FWS letter to the NRC dated September 30, 2014, FWS (2014) recommended the following strategies to further reduce the SMALL potential for bird collisions:

- No construction of additional tall structures on the site;
- Removal of guy wires for structures, when possible;
- Down-shielding of lighting or installation of motion sensors; and
- Limited tower lighting during migration seasons, especially April through May and September through October.

FWS also noted that the current lighting scheme for the Davis-Besse cooling tower (flashing lights) reduces the risk to migratory birds of collision by 50 to 71 percent. Accordingly, FWS recommended that flashing lights continue to be used to limit impacts to migratory birds.

4.8.4 Species Protected by the State of Ohio

Many Ohio-listed species occur (or have been recorded as historically occurring) on and in the vicinity of the Davis-Besse site, including many species of birds, seven species of plants, five species of mussels, and three species of reptiles. These species are discussed in Section 2.2.8.4 of this SEIS. Section 4.14.4 discusses cumulative impacts on Ohio State-listed species.

In their correspondence with FENOC prior to FENOC's submittal of the Davis-Besse license renewal application (LRA) to the NRC, the ODNR determined that the proposed license renewal would not impact any State-listed species because no tree removals, in-water work, or other major construction activities would take place that might disturb the habitat of or otherwise impact any species (ODNR 2010). The NRC (NRC 2010a, 2010b) sent letters to the ODNR during its scoping process to confirm the information contained in ODNR's previous letter to FENOC and to request any updated information concerning State-listed species. In a letter dated August 30, 2011 (ODNR 2011), the ODNR provided the NRC staff with its concurrence on this list. The ODNR provided no updated information concerning effects to State-listed species as a result of the proposed Davis-Besse license renewal. Based on correspondence with the ODNR and the NRC staff's independent review, the NRC staff concludes that the proposed Davis-Besse license renewal will have no adverse impacts on any State-listed species.

4.8.5 Conclusion

The NRC staff concludes that the proposed Davis-Besse license renewal will have no effect on two Federally listed species (eastern prairie fringed orchid and lakeside daisy) and may affect, but is not likely to adversely affect, four Federally listed species (Indiana bat, northern long-eared bat, Kirtland's warbler, and piping plover) and one proposed species (red knot).

4.9 Human Health

Table 4–11 lists the human health issues identified in the GEIS.

Table 4–11. Human Health Issues

Issue	GEIS Section	Category
Radiation exposures to the public during refurbishment	3.8.1[(a)]	1
Occupational radiation exposures during refurbishment	3.8.2[(a)]	1
Microbiological organisms (occupational health)	4.3.6	1
Microbiological organisms (public health, for plants using lakes or canals or cooling towers or cooling ponds that discharge to a small river)	4.3.6[(b)]	2
Noise	4.3.7	1
Radiation exposures to public (license renewal term)	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	Uncertain
Human health impact from chemicals	4.9.1.1.2[(c)]	1
Physical occupational hazards	4.9.1.1.5[(c)]	1

[(a)] Issues apply to refurbishment, an activity that Davis-Besse plans to undertake.
[(b)] Issue applies to plants with features such as cooling lakes of cooling towers that discharge to a small river. This issue does not apply to Davis-Besse.
[(c)] NRC 2013a; 78 FR 37282

Source: 61 FR 28467, June 5, 1996

4.9.1 Generic Human Health Issues

The NRC staff has not identified any new and significant information during its independent review of the applicant's ER (FENOC 2010a), the site audit, the scoping process, or its evaluation of other available information that would change the conclusions in the GEIS (NRC 1996) for the Category 1 human health issues. For the Category 1 human health issues, the GEIS (NRC 1996) concludes the impacts to be SMALL. For the new Category 1 issues identified in the 2013 GEIS, human health impact from chemicals and physical occupational hazards, the impacts have been determined to be SMALL.

The information presented below is a discussion of new human health issues followed by a discussion of selected radiological programs conducted at Davis-Besse.

4.9.1.1 New Category 1 Human Health Issues

As described in Section 1.4 of this draft SEIS, the NRC has approved a revision to its environmental protection regulation, 10 CFR Part 51. With respect to the human health, the final rule amends Table B-1 in Appendix B, Subpart A, to 10 CFR Part 51 by adding two new Category 1 issues, “Human health impact from chemicals” and “Physical occupational hazards.” The first issue considers the impacts from chemicals to plant workers and members of the

public. The second issue only considers the nonradiological occupational hazards of working at a nuclear power plant. An understanding of these nonradiological hazards to nuclear power plant workers and members of the public have been well established at nuclear power plants during the current licensing term. The impacts from chemical hazards are expected to be minimized through the applicant's use of good industrial hygiene practices as required by permits and Federal and State regulations. Also, the impacts from physical hazards to plant workers will be of small significance if workers adhere to safety standards and use protective equipment as required by Federal and State regulations. The impacts to human health for each of these new issues from continued plant operations are SMALL.

The NRC staff has not identified any new and significant information related to these nonradiological issues during its independent review of applicant's ER (FENOC 2010a), the site audit, and the scoping process. Therefore, the NRC staff concludes that there would be no impact to human health from chemicals or physical hazards beyond those impacts described in Table B-1 in Appendix B, Subpart A, to 10 CFR Part 51 of the final rule; therefore, the impacts are SMALL.

4.9.2 Radiological Impacts of Normal Operations

FENOC stated in its ER that it was not aware of any new and significant radiological impacts related to human health issues associated with the renewal of the Davis-Besse operating license. The NRC staff has not identified any new and significant information regarding radiological impacts related to human health issues during its independent review of the applicant's ER, the site audit, the scoping process, or its evaluation of other available information. Therefore, the NRC staff concludes that there would be no impact from radiation exposures to the public or to workers during the renewal term beyond those discussed in the GEIS.

The findings in the GEIS are as follows:

- Radiation exposures to public (license renewal term)—Based on information in the GEIS, the NRC found that radiation doses to the public will continue at current levels associated with normal operations.
- Occupational exposures (license renewal term)—Based on information in the GEIS, the NRC found that projected maximum occupational doses during the license renewal term are within the range of doses experienced during normal operations and normal maintenance outages, and would be well below regulatory limits.

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

The information presented below is a discussion of selected radiological programs conducted at Davis-Besse.

4.9.2.1 Davis-Besse Radiological Environmental Monitoring Program

Davis-Besse conducts a Radiological Environmental Monitoring Program (REMP) to assess the radiological impact, if any, to its employees, the public, and the environment from its operations. The REMP measures the aquatic, terrestrial, and atmospheric environment for radioactivity, as well as the ambient radiation. In addition, the REMP measures background radiation (i.e., cosmic sources, global fallout, and naturally occurring radioactive material, including radon). The REMP supplements the Radioactive Effluent Monitoring Program by verifying that any measurable concentrations of radioactive materials and levels of radiation in the

environment are not higher than those calculated using the radioactive effluent release measurements and transport models.

Radiation levels and radioactivity have been monitored within a 25-mi radius around Davis-Besse since 1972. The REMP was established at Davis-Besse about 5 years before the station became operational. This pre-operational sampling and analysis program provided data on radiation and radioactivity normally present in the area as natural background. Davis-Besse has continued to monitor the environment by sampling air, groundwater, milk, wild meat, fruit and vegetables, wild animal feed, drinking water, surface water, fish, and shoreline sediment, as well as through direct measurement of radiation.

The Davis-Besse REMP is made up of four categories based on the radiation exposure pathways to the public. The REMP collects and measures environmental media samples from the following: atmospheric, terrestrial, aquatic, and direct radiation. The air is sampled in areas around the plant site by measuring the levels of radioactive iodine and particulate matter on filters. Terrestrial monitoring includes the collection and analysis of milk, groundwater, meat, fruits, vegetables, animal feed, and soil samples. Aquatic monitoring includes the collection and analysis of drinking water, untreated surface water, fish, and shoreline sediment from the plant site and the vicinity of Lake Erie. Direct radiation is measured at various locations around the plant site using thermoluminescent Dosimeters (TLDs). In addition to the REMP, Davis-Besse began monitoring groundwater wells near the plant site in 2007, as part of the FENOC Groundwater Protection Initiative (GPI). The initiative is designed to determine whether there have been any inadvertent releases of radioactivity that have impacted groundwater or could potentially affect local water supplies. A detailed discussion of the GPI is contained in Section 2.2.5 of this SEIS.

The NRC staff reviewed Davis-Besse's annual radiological environmental operating reports for 2008 through 2012 to look for any significant impacts to the environment or any unusual trends in the data (FENOC 2009a, 2010b, 2011a, 2012a, 2013a, 2014a). The NRC staff uses a multiyear time period because it provides a data set that covers a broad range of activities that occur at a nuclear power plant such as refueling outages, non-refueling outage years, routine operation, and years where there may be significant maintenance activities. Based on the NRC staff's review of FENOC's reports, no adverse trends (i.e., steadily increasing buildup of radioactivity levels) were observed and the data showed that there was no measurable impact to the environment from operations at Davis-Besse.

4.9.2.2 Davis-Besse Radioactive Effluent Release Program

All nuclear plants were licensed with the expectation that they would release radioactive material to both the air and water during normal operation. However, NRC regulations require that radioactive gaseous and liquid releases from nuclear power plants must meet radiation dose based limits specified in 10 CFR Part 20, and the as low as is reasonably achievable (ALARA) criteria in Appendix I to 10 CFR Part 50. Regulatory limits are placed on the radiation dose that members of the public can receive from radioactive material released by a nuclear power plant. In addition, nuclear power plants are required by 10 CFR 50.36(a) to submit an annual report to the NRC, which lists the types and quantities of radioactive effluents released into the environment. The radioactive effluent release and radiological environmental monitoring reports are available for review by the public through the Agencywide Documents Access and Management System (ADAMS) electronic reading room, which is available through the NRC Web site.

The NRC staff reviewed the annual radioactive effluent release reports for 2008 through 2012 (FENOC 2009b, 2010c, 2011b, 2012b, 2013b, 2014b). The review focused on the calculated doses to a member of the public from radioactive effluents released from Davis-Besse. The

doses were compared to the radiation protection standards in 10 CFR 20.1301, the ALARA dose design objectives in Appendix I to 10 CFR Part 50, and the EPA's 40 CFR Part 190.

Dose estimates for members of the public are calculated based on radioactive gaseous and liquid effluent release data and atmospheric and aquatic transport models. The 2013 annual radioactive material release report (FENOC 2014b) contains a detailed presentation of the radioactive discharges and the resultant calculated doses. The following information summarizes the calculated maximum dose to a member of the public located outside the Davis-Besse site boundary from radioactive gaseous and liquid effluents released during 2013:

- The maximum total body dose to an offsite member of the public from radioactive liquid effluents was 3.74×10^{-3} mrem (3.74×10^{-5} mSv), which is well below the 3 mrem (0.03 mSv) dose criterion in Appendix I to 10 CFR Part 50.
- The maximum organ (liver) dose to an offsite member of the public from radioactive liquid effluents was 3.83×10^{-3} mrem (3.83×10^{-5} mSv), which is well 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 3.16×10^{-5} mrad (3.16×10^{-7} mGy), which is well 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 6.13×10^{-5} mrad (6.13×10^{-7} mGy), which is well below the 20 mrad (0.2 mGy) dose criterion in Appendix I to 10 CFR Part 50.
- The maximum organ (thyroid) dose to an offsite member of the public from radioactive iodine and radioactive material in particulate form was 2.05×10^{-3} mrem (2.05×10^{-5} mSv), which is well below the 15 mrem (0.15 mSv) dose criterion in Appendix I to 10 CFR Part 50.
- The maximum total body dose to an offsite member of the public from the combined radioactive releases (i.e., gaseous, liquid, and direct radiation) was 2.14×10^{-1} mrem (2.14×10^{-3} mSv), which is well below the 25 mrem (0.25 mSv) dose standard in 40 CFR Part 190.

The NRC staff's review of the Davis-Besse Radioactive Effluent Control Program showed that the radiation doses to members of the public from radioactive effluents were controlled within the Federal radiation protection standards contained in 10 CFR Part 20, Appendix I to 10 CFR Part 50 and 40 CFR Part 190.

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 to maintain the dose from radioactive effluents to be ALARA, similar performance is expected during the license renewal term.

The radiological impacts from the current operation of Davis-Besse, including those from refurbishment, are not expected to change significantly. Continued compliance with regulatory requirements is expected during the license renewal term; therefore, the impacts from radioactive effluents would be SMALL.

4.9.3 Electromagnetic Fields—Acute Effects

Based on the GEIS (NRC 1996), the NRC found that electric shock resulting from direct access to energized conductors or from induced charges in metallic structures has not been found to be a problem at most operating plants and generally is 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 along the portions of the transmission lines that are within the scope of this SEIS.

In the GEIS, the NRC staff found that without a review of the conformance of each nuclear plant transmission line with National Electrical Safety Code (NESC) criteria, it was not possible to determine the significance of the electric shock potential (IEEE 2002). Evaluation of individual plant transmission lines is necessary because the issue of electric shock safety was not addressed in the licensing process for some plants. For other plants, land use in the vicinity of transmission lines may have changed or power distribution companies may have chosen to upgrade line voltage. To comply with 10 CFR 51.53(c)(3)(ii)(H), the applicant must provide an assessment of the impact of the proposed action on the potential shock hazard from the transmission lines if the transmission lines that were constructed for the specific purpose of connecting the plant to the transmission system do not meet the recommendations of the NESC for preventing electric shock from induced currents. The NRC uses the NESC criteria as its baseline to assess the potential human health impact of the induced current from an applicant's transmission lines. As discussed in the GEIS, the issue of electric shock is of small significance for transmission lines that are operated in adherence with the NESC criteria.

Davis-Besse electrical output is delivered via three separate 345 kilovolt (kV) transmission lines to three different Toledo Edison substations. The Bay shoreline is about 21 mi long, extending from the Davis-Besse switchyard west and then northwest to Toledo Edison's Bay Shore substation. The Lemoyne line also is about 21 mi long, extending from the Davis-Besse switchyard west and then southwest to Toledo Edison's Lemoyne substation. The Beaver line is about 59 mi long, extending from the Davis-Besse switchyard south and then southeast to Ohio Edison's Beaver substation.

The Bay Shore, the Lemoyne, and the Beaver transmission lines were constructed before the 1977 NESC adoption of the 5 milliamperes (mA) provision for electric shock produced from induced currents. Therefore, FENOC conducted a screening analysis for each road crossing under the three transmission lines to determine conformance with the 5 mA NESC standard. FENOC's evaluation of their transmission lines concluded that the induced current was less than the 5 mA NESC standard (FENOC 2010a).

The Davis-Besse transmission line corridor consists of approximately 1,800 acres of primarily flat agricultural land for ROWs. FENOC conducts routine vegetation maintenance of its rural transmission line corridors approximately every 5 years. Maintenance includes removal or pruning of woody vegetation, as necessary, to ensure adequate line clearance and to allow vehicular access for maintenance (FENOC 2010a).

The NRC staff reviewed the available information, including the applicant's evaluation and results. Based on this information, and because the transmission lines are operated in adherence with NESC criteria, the NRC staff concludes that the potential impacts from electric shock during the renewal period would be SMALL.

4.9.4 Electromagnetic Fields—Chronic Effects

In the GEIS, the effects of chronic exposure to 60-hertz (Hz) electromagnetic fields from powerlines 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 effects of chronic exposure from these fields continue to be studied and are 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 (NIEHS 1999) contains the following conclusion:

> The NIEHS concludes that ELF-EMF (extremely low frequency-electromagnetic field) exposure cannot be recognized as entirely safe because of weak scientific evidence that exposure may pose a leukemia hazard. In our opinion, this finding is insufficient to warrant aggressive regulatory concern. However, because virtually everyone in the United States uses electricity and therefore is routinely exposed to ELF-EMF, passive regulatory action is warranted such as 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 is not sufficient to cause the NRC staff to change its position with respect to the chronic effects of electromagnetic fields. The NRC staff considers the GEIS finding of “UNCERTAIN” still appropriate and will continue to follow developments on this issue.

4.10 Socioeconomics

The socioeconomic issues applicable to Davis-Besse are shown in Table 4–12 for Category 1 and Category 2. Section 2.2.9 of this SEIS describes the socioeconomic conditions near Davis-Besse.

Table 4–12. Socioeconomics During the Renewal Term

Issues	GEIS Section(s)	Category
Housing impacts	4.7.1	2
Public services—public safety, social services, and tourism & recreation	4.7.3; 4.7.3.3; 4.7.3.4; 4.7.3.6	1
Public services—public utilities	4.7.3.5	2
Public services—education (license renewal term)	4.7.3.1	1
Public services—transportation	4.7.3.2	2
Aesthetic impacts (license renewal term)	4.7.6	1
Aesthetic impacts of transmission lines (license renewal term)	4.5.8	1
Environmental justice minority & low-income populations	4.10.1[a]	2
Offsite land use (license renewal term)	4.7.4	2
Historic & archaeological resources	4.7.7	2

[a] NRC 2013a; 78 FR 37282.

Source: 61 FR 28467, June 5, 1996

4.10.1 Generic Socioeconomic Issues

The Davis-Besse ER (FENOC 2010a), scoping comments, other available data records on Davis-Besse were reviewed and evaluated for new and significant information. The review included a data gathering site visit to Davis-Besse. No new and significant information was identified during this review that would change the conclusions presented in the GEIS. Therefore, for these Category 1 issues, impacts during the renewal term are not expected to exceed those discussed in the GEIS. Impacts for Category 2 and environmental justice, which was listed as an uncategorized issue in the 1996 rule (61 FR 28467), are discussed in Sections 4.10.2 through 4.10.4, 4.11, 4.12, and 4-13. The NRC uses the existing socioeconomic conditions described in Section 2.2.9 of this SEIS as its baseline to evaluate the potential socioeconomic impacts resulting from license renewal. These baseline socioeconomic conditions include existing housing, transportation, offsite land use, demographic information, public services, and economic conditions affected by ongoing operations at the nuclear power plant.

4.10.2 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 mi (32 km) of the site, and proximity measures population density and city size within 50 mi (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, an estimated 129,411 people lived within 20 mi (32 km) of Davis-Besse, which equates to a population density of 169 persons per square mile (mi^2) (FENOC 2010a). This translates to a Category 4, “least sparse,” population density using the GEIS measure of sparseness (greater than or equal to 120 persons per mi^2 within 20 mi). An estimated 2,375,624 people live within 50 mi (80 km) of Davis-Besse with a population density of 316 persons per mi^2 (FENOC 2010a). Applying the GEIS proximity measures, Davis-Besse is classified as proximity Category 4 (greater than, or equal to, 190 persons per mi^2 within 50 mi). 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 the Davis-Besse is located in a high-population area.

Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, states that impacts on housing availability are expected to be of small significance in a medium or high-density population area where growth-control measures are not in effect. Since Davis-Besse is located in a high-population area and Lucas, Ottawa, Sandusky and Wood counties are not subject to growth-control measures that would limit housing development, any changes in employment at Davis-Besse would have little noticeable effect on housing availability in these counties. Since FENOC has no plans to add non-outage employees during the license renewal period, employment levels at Davis-Besse would remain relatively constant with no additional demand for permanent housing during the license renewal term. Based on this information, there would be no additional impact on housing during the license renewal term beyond what has already been experienced; therefore, the NRC staff concludes that the impact on housing would be SMALL.

FENOC indicated in their ER (FENOC 2010a) that the steam generators would be replaced during the license renewal term in 2017, however steam generator replacement is now scheduled to be done during the 2014 refueling outage. FENOC estimates that steam generator replacement would require a one-time increase in the number of refueling outage workers for up to 70 days (FENOC 2010a). These additional workers would create an additional demand for temporary (rental) housing in the immediate vicinity of Davis-Besse.

Steam generator replacement impacts are discussed in Chapter 3 of this SEIS. As a result of replacing the steam generators, there will be a one-time increase in the need for temporary housing for the additional workers. However, the NRC staff concludes that the overall impacts on housing due to steam generator replacement will remain SMALL.

4.10.3 Public Services—Public Utilities

While the impact findings of SMALL, MODERATE and LARGE are defined in Section 1.4 of this SEIS, the definitions for these three findings are slightly different with respect to the impact on public utilities. Impacts on public utility services (e.g., water, sewer) are considered SMALL if the public utility has the ability to respond to changes in demand and would have no need to add or modify facilities. Impacts are considered MODERATE if service capabilities are overtaxed during periods of peak demand. Impacts are considered LARGE if additional system capacity is needed to meet ongoing demand.

Analysis of impacts on the public water systems considered both plant demand and plant-related population growth. Section 2.1.7 describes the permitted withdrawal rate and actual use of water for reactor cooling at Davis-Besse.

Since FENOC has no plans to add non-outage employees during the license renewal period, employment levels at Davis-Besse would remain relatively unchanged with no additional demand for public water services. Public water systems in the region are 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.

As discussed in Section 4.9.2, FENOC indicated in their ER that steam generators would be replaced during the license renewal term in 2017, however steam generator replacement is now scheduled to be done during the 2014 refueling outage (FENOC 2010a). The additional number of refueling outage workers needed to replace the steam generators would cause a short-term increase in the amount of public water and sewer services used in the immediate vicinity of Davis-Besse. The impacts to public utilities from refurbishment activities are discussed in Chapter 3 of this SEIS, and have been determined to be SMALL.

4.10.4 Public Services—Transportation

Table B-1 of Appendix B to Subpart A of 10 CFR Part 51 states the following:

> 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.

The regulation in 10 CFR 51.53(c)(3)(ii)(J) requires all applicants 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 FirstEnergy Davis-Besse has no plans to add non-outage employees during the license renewal period, traffic volume and levels of service on roadways in the vicinity of Davis-Besse would not change. Therefore, there would be no transportation impacts during the license renewal term beyond those already being experienced.

As discussed in Section 4.9.2, FENOC indicated in their ER that steam generators would be replaced during the license renewal term in 2017, however steam generator replacement is now scheduled to be done during the 2014 refueling outage (FENOC 2010a). The additional number

of refueling outage workers and truck material deliveries needed to support the replacement of the steam generators would cause a short-term transportation impact on access roads in the immediate vicinity of Davis-Besse. The impacts to transportation from refurbishment activities are discussed in Chapter 3 of this SEIS, and have been determined to be SMALL.

4.11 Environmental Justice

As described in Section 1.4 of this SEIS, the NRC has approved a revision to its environmental protection regulation, 10 CFR Part 51. With respect to environmental justice concerns, the final rule amends Table B-1 in Appendix B, Subpart A, to 10 CFR Part 51 by adding a new Category 2 issue, “Minority and low-income populations,” to evaluate the impacts of continued operations and any refurbishment activities during the license renewal term on minority populations and low-income populations living in the vicinity of the plant. Environmental justice was listed in Table B-1 as a concern before this final rule, but it was not evaluated in the 1996 GEIS and, therefore, is addressed in each SEIS.

Under Executive Order (EO) 12898 (59 FR 7629), Federal agencies are responsible for identifying and addressing, as appropriate, 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), which states, “The Commission is committed to the general goals set forth in EO 12898, and strives to meet those goals as part of its NEPA review process.”

The Council of Environmental Quality (CEQ) provides the following information in Environmental Justice: Guidance Under the National Environmental Policy Act (CEQ 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 employed 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 employed 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 employed 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 Davis-Besse during the renewal term. In assessing the impacts, the following definitions of minority individuals and populations and low-income population were used (CEQ 1997):

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 P60, on Income and Poverty.

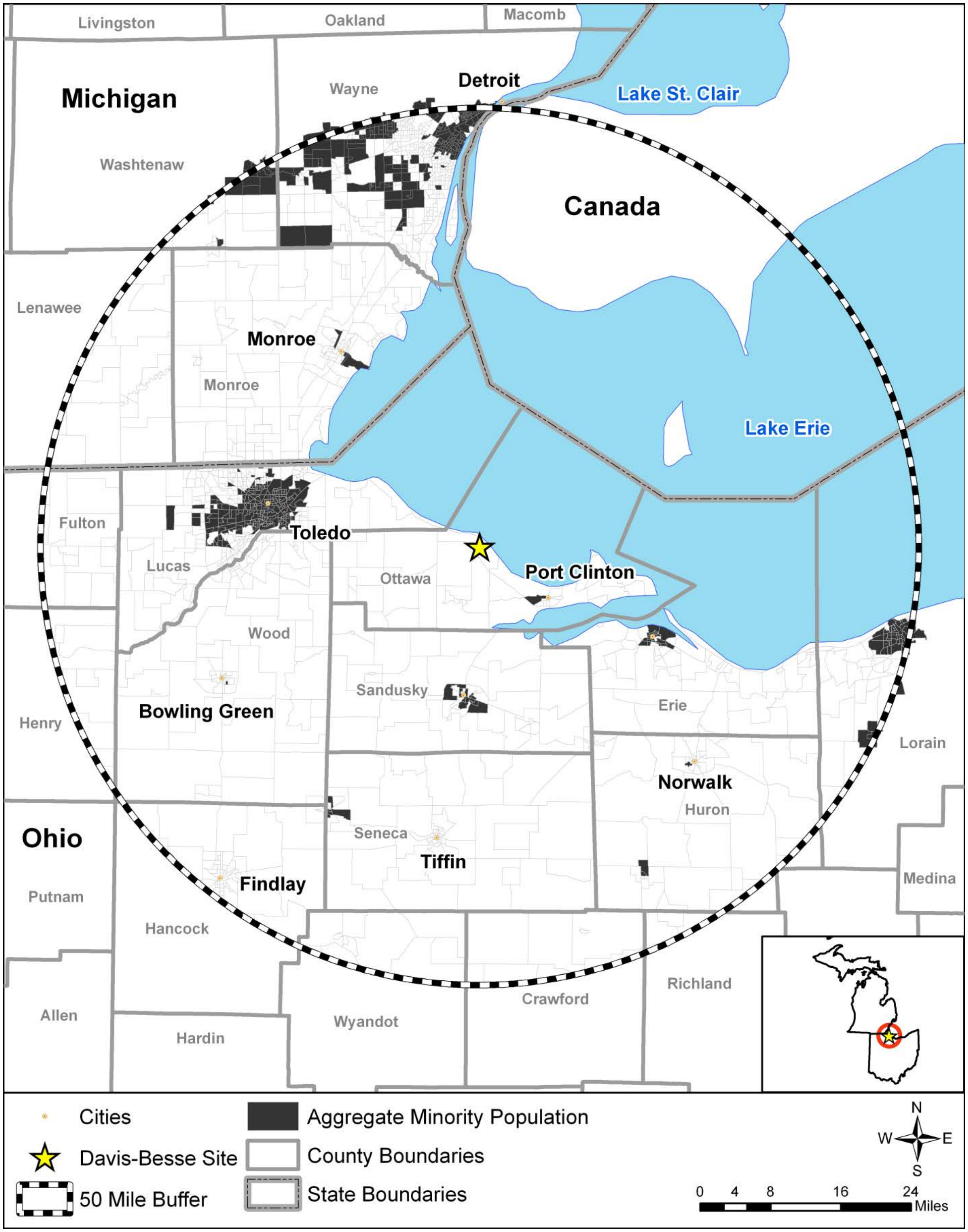
4.11.1 Minority Population

According to 2010 Census data, approximately 23 percent of the U.S. population (approximately 1,809,000 persons) residing within a 50-mi (80 km) radius of Davis-Besse identified themselves as minority individuals. The largest minority group was Black or African American (11.4 percent), followed by Hispanic or Latino (of any race) (7.0 percent) (CAPS 2012).

According to 2010 Census data, minority populations in the socioeconomic ROI (Lucas, Ottawa, Sandusky, and Wood) comprised 22.7 percent of the total four-county population (see Table 2–17). Persons identifying themselves as Black or African American comprised the largest minority race population at 13 percent of the combined total four-county population. Hispanic or Latinos comprised the next largest minority population at 5.9 percent (USCB 2012). Figure 4–1 shows minority block groups, using 2010 Census data for race and ethnicity, within 50-mi (80-km) radius of Davis-Besse that exceed 23 percent or more minority populations.

Census block groups were considered minority population block groups if the percentage of the minority population within any block group exceeded 23 percent (the percent of the minority population within the 50-mi radius of Davis-Besse). A minority population block group exists if the percentage of the minority population within the block group is meaningfully greater than the minority population percentage in the 50-mi (80-km) radius. Of the approximately 1,629 census block groups located within the 50-mi radius of Davis-Besse, 504 block groups were found to have minority race population percentages that exceeded 23 percent or more. Minority population block groups are concentrated primarily in the Toledo and Detroit metropolitan areas, with smaller concentrations in Fremont and Sandusky in Ohio. The minority population nearest to Davis-Besse is located in Oak Harbor, Ohio.

Figure 4–1. Census 2010 Minority Block Groups Within a 50-mi Radius of Davis-Besse



Source: USCB 2012

4.11.2 Low-Income Population

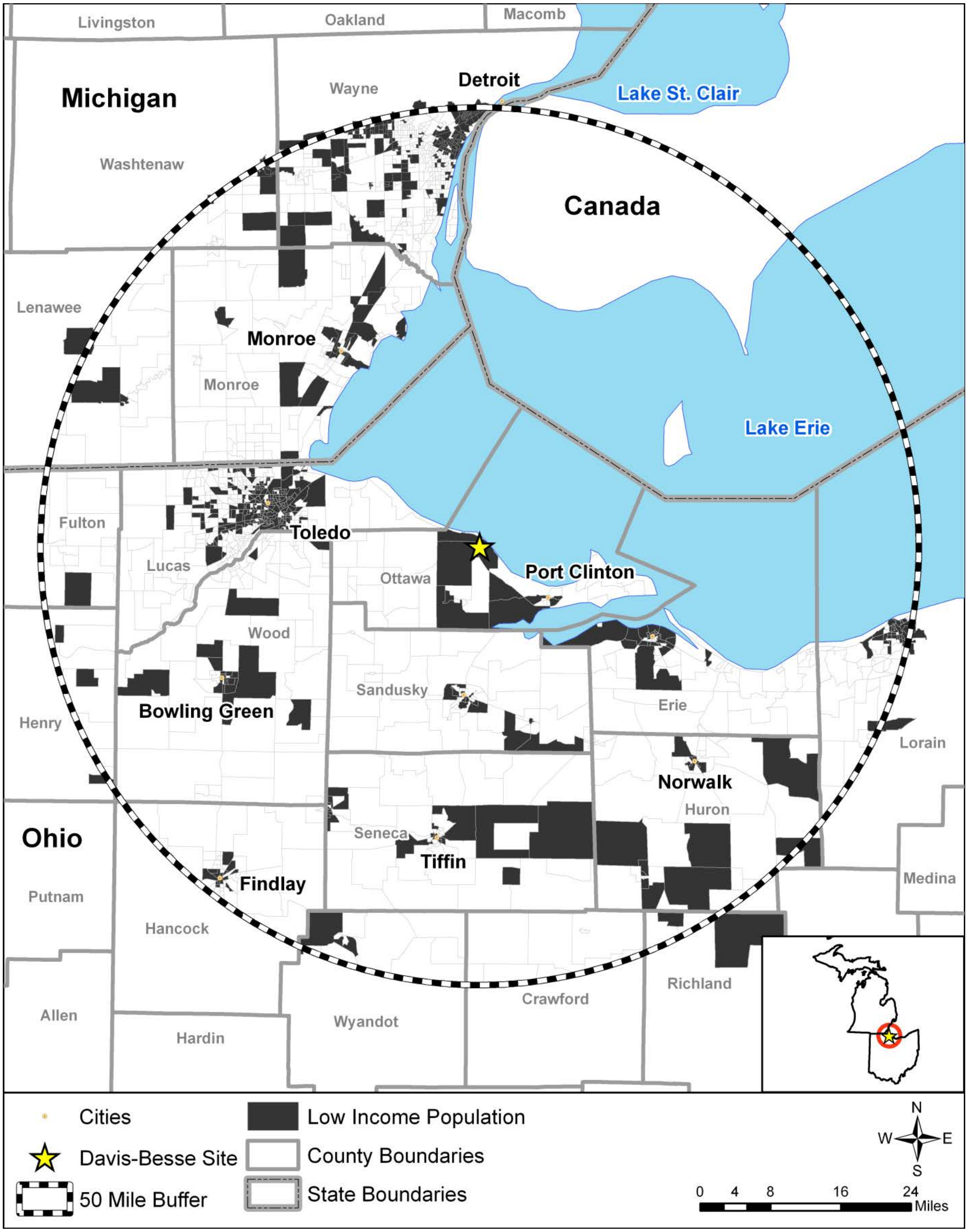
According to 2010 Census data, approximately 15.4 percent of the U.S. population residing within a 50-mi (80 km) radius of Davis-Besse were identified as living below the Federal poverty threshold in 2010. The 2010 Federal poverty threshold was $22,314 for a family of four (USCB 2012). According to 2010 American Community Survey 1-year estimates, 11.8 percent of families and 15.8 percent of individuals in Ohio were living below the Federal poverty threshold in 2010, and the median household income for Ohio was $45,090 (USCB 2012).

According to 2008-2010 American Community Survey 3-year estimates, Ottawa County had a higher median household income average ($51,712) and lower percentages of individuals (10 percent) and families (6.9 percent) living below the poverty level when compared to the state average. Conversely, Lucas County had the lowest median household income average ($40,017) and highest percentage of individuals (19.1 percent) and families (14.9 percent) living below the poverty level when compared to the other three counties. Sandusky County had a median household income of $46,024 with 11.6 percent of individuals and 7.9 percent of families living below the poverty level. Wood County had the highest median household income ($52,512) and the lowest percentage of families (7.3 percent) living below the poverty level amongst the four counties (USCB 2012).

Figure 4–2 shows low-income census block groups within a 50-mi (80 km) radius of Davis-Besse that exceeds 15.4 percent or more low-income populations. Census block groups were considered low-income population block groups if the percentage of individuals living below the Federal poverty threshold within any block group exceeded the percent of the individuals living below the Federal poverty threshold within the 50-mile radius of Davis-Besse. Approximately 582 of the 1,629 census block groups located within the 50-mile (80-kilometer) radius of Davis-Besse were determined to have meaningfully greater low-income populations.

Low-income population block groups appear evenly distributed throughout the 50-mi (80 km) radius including the block group that contains Davis-Besse. Similar to the locations of minority population block groups, the majority of low-income population block groups are located in the Toledo and Detroit metropolitan areas, with smaller concentrations in Fremont and Bowling Green, Ohio.

Figure 4–2. Census 2010 Low-Income Block Groups Within a 50-mi Radius of Davis-Besse



Source: USCB 2012

4.11.3 Analysis of Impacts

The NRC addresses environmental justice matters for license renewal through (1) identifying the location of minority and low-income populations that the continued operation of the nuclear power plant may affect during the license renewal term, (2) determining whether there would be any potential human health or environmental effects to these populations and special pathway receptors, and (3) determining if any of the effects may be disproportionately high and adverse. The discussion and figures above identifies the minority and low-income populations residing within a 50-mi (80-km) radius of Davis-Besse. This area of impact is consistent with the impact analysis for public and occupational health and safety, which also focuses on populations within a 50-mi (80-km) radius of the plant. As previously discussed for the other resource areas in Chapter 4, the analyses of impacts for all environmental resource areas indicated that the impact from license renewal would be SMALL.

Potential impacts to minority and low-income populations (including migrant workers or Native Americans) would mostly consist of socioeconomic and radiological effects; however radiation doses from continued operations associated with this license renewal are expected to continue at current levels, and would remain within regulatory limits. Socioeconomic impacts were likewise found to be SMALL. Chapter 5 of this SEIS discusses the environmental impacts from postulated accidents that might occur during the license renewal term, which include design basis accidents. The Commission has generically determined that impacts associated with such accidents are SMALL because the plant was designed to successfully withstand design basis accidents.

Therefore, based on this information and the analysis of human health and environmental impacts presented in Chapters 4 and 5, it is unlikely there would be any disproportionately high and adverse impacts to minority and low-income populations from the continued operation of Davis-Besse during the license renewal term.

4.11.4 Subsistence Consumption of Fish and Wildlife

As part of addressing environmental justice concerns associated with license renewal, the NRC also assessed the potential radiological risk to special population groups (such as minority and low-income populations, migrant workers, and Native Americans) from exposure to radioactive material received through their unique consumption and interaction with the environment. Patterns of exposure include subsistence consumption of fish, native vegetation, surface waters, sediments, and local produce; absorption of contaminants in sediments through the skin; and inhalation of airborne radioactive material released from the plant during routine operation. 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, such as migrant workers or Native Americans. This analysis is presented below.

Section 4-4 of Executive Order 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 or wildlife for subsistence and to communicate the risks of these consumption patterns to the public. In this SEIS, NRC considered whether there were any means for minority or low-income populations to be disproportionately affected by examining impacts to Native Americans, Hispanics, migrant workers, and other traditional lifestyle special pathway receptors. Special pathways that took into account the levels of contaminants in native vegetation, crops, soils and sediments, groundwater, surface water, fish, and game animals on or near Davis-Besse were considered.

The following is a summary discussion of the NRC's evaluation from Section 4.8.2 of the radiological environmental monitoring programs that assess the potential impacts for subsistence consumption of fish and wildlife near the Davis-Besse site.

FENOC has an ongoing comprehensive REMP at Davis-Besse to assess the impact of site operations on the environment. To assess the impact of the nuclear power station on the environment, samples of environmental media are collected and analyzed for radioactivity. Two types of samples are taken. The first type, control samples, is collected from areas that are beyond measurable influence of the nuclear plant. These samples are used as reference data. Normal background radiation levels, or radiation present due to causes other than nuclear power generation, can be compared to the environment surrounding the nuclear plant. Indicator samples are the second sample type obtained. These samples show how much radiation or radioactivity is contributed to the environment by the nuclear power plant. Indicator samples are taken from areas close to the station where any contribution will be at the highest concentration. An effect would be indicated if the radioactive material detected in an indicator sample was significantly larger than the background level or control sample.

Samples of environmental media are collected from the aquatic and terrestrial pathways in the vicinity of Davis-Besse. Over 2,000 radiological environmental samples were collected and analyzed in 2010. The aquatic pathways include groundwater, surface water, drinking water, fish, and shoreline sediment. The terrestrial pathways include airborne particulates, milk, food products (i.e., fruit apples and leafy vegetables such as kale and cabbage, are collected from gardens and farms in the vicinity of the Station), wild animal feed (i.e., edible portions of cattails), wild animal meat (i.e., waterfowl, deer, rabbits and muskrats), and leafy vegetation. During 2010, analyses performed on samples of environmental media showed no significant or measurable radiological impact above background levels from site operations (FENOC 2011).

Based on the radiological environmental monitoring data from Davis-Besse, the NRC finds that 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 water, local food, fish, and wildlife.

4.12 Offsite Land Use

Offsite land use during the license renewal term is a Category 2 issue (10 CFR Part 51, Subpart A, Appendix B, Table B-1). Table B-1 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 SMALL when there will be little new development and minimal changes to an area's land-use pattern. It is defined as MODERATE when there will be considerable new development and some changes to the land-use pattern, and it is defined as LARGE when there will be 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 the following:

- the size of the plant's tax payments relative to the community's total revenues,
- the nature of the community's existing land-use pattern, and

- 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 tax payments by the plant owner 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 not provided adequate public services to support and guide development.

4.12.1 Population-Related Impacts

Since FENOC has no plans to add non-outage employees during the license renewal period, there would be no plant operations-driven population increase in the vicinity of Davis-Besse. Therefore, there would be no additional population-related offsite land use impacts during the license renewal term beyond those already being experienced.

As discussed in Section 4.9.2, FENOC indicated in their ER that steam generators would be replaced during the license renewal term in 2017 (FENOC 2010a), however the steam generators will actually be replaced during the 2014 refueling outage. Due to the short amount of time needed to replace the steam generators, the additional number of refueling outage workers would not cause any permanent population-related land use changes in the immediate vicinity of Davis-Besse. These impacts are discussed in Chapter 3 of this SEIS.

4.12.2 Tax Revenue-Related Impacts

As discussed in Chapter 2, FENOC pays property taxes for Davis-Besse to Ottawa County, Carroll Township, the Benton-Carroll-Salem School District, and the Penta County Joint Vocational School. Since FENOC started making property tax payments to local jurisdictions, population levels and land use conditions in Ottawa County have declined; therefore, tax revenue has had not any effect on land use activities within the county. For the 5-year period from 2005 through 2009, property tax payments to Ottawa County contributed less than 10 percent of the total operating budget. Property tax payments to Carroll Township ranged from 11 to 28 percent of the operating budget, while payments to the Benton-Carroll-Salem School District averaged about 17 percent of the operating budget. Payments to the Penta County Joint Vocational School averaged 1.6 percent (FENOC 2010a).

Since FirstEnergy Davis-Besse has no plans to add non-outage employees during the license renewal period, employment levels at Davis-Besse would remain relatively unchanged. There would be no increase in the assessed value of Davis-Besse, and annual property tax payments would also remain relatively unchanged throughout the license renewal period. Based on this information, there would be no additional tax-revenue-related offsite land use impacts during the license renewal term beyond those already being experienced.

As discussed in Section 4.9.2, FENOC indicated in their ER that steam generators would be replaced during the license renewal term in 2017 (FENOC 2010a), however the steam generators will actually be replaced during the 2014 refueling outage. The replacement of the existing steam generators could increase the assessed value of Davis-Besse, and property tax

payments could increase. These and other tax-revenue related impacts associated with refurbishment are discussed in Chapter 3 of this SEIS. The NRC staff has determined there will be no noticeable effect on offsite land use.

4.13 Historic and Archaeological Resources

As listed in Table 4–12, historic and archaeological resources is a Category 2 issue, and therefore, the NRC staff is required to perform a site-specific review. The National Historic Preservation Act of 1966 (NHPA), as amended through 2000, requires Federal agencies to take into account the potential 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 include the following (ACHP 2008):

- association with significant events in history;
- association with the lives of persons significant in the past;
- embodiment of distinctive characteristics of type, period, and construction; and
- association with or potential to yield important information.

The historic preservation review process mandated by Section 106 of the NHPA is outlined in regulations issued by the Advisory Council on Historic Preservation (ACHP) in 36 CFR Part 800.

The issuance of a renewed operating license for a nuclear power plant is a Federal undertaking that could possibly affect either known or currently undiscovered historic properties located on or near the plant site and its associated transmission corridors. In accordance with the provisions of the NHPA, the NRC is required to make a reasonable effort to identify historic properties in the area of potential effect. If no historic properties are present or affected, the NRC is required to notify the State Historic Preservation Office (SHPO) before proceeding. If it is determined that historic properties are present, the NRC is required to assess and resolve possible adverse effects of the undertaking.

In accordance with 36 CFR 800.8(c), the NRC initiated Section 106 consultation with the ACHP and the Ohio SHPO in December 2010 by notifying them of the agency's intent to conduct a review of a request from FENOC to renew Davis-Besse's operating license (NRC 2010c, 2010d). Documentation for consultation with the ACHP and the Ohio SHPO is presented in Appendix D. As of the time of publication of this SEIS, the Ohio SHPO and ACHP have not responded to the NRC.

The NRC also initiated consultation with eight Federally recognized Native American tribes, notifying them of the proposed action and requesting comments and concerns (NRC 2010e). To date, one of the tribes, the Peoria Tribe of Indians of Oklahoma, has responded (Peoria Tribe of Indians of Oklahoma 2010). They indicated no objection to the undertaking, but asked to be contacted in the event skeletal remains were discovered within the area of potential effect. Documentation for tribal consultation is presented in Appendix D. As of the time of publication of this SEIS, the other seven tribes contacted have not responded to the NRC.

FENOC has not proposed any new facilities, service roads, or transmission lines to support continued operations at Davis-Besse. FENOC has formal guidelines in its *Environmental Procedure* (NOP-OP-2010 Revision 5) for protecting historic and archaeological resources and consulting with the SHPO prior to ground-disturbing activities. An additional procedure, FENOC *Environmental Best Management Practices* (NOBP-OP-2000 Revision 002) requires work to be stopped and consultation with the SHPO if any human remains or

archaeological, cultural, or historic resource is encountered. These guidelines are in place to ensure that any archaeological resources that may be present receive consideration and protection. On Davis-Besse lands leased to the FWS, the FWS personnel have procedures in place to stop work upon the discovery of a cultural resource, protect the area from further disturbance, and contact the FWS Cultural Resource Specialist in their Minnesota office. It is the responsibility of the Cultural Resource Specialist to contact the Ohio SHPO should cultural resources be encountered.

As noted in Section 2.2.10.2, the potential for any significant historic and archaeological resources in this area is low. However, since no formalized survey has been conducted of the entire property and portions of the area are undisturbed, the potential for additional resources to be present on the property and disturbed during normal operations remains. The only historic or cultural resource recorded on Davis-Besse property by the Ohio SHPO was listed as not eligible for the NRHP. The Refuge Site, 33-OT-25, is situated on a small peninsula of dry land in the marshy area of the southeast corner of the property. This is a historic site consisting of nails, glass mason jar fragments, and a kaolin pipe fragment that has been determined to be ineligible for listing in the National Register of Historic Places (NRHP). There are no historic properties located on Davis-Besse property.

Therefore, based on the NRC staff's review of Ohio SHPO files, review of FENOC's cultural resource management plan, and the potential for additional resources to be located on Davis-Besse property, NRC staff concludes that potential impacts from license renewal of Davis-Besse on historic and archaeological resources would be SMALL to MODERATE. There would be no adverse effect on historic properties per 36 CFR 800.4(d)(1).

4.14 Evaluation of New and Potentially Significant Information

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

In preparing to submit its application to renew the Davis-Besse operating license, FENOC developed a process to ensure that information not addressed in or available during the GEIS evaluation regarding the environmental impacts of license renewal for Davis-Besse would be properly reviewed before submitting the ER. It also ensured that such new and potentially significant information related to renewal of the operating license for Davis-Besse would be identified, reviewed, and assessed during the period of NRC review. FENOC reviewed the Category 1 issues that appear in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, to verify that the conclusions of the GEIS remained valid with respect to Davis-Besse. This review was performed by personnel from Davis-Besse and its support organization that were familiar with NEPA issues and the scientific disciplines involved in the preparation of a license renewal ER.

The NRC staff also has a process for identifying new and significant information. That process is described in detail in NUREG-1555, Supplement 1, *Standard Review Plans for Environmental Reviews for Nuclear Power Plants, Supplement 1: Operating License Renewal* (NRC 1999b, 2013c). The search for new information includes the following:

- review of an applicant's ER and the process for discovering and evaluating the significance of new information;
- review of records of public comments;

- review of environmental quality standards and regulations;
- coordination with Federal, State, and local environmental protection and resource agencies; and
- review of the technical literature.

New information discovered by the NRC staff is evaluated for significance using the criteria set forth in the GEIS. For Category 1 issues where new and significant information is identified, reconsideration of the conclusions for those issues is limited in scope to the assessment of the relevant new and significant information. The scope of the assessment does not include other facets of the issue that are not affected by the new information.

The NRC staff has not identified any new and significant information on environmental issues listed in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, related to the operation of Davis-Besse during the period of license renewal. The NRC staff also determined that information provided during the public comment period did not identify any new issues that require site-specific assessment. The NRC staff reviewed the discussion of environmental impacts in the GEIS (NRC 1996) and conducted its own independent review (including the public scoping meetings held in July 2008) to identify new and significant information.

4.15 Cumulative Impacts

> **Cumulative Impacts**, as defined by CEQ in §1508.7, are the impacts on the environment which result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

As described in Section 1.4 of this SEIS, the NRC has approved a revision to its environmental protection regulation, 10 CFR Part 51. With respect to cumulative impacts, the final rule amends Table B-1 in Appendix B, Subpart A, to 10 CFR Part 51 by adding a new Category 2 issue, “Cumulative impacts,” to evaluate the potential cumulative impacts of license renewal.

The NRC staff considered potential cumulative impacts in the environmental analysis of continued operation of Davis-Besse during the 20-year license renewal period. Cumulative impacts may result when the environmental effects associated with the proposed action are overlaid or added to temporary or permanent effects associated with other past, present, and reasonably foreseeable actions. Cumulative impacts can result from individually minor, but collectively significant, actions taking place over time. It is possible that an impact that may be SMALL by itself could result in a MODERATE or LARGE cumulative impact when considered in combination with the impacts of other actions on the affected resource. Likewise, if a resource is regionally declining or imperiled, even a SMALL individual impact could be important if it contributes to or accelerates the overall resource decline.

For the purposes of this cumulative analysis, past actions are those before the receipt of the LRA. Present actions are those related to the resources at the time of current operation of the power plant, and future actions are 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 reasonably foreseeable actions would occur is dependent on the type of action considered.

To evaluate cumulative impacts, the incremental impacts of the proposed action, as described in Sections 4.1 through 4.12, are combined with other past, present, and reasonably

foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such actions. The NRC staff used the information given in the ER (FENOC 2010a); responses to requests for additional information; information from other Federal, State, and local agencies; scoping comments; and information gathered during the visits to the Davis-Besse site to note other past, present, and reasonably foreseeable actions. To be considered in the cumulative analysis, the NRC staff determined if the project would occur within the geographic areas of interest and within the period of extended operation, if it was reasonably foreseeable, and if there would be potential overlapping effect with the proposed action. For past actions, consideration within the cumulative impacts assessment is resource- and project-specific. In general, the effects of past actions are included in the description of the affected environment in Chapter 2, which serves as the baseline for the cumulative impacts analysis. However, past actions that continue to have an overlapping effect on a resource potentially affected by the proposed action are considered in the cumulative analysis. Other actions and projects that were noted during this review and considered in the NRC staff's independent analysis of the potential cumulative effects are described in Table 4–13.

Table 4–13. Other Projects and Actions Considered in the Cumulative Analysis for Davis-Besse

Project/Action	Location	Status
Locust Point Firing Range; served as an anti-aircraft artillery range in support of the Erie Army Depot	Northeast of Davis-Besse, a portion of the site is within the eastern section of the Davis-Besse site	Closed in 1963; In 1996 & 2001, Davis-Besse personnel found ordnance rounds along the beach area near the mouth of the Toussaint River (FENOC 2010a)
Camp Perry Military Reservation; site is part of the Ohio National Guard	Between Davis-Besse & Port Clinton (6 mi southeast of Davis-Besse)	Operational (FENOC 2010a)
Lake Erie Industrial Park	Between Davis-Besse & Port Clinton (6 mi southeast of Davis-Besse)	Operational (FENOC 2010a)
Cleveland-Toledo-Detroit Passenger Rail Line; addition to regional transportation hub with rail lines connecting Cleveland, Buffalo, Toronto, Pittsburgh, Cincinnati, & Detroit	Rail line would run from Cleveland to Toledo, passing through Ottawa County	Proposed; schedule undetermined (MHR 2011)
FWS Private Lands Program	Northwestern Ohio	Ongoing; total of 6,898 acres on 801 sites across Ohio have been restored since program implementation (FWS 2011).
Energy projects		
Independent Spent Fuel Storage Installation on Davis-Besse site; dry spent-fuel storage	Davis-Besse site	3 NUHOMS 24P Canisters
Fremont Energy Center; 540 megawatts (MW) natural gas-fired combined-cycle electric generating plant, with a peaking capacity of 704 MW	Sandusky Township, Ohio (15 mi south of Davis-Besse)	In construction; operations projected to begin in mid-2012 (OPSB 2011a)
Bay Shore Plant; 648 MW of electricity produced from three coal-fired units, one petroleum coke-fired unit, & one oil-fired unit	Maumee Bay in Oregon, Ohio (16 mi northwest of Davis-Besse)	Operational (FEco 2007)
Toledo Refinery Substation Project; construction of a new 138/69 kV substation to provide additional electrical power & improved reliability to the BP-Husky Refinery	Oregon, Ohio, near the existing BP Refinery in an industrial area (19 mi west of Davis-Besse)	Proposed (OPSB 2011b)
Troy Energy Facility; 600 MW gas turbine peaking plant	Lemoyne Industrial Park, Troy Township, Ohio (20 mi southwest of Davis-Besse)	Operations began in 2002 (OPSB 2003)
J.R. Whiting Power Plant; 328 MW coal-fired plant	On Lake Erie in Luna Pier, MI (23 mi northeast of Davis-Besse)	Operational (CE 2011)
Detroit Edison Monroe Power Plant; 3,280 MW coal-fired plant	On Lake Erie in Monroe, MI (24 mi northeast of Davis-Besse)	Operational (DTE 2011a)
Fermi Nuclear Power Plant, Unit 1	Near Monroe, MI, on Lake Erie (27 mi northeast of Davis-Besse)	Not operational; proposed decommissioning & demolition of the plant (DTE 2011b)

Project/Action	Location	Status
Fermi Nuclear Power Plant Unit 2; 1,098 MW nuclear power plant	Near Monroe, MI, on Lake Erie (27 mi northeast of Davis-Besse)	Operational (DTE 2011b)
Fermi Nuclear Power Plant Unit 3; 1,535 MW proposed nuclear reactor	Near Monroe, MI, on Lake Erie (27 mi northeast of Davis-Besse)	Proposed; operations could begin as early as 2021 (DTE 2011b)
Independent spent fuel storage installation on Fermi site; dry spent-fuel storage	Near Monroe, MI, on Lake Erie (27 mi northeast of Davis-Besse)	Proposed (DTE 2011b)

4.15.1 Cumulative Impacts on Air Quality

The following analysis considers potential impacts through the end of the current license term as well as the 20-year renewal license term. In evaluating the potential impacts on air quality associated with license renewal, the NRC staff uses as its baseline the existing air quality conditions described in Section 2.2.2.1 of this SEIS. These baseline conditions encompass the existing air quality conditions (EPA's NAAQS county designations) potentially affected by air emissions from the continued operations and refurbishment activities. As described in Section 2.2.2.1, Ottawa County—where Davis-Besse is located—is designated in attainment for CO, Pb, NO_2, PM_{10}, $PM_{2.5}$ and is not designated for SO_2 (OEPA 2013). Lucas and Wood counties, abutting Ottawa County to the west, are designated as maintenance area for 8-hour ozone NAAQS. The nearest non-attainment area is Monroe County[1] in Michigan, for $PM_{2.5}$ NAAQS, which is northwest of Ottawa County.

Currently, Davis-Besse is operating under one air permit for an auxiliary boiler but exempt for emergency generators. Davis-Besse is applying for a "synthetic minor" permit to OEPA, which covers the sitewide emission sources. Davis-Besse operations comply with its air pollution control permit application, and FENOC has no plans that would change this practice for the license renewal term (FENOC 2010). Annual emissions of criteria pollutants, volatile organic compounds (VOCs), and hazardous air pollutants (HAPs) at Davis-Besse vary from year to year but are well below the threshold for a major source (see Table 2.2-1). Accordingly, air emissions from continued operation of the plant and associated impacts on ambient air quality would not be expected to change during the license renewal period. Considering the location of nearby non-attainment and maintenance areas and the prevailing southwesterly wind direction in the area, these emissions are not anticipated to deteriorate the current nonattainment and maintenance status. Minor and short-duration air quality impacts can be expected to occur during the steam generator replacement project activities. The main contributors to air quality impacts associated with completed and ongoing refurbishment activities would be fugitive dust generation from facility construction activities, refurbishment work to open the shield building and containment vessel to replace the steam generators and related equipment, and exhaust emissions from motorized equipment and vehicles of temporary workers.

Combustion-related greenhouse gas (GHG) emissions (such as CO_2, CH_4, and N_2O) at Davis-Besse are minor, given the nature of a nuclear facility that is not burning fossil fuels to generate electricity. As discussed in Section 2.2.2.1, GHG stationary emission sources at the

[1] Michigan Department of Environmental Quality finds that, based in part on air quality monitoring data collected in the 2007 through 2010 period, all its counties are currently in compliance with the $PM_{2.5}$ standards and has drafted a letter to the U.S. EPA requesting that it make a determination that Southeast Michigan is in attainment with the $PM_{2.5}$ NAAQS (see http://www.michigan.gov/documents/deq/deq-aqd-draft-SE-redesignation_pm2.5v9_350980_7.pdf).

station include primarily auxiliary boilers, small and large emergency diesel generators, and miscellaneous diesel-powered equipment. These combustion sources are designed for efficiency and operated using good combustion practices on a limited basis throughout the year (i.e., often only for testing). Other combustion-related GHG emission sources at Davis-Besse include commuter, visitor, support, and delivery vehicle traffic within, to, and from the plant. In addition, small amounts of HFCs, PFCs, and sulfur hexafluoride (SF_6) might be released into the atmosphere during normal operations or at various stages of the equipment's life cycle.

In April 2012, EPA published the official U.S. inventory of GHG emissions, which finds and quantifies the primary anthropogenic sources and sinks of GHGs. EPA reported that, in 2010, the total amount of carbon dioxide equivalent[2] (CO_2e) emissions related to electricity generation was 2,277.3 teragrams (2,277.3 MMT) (EPA 2012). The EIA reported that, in 2010, electricity production in Ohio was responsible for 121 teragrams of CO_2 emissions (121 MMT CO_2e) (EIA 2012). The NRC staff estimates that annual carbon dioxide equivalent emissions from operation at Davis-Besse amount to 4,693 MT/year.

Changes in climate, as discussed in Section 2.2.2, can impact air quality as a result of the changes in meteorological conditions. The formation, transport, dispersion, and deposition of air pollutants are sensitive to winds, temperature, humidity, and precipitation. Sunshine, high temperatures, concentration of precursors, and air stagnation are favorable meteorological conditions to higher levels of ozone (USGCRP 2014). The emission of ozone precursors (nitrogen oxides and volatile organic compounds) also depends on temperature, wind, and solar radiation (IPCC 2007). The combination of higher temperatures, stagnant air masses, sunlight, and emissions of precursors may make it difficult to meet ozone National Ambient Air Quality Standards (USGCRP 2009, 2014). Regional air quality modeling indicates that the northern regions of the United States can experience a decrease in ozone concentration by the year 2050 (Tagaris 2009). However, air quality projections (particularly ozone) are uncertain, complex, and indicate that concentrations are driven primarily by emissions rather than by physical climate change (IPCC 2013; USGCRP 2014).

In Ohio, Senate Bill 221, Alternative Energy Portfolio Standard (AEPS) and Energy Efficiency Portfolio Standard (EEPS)—which establishes annual benchmarks for renewable energy and energy efficiency—was signed into law on May 1, 2008 (Ohio Department of Development 2011). SB 221 requires Ohio investor-owned utilities to meet both AEPS and EEPS by 2025. The AEPS includes requirements for renewable energy sources to supply 12.5 percent of electricity demand, and the EEPS will achieve a cumulative, annual energy savings in excess of 22 percent. Ohio's renewable energy standard requires at least 6,000 MW of new wind and solar capacity. Solar photovoltaics, of about 450 to 800 MW, will be deployed or delivered to the State due to the 0.5 percent solar requirement.

Based on all of the above information, the NRC staff concludes that combined with the emissions from other past, present, and reasonably foreseeable future actions, cumulative impacts of criteria and hazardous air pollutants on ambient air quality from operations at Davis-Besse would be SMALL.

[2] Carbon dioxide equivalent (CO_2e) is a measure used to compare the emissions from various GHGs on the basis on their global warming potential (GWP), defined as the cumulative radiative forcing effects of a gas over a specified time horizon resulting from the emission of a unit mass of gas relative to a reference gas, CO_2. The CO_2e for a gas is derived by multiplying the mass of the gas by the associated GWP. For example, the GWP for CH_4 is estimated to be 21; thus, one ton of CH_4 emission is equivalent to 21 tons of CO_2 emissions.

4.15.2 Cumulative Impacts on Water Resources

This section addresses the direct and indirect effects of license renewal on water resources when added to the aggregate effects of other past, present, and reasonably foreseeable future actions. Water availability and water quality are both considered. The geographic area considered in this analysis is defined for groundwater as an area within a 3-mi (5-km) radius of the site, groundwater impacts to tributaries for impacts to Lake Erie, and, for surface water, as Lake Erie in its entirety.

4.15.2.1 Groundwater

As discussed in Section 2.2.2, climate models project an increase in precipitation intensity in winter and spring, with more frequent heavy downpours. The increased intensity of storms will likely cause faster runoff rates and a reduction in overall recharge of groundwater and aquifers. Soil moisture changes as a result of increased temperatures, and greater evaporation will further impact the recharge of groundwater aquifers. As documented in the Lake Erie Lakewide Management Plan (LAMP) the reduction in groundwater recharge due to the increase of spring runoff has resulted in a reduction in summer groundwater base flows. In addition, the continued human use and consumption of groundwater resources reduced water tables and consequently reduced spring water flow to rivers and streams that feed into Lake Erie (EPA 2008).

Although Davis-Besse has not withdrawn groundwater since construction-phase dewatering, 60 percent of all Ottawa County residents rely on groundwater (Graham et al., 1997). As a result, NRC staff concludes that the impact to groundwater quantity is MODERATE due to the noticeable cumulative impacts due to urbanization and climate change. The direct and indirect impacts from continued operation of Davis-Besse however would be SMALL.

Groundwater quality in the vicinity of the site may be affected by point source pollution, such as industries or septic tanks, and non-point source pollution, such as agricultural chemical usage and lawn chemicals (Graham et al. 1997). In a study summarized by Graham et al. (1997), nitrate-nitrogen (a common agricultural chemical) results from a county-wide Groundwater Sampling Program were found to be below the safe drinking water standard of 10 ppm. As described in Section 2.2.5, groundwater at Davis-Besse has been shown to have tritium elevated above background but well below the drinking water standard. Petroleum products have been released on site but are not believed to have traveled offsite, and they have undergone partial remediation. Other operational or planned projects or industries, such as those in Table 4–13, could affect groundwater quality but likely would not result in significant, widespread groundwater impacts, especially within several miles of Davis-Besse.

The NRC staff concludes that the cumulative impacts on groundwater quality from the proposed license renewal and other past, present, and reasonably foreseeable projects would be SMALL. The direct and indirect impacts from continued operation of Davis-Besse on groundwater quality would also be SMALL.

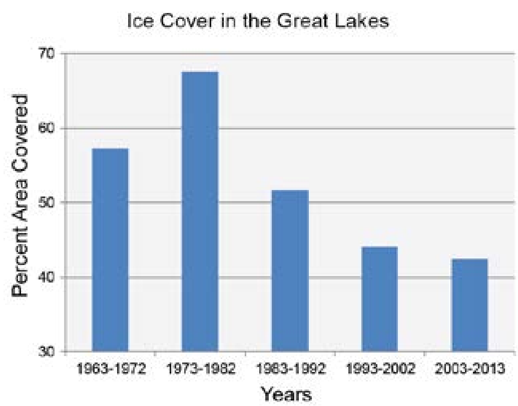
4.15.2.2 Surface Water

The water of Lake Erie is a valuable resource both in the relatively shallow western basin adjacent to Davis-Besse and across the entire lake. Public supply systems in Ottawa County relying on surface water (mainly from Lake Erie) withdraw an average of 3,447,000 gallons per day (Graham et al. 1997). The intake for Toledo, OH, is 12 mi west of Davis-Besse; average withdrawal is 77,800,000 gallons per day (FENOC 2010d). In total, U.S. and Canadian annual Lake Erie water use was over 56,543 million gallons per day (mgd) in 2004, with 54,723 mgd as power plant withdrawals and 1,106 mgd as public-supply withdrawals (GLC 2006). In 2004, the total consumptive use was 485 mgd (GLC 2006). Active or proposed projects, such as those listed in Table 4–13, have the potential to consume large amounts of lake water, especially for

cooling systems at power plants. In addition to the projects listed, other industries relying on Lake Erie water will be operating in the U.S. and Canada during the license renewal term.

Climate change has the potential to affect water resources available for cooling systems and surface water availability in general for other users. As discussed in Section 2.2.2, climate models project that regional climatic changes during the license renewal period include an increase in average temperature. Precipitation is expected to increase in the winter and spring, with more intense rainstorms year-round. The average lake level of Lake Erie could decrease by 7.8 to 9.8 in. (20 to 25 cm) compared to the current long term mean by 2050 (Mackey 2012; USGCRP 2014). As discussed in 2.1.7.1, Davis-Besse's intake is about 14 ft (4.3 m) below the lake surface, so plant operations should be unaffected if lake levels fall as predicted. However, warmer lake water would result in increased cooling water use by power plants. Model projections indicate that water surface temperatures will increase by 2.7 to 7.0 °F (1.5 to 3.9 °C) by 2050 (Mackey 2012; USGCRP 2014). The impact from climate change could be measureable in Lake Erie, and these changes are potentially significant (Figure 4–3).

Figure 4–3. Observed Changes in Great Lakes Ice Cover 1963–2013



Source: USGCRP 2014

Point and non-point sources of pollution have affected the water quality of the western basin of Lake Erie. Ottawa County rivers and creeks, including the Toussaint River, are affected by non-point source contamination (Graham et al. 1997). Sources include channelization, sanitary landfills, urbanization, silviculture, livestock, and agricultural production. These rivers and creeks are tributaries to Lake Erie. Similar issues have the potential to affect water quality from numerous other Lake Erie tributaries located in Ohio, Pennsylvania, New York, and Ontario. The two main water quality concerns in Lake Erie are increased phosphorus loading, which can cause toxic algal blooms, and elevated concentrations of the bioaccumulative contaminants dioxin, polychlorinated biphenyls (PCBs), and mercury (Brannan 2009; Hartig et al. 2007). In the ER (FENOC 2010a), over 200 facilities were identified that have an NPDES permit to discharge in the four-county (Ottawa, Lucas, Wood, Sandusky) area closest to Davis-Besse. These discharges are generally made to Lake Erie or its tributaries. Numerous other dischargers are present in the Lake Erie watershed in the U.S. and Canada.

The EPA's Great Lakes National Program Office has initiated the Great Lakes Restoration Initiative (EPA 2011e), a consortium of 11 Federal agencies that developed an action plan to address environmental issues. These issues fall into five areas—cleaning up toxics and areas of concern, combating invasive species, promoting nearshore health by protecting watersheds from polluted runoff, restoring wetlands and other habitats, and tracking progress and working

with strategic partners. This long-term initiative includes the water quality concerns of Lake Erie.

Climate change, discussed above, could affect surface water quality in the region (USGCRP 2014). Increased frequency and intensity of heavy downpours could increase erosion and sediment loads in tributaries of Lake Erie. Lower lake levels could magnify factors such as sediment loading, phosphorous loading, and bioaccumulative contaminants (USGCRP 2014). The thermal plume from power plant cooling systems would increase, and a reduced lake volume would result in a larger thermal mixing zone. Warmer average lake water temperature would result in increased water usage for cooling systems, further increasing the thermal plumes. These changes are potentially significant.

The NRC staff concludes that cumulative impacts on surface water resources in the geographic area of interest from the proposed license renewal and other past, present, and reasonably foreseeable actions would be SMALL to MODERATE. However, the overall direct and indirect impacts from the proposed license renewal would be SMALL and would not noticeably alter onsite or adjacent water bodies, including Lake Erie.

4.15.3 Cumulative Impacts on Aquatic Resources

This section addresses the direct and indirect effects of license renewal on aquatic resources when added to the aggregate effects of other past, present, and reasonably foreseeable future actions. The geographic area considered in the cumulative aquatic resources analysis includes the western basin of Lake Erie, along which the Davis-Besse site is located.

Consistent with other agencies' and CEQ's (1997) NEPA guidance, the term "baseline" pertains to the condition of the resource without the action (i.e., under the no-action alternative). Under the no-action alternative, the plant would shutdown, and the resource would conceptually return to its condition without the plant (which is not necessarily the same as the condition before the plant was constructed). The baseline, or benchmark, for assessing cumulative impacts on aquatic resources takes into account the pre-operational environment as recommended by the EPA (1999) for its review of NEPA documents:

> Designating existing environmental conditions as benchmark may focus the environmental impact assessment too narrowly, overlooking cumulative impacts of past and present actions or limiting assessment to the proposed action and future actions. For example, if the current environmental condition were to serve as the condition for assessing the impacts of relicensing a dam, the analysis would only identify the marginal environmental changes between the continued operation of the dam and the existing degraded state of the environment. In this hypothetical case, the affected environment has been seriously degraded for more than 50 years with accompanying declines in flows, reductions in fish stocks, habitat loss, and disruption of hydrologic functions. If the assessment took into account the full extent of continued impacts, the significance of the continued operation would more accurately express the state of the environment and thereby better predict the consequences of relicensing the dam.

The geographic area considered in the cumulative aquatic resources analysis includes the western basis of Lake Erie, along which the Davis-Besse site is located.

Sections 2.2.5 and 2.2.7 present an overview of the condition of Lake Erie near Davis-Besse and the history and factors that led to its current condition.

<u>Invasive Species</u>. Invasive species have caused dramatic shifts in fish populations in the lake and have resulted in the extirpation of many species (see Section 2.2.5). Invasive species have irreversibly altered the Lake Erie ecosystem and will continue to affect Lake Erie fish and

invertebrate populations in the foreseeable future. Ballast water releases have introduced about 30 percent of the invasive species in the Great Lakes today (EPA 2011e). The U.S. Coast Guard is in the process of developing ballast water discharge standards, which would limit the introduction of additional exotic species in the future. However, the existing exotic species in the Lake Erie system will continue to affect the ecosystem balance in the future. Zebra mussels (*Dreissena polymorpha*) and quagga mussels (*D. rostriformis bugensis*) outcompete native species. These mussels clog the intake pipes and cooling systems of power plants and make efforts to recover native mussel and clam populations difficult. The sea lamprey is attributed to the collapse of lake trout (*Salvelinus namaycush*), whitefish (*Coregonus clupeaformis*), and chub (*Couesius plumbeus*) populations, which has negatively affected the fishing economy (GLFC 2000). The Lake Erie LAMP (EPA 2008) includes management objectives and measures to reduce the impact of current invasive species on the lake's ecosystem and prevent new exotic species from entering the lake.

<u>Fishing</u>. Fishing has been a major influence on commercially and recreationally sought fish species within Lake Erie. The ODNR manages the fishing of the 19 harvested fish species in the lake, which are discussed in Section 2.2.5. Many native fish species have suffered population declines due to invasive species. The most acute declines have been those of the lake trout, whitefish, and chub beginning in the 1940s and 1950s (GLFC 2000). The walleye population recovered considerably in the 1980s but has since declined. Continued fishing of these and other fish will slow the recovery of those species in decline.

<u>Energy Development</u>. Many energy-producing facilities are located near Davis-Besse (see Table 4–13) that affect aquatic resources. Fermi Nuclear Power Plant, the Bay Shore Plant, J.R. Whiting Power Plant, and the Detroit Edison Monroe Power Plant all use Lake Erie as a source of cooling water. Though each plant's impact on aquatic populations for impingement, entrainment, and thermal discharge is individually small, the cumulative impact may result in disproportionate loss of nearshore species and those species with pelagic (buoyant) eggs, which are more likely to be swept into the intake. Proposed energy-producing facilities—such as the proposed new unit at Fermi Nuclear Power Plant, Fremont Energy Center, and others listed in Table 4–13—will likely increase this cumulative impact.

<u>Urbanization and Shoreline Development</u>. About one-third of the Great Lakes population (11.6 million people) lives within the Lake Erie watershed (EPA 2008). Given that Lake Erie is also the smallest Great Lake, it has experienced the most dramatic effects from urbanization and shoreline development. Lake Erie was the first Great Lake to experience massive algal blooms and depleted oxygen levels characteristic of a eutrophic environment. Beginning in the 1950s, phosphorus and oxygen levels from developed and agricultural runoff became a major concern in the lake. In the 1970s, industrialization and chemical production became another stressor to the lake and resulted in an additional source of contaminants. Phosphorus levels decreased in the 1980s due to various control measures and monitoring but began to increase again in the 1990s (EPA 2008). Filling of Lake Erie's wetland and marshes (discussed in Section 4.11.2) exacerbated the lake's nutrient imbalances. Today, many programs and initiatives, including the Great Lakes Water Quality Agreement, are helping to restore the integrity of the lake, but Lake Erie continues to be significantly altered by past changes in land use and continued urban development.

<u>Climate Change</u>. The potential cumulative effects of climate change on Lake Erie could result in a variety of changes that would affect aquatic resources. The U.S. Global Change Research Program (USGCRP) (2009, 2014) identified higher temperatures as a major concern for the Great Lakes. Model projections predict that water surface temperatures by 2050 will increase by 2.7 to 7.0 °F (1.5 to 3.9 °C). Higher temperatures, increases in precipitation, and lengthened growing seasons favor production of blue-green and toxic algae that can harm fish, water

quality, habitats, and could heighten the impact of invasive species already present (Mackey 2012; USGCRP 2014). For instance, warmer lakes will provide a habitat for warm water fish species as the habitat for coldwater fish shrinks. Higher water temperatures result in greater evaporation, and a reduced amount of lake ice would form in the winter, exacerbating the evaporation (USGCRP 2009). By 2050, water levels may be 7.8 to 9.8 in. (20 to 25 cm) lower than the current long-term mean (Mackey 2012; USGCRP 2014). Lower water levels could ultimately contribute to loss of species; loss of habitat, especially nearshore spawning areas; and increased concentrations of contaminants (USGCRP 2009, 2014). However, projected lake levels for the Great Lakes are uncertain and variable. Furthermore, higher temperatures and increased precipitation intensity also increase erosion and agricultural runoff, which can result in increased phosphorus and nitrogen loading that can prolong harmful occurrences of low oxygen levels in Lake Erie.

Conclusion. The NRC staff examined the cumulative effects of historical conditions of Lake Erie's western basin and the impacts from invasive species, fishing, energy development, urbanization and shoreline development, and climate change. While the aquatic impacts associated with the continued operation of Davis-Besse are SMALL, the NRC staff believes that the factors discussed in this section—especially invasive species and urban development—have led to LARGE cumulative impacts to Lake Erie aquatic resources.

4.15.4 Cumulative Impacts on Terrestrial Resources

This section addresses the direct and indirect effects of license renewal on terrestrial resources when added to the aggregate effects of other past, present, and reasonably foreseeable future actions. The geographic area considered in this analysis is the Davis-Besse site and in-scope transmission line corridors.

Section 2.2.6 presents an overview of the current condition of the Davis-Besse site and in-scope transmission line corridors and the history and factors that led to its current condition. At present, the area is predominantly wetlands, much of which is managed by the FWS as part of the Ottawa National Wildlife Refuge. The 733 ac (297 ha) leased to the FWS connect other marsh areas within the Ottawa National Wildlife Refuge network and serve as vital habitat for migrating bird species and wetland-dependent wildlife.

Historical Conditions. Historically, the Great Black Swamp in northwestern Ohio covered an area about the size of the State of Connecticut. The USGS (1999) estimates that wetland drainage of Lake Erie marshes likely began in 1836, and Ohio's swamp forests were heavily logged for a mix of birch, ash, elm, oak, cottonwood, poplar, maple, basswood, and hickory. Settlers also cleared many of the forests and filled in wetlands to create land for building houses and cultivating crops (UT, undated). To fill in the wetlands, series of ditches were dug to drain the land, which caused a drastic reduction in wetland-dependent species' populations.

Protected Species. Sections 2.2.8 and 4.7 discuss protected species. Many protected species occur on the Davis-Besse site including many species of migratory birds and six species of Ohio-listed plants. Additionally, the Davis-Besse site and transmission line corridors have the potential to provide habitat for four Federally listed species (see Section 4.7), as well as other State-listed amphibians, reptiles, insects, and mammals. The Davis-Besse site and transmission line corridors, as well as the network of wetlands within the Ottawa National Wildlife Refuge, will continue to provide habitat for protected species. However, other factors discussed in this section—such as invasive species, habitat fragmentation, and climate change—may reduce the population sizes of some protected species and force species to compete for more limited resources in the future.

Invasive Species. Invasive species are non-native species that thrive outside of their natural range due to favorable environmental conditions and a lack of natural predators or other environmental controls. Invasive species are able to colonize and rapidly spread, threatening the success of native species populations in the process. The invasive purple loosestrife (*Lythrum salicaria*), reed canary grass (*Phalaris arundinacea*), common reed (*Phragmites australis*), and flowering rush (*Butomus umbellatus*) occur on the Davis-Besse site. Additionally, many non-native insect and other wildlife species occur in the region. As discussed in Section 2.2.6, the FWS maintains portions of the Ottawa National Wildlife Refuge, including Navarre Marsh on the Davis-Besse site, for invasive plant species through a variety of methods. Continued efforts to control these species will help to protect native species populations in the future. However, the high number of invasive plant and pest species in Ohio—138 and 21, respectively (EFETAC 2011)—means that some invasive species that are not currently in the Davis-Besse region will likely spread to this area in the future.

Energy Development. Table 4–13 summarizes many energy development projects that are in operation now as well as those that are planned for future operation including, coal-fired plants, gas-fired plants, and one nuclear facility (Fermi Nuclear Power Plant). Coal-fired plants are a major source of air pollution in the U.S. because they release sulfur dioxide, nitrogen oxides, mercury, carbon dioxide, and particulates. Nitrous oxides and sulfur dioxides combine with water to form acid rain, which can lead to erosion and changes in soil pH levels. Mercury deposits onto soil and surface water, which may then be taken up by terrestrial and aquatic plant or animal species and poses the risk of bioaccumulation. Gas-fired plants also emit nitrogen oxides and carbon dioxide but at a lower rate than coal-fired plants. Gas-fired plants can also emit methane, a GHG, if the natural gas is not burned completely. Impacts on the terrestrial environment from Fermi Nuclear Power Plant can be expected to be similar to those from Davis-Besse, as discussed in Section 4.6.

Urbanization and Habitat Fragmentation. As the region surrounding Davis-Besse becomes more developed, habitat fragmentation will increase. Species that require larger ranges, especially predators, will likely suffer reductions in their populations. In contrast, herbivores will experience less predation pressure, and their populations are likely to increase. Edge species will likely benefit from the fragmentation, while species that require interior forest or swamp habitat will likely suffer. The transmission line corridors established for Davis-Besse's transmission lines represent habitat fragmentation, though many of these corridors pass through cultivated land that has already been converted from its native habitat. Habitat fragmentation of surrounding areas may increase the value of the network of wetlands within the Ottawa National Wildlife Refuge, part of which is on the Davis-Besse site, because this land will not experience fragmentation or other human-induced impacts.

Habitat Restoration. The FWS has worked to convert a total of 6,898 ac on 801 sites across northwestern Ohio to native wetlands through the FWS Private Lands Program (FWS 2011). As part of this effort, the FWS is in the process of acquiring an 800-ac parcel of farmland through a fee title adjacent to Metzger Marsh in Lucas County (GLRC 2009). The U.S. Army Corps of Engineers is developing a program to convert and restore 200 ac of Lake Erie coastal wetland habitat along Maumee Bay near Toledo (GLRC 2009). The U.S. Army Corps of Engineer's Great Lakes Habitat Restoration Database lists 32 other restoration or habitat enhancement projects within the Great Lakes region of Ohio. The cumulative effect of these programs will strengthen the overall integrity of terrestrial habitats and provide connectivity between habitat areas.

Climate Change. As described in Section 2.2.2, the Midwest will likely experience rising temperatures and heavier precipitation events during the proposed license renewal period. As the climate changes, terrestrial resources will need to be able to tolerate the new physical

conditions or shift their population range to new areas with a more suitable climate. Some species may readily adapt to a changing climate, while others may be more prone to experience adverse effects. Species that are most vulnerable to climate change are those that have specific habitat requirements, occur in isolated habitats, and have low reproductive rates (USGCRP 2014). For many Midwest species, including those near the Great Lakes, migration to changed habitats is projected to be slow because of fragmented habitats, flat topography, and high latitudes (USGCRP 2014). Habitat ranges for forest systems in the Midwest—such as paper birch, balsam fir, black spruce—are projected to decline across the area as they shift northward, and species that are common farther south—such as oaks and pines—will expand their range north into the Midwest region (USGCRP 2014). Changing climate conditions will also allow invasive species, especially pest insects that are now controlled by harsh winters, to become more successful colonizers and grow into larger populations (USGCRP 2009). As cited by USGCRP, the loss of moisture from soils because of higher temperatures along with evapotranspiration from vegetation is likely to increase the frequency, duration, and intensity of droughts across the region into the future.

Drought conditions will likely lead to a reduced area of wetland habitat. Given the high value of wetlands in the Davis-Besse region for dozens of migrating bird species, the reduction in wetland habitat could negatively affect certain migrating bird species populations as they compete with one another for limited resources within a reduced area of land. Changing climate conditions will also cause many native wildlife species to shift their ranges and allow invasive species, especially pest insects that are now controlled by harsh winters, to become more successful colonizers and grow into larger populations (USGCRP 2009).

Conclusion. As stated in Section 4.7.1, the NRC staff concluded that the impacts associated with the Davis-Besse license renewal are SMALL. However, the NRC staff examined the cumulative effects of historical conditions at the Davis-Besse site, protected species, invasive species, urbanization and habitat fragmentation, and climate change. The NRC staff believes that the cumulative impact of the historical draining of wetlands and loss of forested swamps—when added to present conditions and future impacts from urban development, habitat fragmentation, and climate change—will result in loss of habitat and a decline in species diversity of MODERATE impact to the terrestrial environment.

4.15.5 Cumulative Human Health Impacts

4.15.5.1 Radiological

The NRC and EPA established radiological dose limits for protection of the public and workers from both acute and long-term exposure to radiation and radioactive materials. As discussed in Section 4.8.1, the doses resulting from operation of Davis-Besse are below regulatory limits, and the impacts of these exposures would be SMALL. For the purposes of this analysis, the geographical area considered is the area included within an 50 mi (80 km) radius of the Davis-Besse site.

EPA regulations in 40 CFR Part 190 limit the annual cumulative radiation dose to members of the public from all sources in the nuclear fuel cycle, including nuclear power plants, fuel fabrication facilities, waste disposal facilities, and transportation of fuel and waste to 25 mrem (0.25 mSv). The NRC staff's review of radioactive releases from Davis-Besse shows that the annual radiation dose to the public has been less than 1.0 mrem (0.01 mSv). This dose is well within the NRC's and EPA's radiation protection standards. In addition, as discussed in Section 4.8.1, Davis-Besse conducts an REMP around its site. The program measures radiation and radioactive materials in the environment from Davis-Besse and all other sources (i.e., other nuclear power plants as well as other licensed users of radioactive material).

Therefore, the REMP would monitor any cumulative impacts. As discussed in Section 4.8.1, the NRC staff reviewed the historical radiological environmental monitoring results for Davis-Besse and found no significant environmental impact associated with the operation of the plant.

Davis-Besse operates an independent spent fuel storage installation (ISFSI) on the plant site. There is currently one other uranium fuel cycle facility within a 50-mi (80 km) radius of Davis-Besse that can contribute to the cumulative radiological impacts. The Fermi Nuclear Power Plant, Units 1 and 2, are located near Monroe, MI, on Lake Erie, approximately 27 mi northeast of Davis-Besse. Fermi Nuclear Power Plant, Unit 1, is non-operational and undergoing decommissioning. Fermi Nuclear Power Plant, Unit 2, is a 1,098 MW operating nuclear power plant, licensed by the NRC. Proposed projects on the Fermi plant site include the construction and operation of a 1,535 MW nuclear power plant (Fermi Nuclear Power Plant, Unit 3) and an ISFSI for dry storage of spent nuclear fuel.

The currently-operating facilities and proposed new nuclear facilities at the Fermi plant site would contribute to the cumulative radiological impacts in the vicinity of the Davis-Besse site. However, as discussed above, the cumulative radiological impacts from all uranium fuel cycle facilities in proximity to each other are limited to the radiation protection standards in 10 CFR Part 20 and 40 CFR Part 190.

Based on the NRC staff's review of Davis-Besse's radioactive effluent and environmental monitoring data, the information on the refurbishment of the reactor vessel head, the proposed steam generator replacement, and the expected continued compliance with Federal radiation protection standards, the cumulative radiological impacts from the operation of Davis-Besse and its ISFSI and the present and future radiological impacts from the Fermi plant site during the renewal term would be SMALL. The NRC will regulate any future nuclear power facility construction and operation near the Davis-Besse site that could contribute to cumulative radiological impacts. In addition, the State of Ohio will regulate facilities using radioactive material licensed by the State. Therefore, the NRC staff concludes that the cumulative radiological impacts to human health from the continued operation of Davis-Besse, including the nuclear facilities discussed above, during the license renewal term would be SMALL.

4.15.5.2 Microbiological Organisms

This section addresses the direct and indirect effects of license renewal on Human Health due to the presence of microbiological organisms when added to the aggregate effects of other past, present, and reasonably foreseeable future actions. The geographic area considered in this analysis is Lake Erie.

During the Davis-Besse scoping process, public comments informed the NRC staff of the cyanobacterial effects occurring on Lake Erie. Although several forms of bacteria and algae exist within Lake Erie two nuisance species, *Microcystis aeruginosa* and *Lyngbya wollei*, were the species of greatest concern.

In the 1960s and 1970s, the cyanobacterial blooms were a yearly occurrence. The blooms were visibly apparent due to the aqua colored shoreline trim and thick blankets in offshore waters. The implementation of phosphorus controls resulted in the reduction of Lake Erie's phosphorous levels and the blooms ultimately disappeared. Suddenly and unexpectedly, in 1995, the blooms reappeared dominated by *Microcystis aeruginosa*. The blooms did not return in 1996 or 1997, but have been present every year thereafter since 1998. In 2006, blooms of *Lyngbya wollei* were present along the shoreline of Maumee Bay and have since been recurrent in various severities. *Lyngbya wollei*, although known to exist in Lake Erie, had never been documented in bloom proportions within Lake Erie prior to the initial occurrence in 2006 The

origin of the blooms is not known but is likely related to farm fertilizer runoff and sewage overflows (EPA 2008).

Some species of cyanobacteria, for instance *Microcystis aeruginosa,* release toxins into the water. Humans can be affected by these toxins with symptoms such as, skin irritation, stomach cramps, vomiting, nausea, diarrhea, fever, sore throat, headache, muscle and joint pain, blisters of the mouth and liver damage. Partaking in recreational activities including and similar to swimming in water bodies, where the toxins are present, may result in allergic reactions, such as asthma, eye irritation, rashes, and blisters around the mouth and nose. The World Health Organization (WHO) has documented cases resulting in skin rashes from contact with *Microcystis aeruginosa* (WHO 1999).

Current operation of Davis-Besse has not been linked to the presence or growth of the cyanobacteria in Lake Erie. Based on the reported health effects from contact of the cyanobacteria, NRC staff concludes that the cumulative impact on human health because of the presence of microbiological organisms is MODERATE.

4.15.5.3 Electromagnetic Fields

For electromagnetic fields, the NRC staff concludes that the Davis-Besse transmission lines are operating within NESC criteria, and the impacts would be SMALL. Any additional transmission lines would be required to meet the NESC criteria.

For the effects of chronic exposure to extremely low frequency-electromagnetic fields (ELF-EMFs), although the GEIS finding of "UNCERTAIN" is appropriate for Davis-Besse, the transmission lines associated with Davis-Besse are unlikely to significantly contribute to the regional exposure to ELF-EMFs.

Therefore, the NRC staff has concluded that the cumulative impacts of continued operation of the Davis-Besse transmission lines and other lines in the area would be SMALL.

4.15.6 Cumulative Socioeconomic Impacts

This section addresses socioeconomic factors that have the potential to be directly or indirectly affected by changes in operations at Davis-Besse in addition to the aggregate effects of other past, present, and reasonably foreseeable future actions. The primary geographic area of interest considered in this cumulative analysis is Lucas, Ottawa, Sandusky, and Wood counties where approximately 87.5 percent of Davis-Besse employees reside (FENOC 2010a). This area is where the economy, tax base, and infrastructure would most likely be affected since Davis-Besse employees and their families reside, spend their income, and use their benefits within these counties.

As discussed in Section 4.9 of this SEIS, continued operation of Davis-Besse during the license renewal term would have no impact on socioeconomic conditions in the region beyond those already experienced. Since FENOC has no plans to hire additional workers during the license renewal term, overall expenditures and employment levels at Davis-Besse 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. Based on this and other information presented in Chapter 4 of this SEIS, there would be no additional contributory effect on socioeconomic conditions in the future from the continued operation of Davis-Besse during the license renewal term beyond what is currently being experienced.

FENOC indicated in their ER that steam generators would be replaced during the license renewal term in 2017 but will be replacing the steam generators during the 2014 refueling

outage. FENOC estimates that steam generator replacement would require a one-time increase in the number of refueling outage workers for up to 70 days (FENOC 2010a). These additional workers would create a one-time short-term increase in the demand for temporary (rental) housing and increased use of public water and sewer services and transportation impacts on access roads in the immediate vicinity of Davis-Besse. Given the short amount of time needed to replace the steam generators, the additional number of refueling outage workers and truck material deliveries needed to support this one-time replacement of the steam generators could have a temporary cumulative effect on socioeconomic conditions in the vicinity of the nuclear plant. However, there would be no long-term cumulative socioeconomic impacts from the steam generator replacement in the region. The NRC staff concludes that the cumulative socioeconomic impacts of continued operation of Davis-Besse would be SMALL.

4.15.7 Cumulative Historic and Archaeological Impacts

It does not appear likely that the proposed license renewal would adversely affect cultural resources at Davis-Besse. Any ground-disturbing activities that would occur during the license renewal term are unlikely to result in the loss of historic and archaeological resources, provided that the existing earth-moving procedures to protect presently undiscovered resources are implemented and because the disturbance of known historic and archaeological resources in coastal or inland areas are unlikely to occur. However, as noted in Section 2.2.9, there is potential for additional cultural resources to be present in the undisturbed areas in the southern portions of the site. Therefore, prior to any ground-disturbing activity in an undisturbed area, it is expected that the applicant would evaluate the potential for impacts on historic and archaeological resources according to their procedures and in consultation with the SHPO and appropriate Native American Tribes, as required under Section 106 of the NHPA. In the vicinity of Davis-Besse and its transmission lines, some projects have the potential to affect historic and archaeological resources, such as new or expanded road systems or pipeline construction; however, linear projects have some flexibility in the siting process and can typically avoid significant cultural resources, minimizing the potential for impact.

The NRC staff concludes that, when combined with past, present, and reasonably foreseeable future actions, the cumulative impact on historic and archaeological resources by continued operation of Davis-Besse during the license renewal period would be SMALL and would not result in the loss of historic and cultural resources.

4.15.8 Cumulative Impacts of Environmental Justice

The environmental justice cumulative impact analysis assesses the potential for disproportionately high and adverse human health and environmental effects on minority and low-income populations that could result from past, present, and reasonably foreseeable future actions including Davis-Besse operations during the renewal term. 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. Disproportionately high environmental effects refer to impacts or risk of impact on the natural or physical environment in a minority or low-income community that are significant and appreciably exceeds the environmental impact on the larger community. Such effects may include biological, cultural, economic, or social impacts. Some of these potential effects have been identified in resource areas presented in Chapter 4 of this SEIS. Minority and low-income populations are subsets of the general public residing in the area, and all would exposed to the same hazards generated from Davis-Besse operations. As previously discussed

in this chapter, the impact from license renewal for all resource areas (e.g., land, air, water, ecology, and human health) would be SMALL.

As discussed in Section 4.10 of this SEIS, there would be no disproportionately high and adverse impacts to minority and low-income populations from the continued operation of Davis-Besse during the license renewal term. Since FENOC has no plans to hire additional workers during the license renewal term, employment levels at Davis-Besse would remain relatively constant with no additional demand for housing or increased traffic. Based on this information, and the analysis of human health and environmental impacts presented in Chapters 4 and 5, it is unlikely that there would be any disproportionately high and adverse contributory effect on minority and low-income populations from the continued operation of Davis-Besse during the license renewal term.

Potential impacts to minority and low-income populations from refurbishment-related plant modifications (steam generator replacement) at Davis-Besse would mostly consist of environmental and socioeconomic effects (e.g., noise, dust, traffic, employment, and housing impacts). Radiation doses from plant operations after steam generator replacement are expected to remain at current levels and well within regulatory limits.

Noise and dust impacts during steam generator replacement would be short-term and limited to onsite activities at Davis-Besse. Minority and low-income populations residing along site-access roads would experience increased commuter vehicle traffic during shift changes. In addition, increased demand for rental housing during the refueling outages and steam generator replacement at the Davis-Besse could disproportionately affect low-income populations. However, due to the short duration of this refurbishment activity and the availability of rental housing in the four-county ROI, impacts to minority and low-income populations would be short-term and limited. According to American Community Survey 3-year estimates for 2008 through 2010, there were a combined total of over 39,000 vacant housing units in Lucas, Ottawa, Sandusky, and Wood counties (USCB 2012).

Based on this information and the analysis of human health and environmental impacts presented in this SEIS, the steam generator replacement would not have any long-term cumulative disproportionately high and adverse human health and environmental operational effects on minority and low-income populations residing in the vicinity of Davis-Besse.

4.15.9 Summary of Cumulative Impacts

The NRC staff considered the potential impacts resulting from operation of Davis-Besse during the period of extended operation and other past, present, and future actions in the vicinity of Davis-Besse. The final determination is that the potential cumulative impacts would range from SMALL to MODERATE depending upon the resource area (Table 4–14).

Table 4–14. Summary of Cumulative Impacts on Resource Areas

Resource Area	Impact	Discussion
Air Quality	SMALL	Considering the distance to nearby non-attainment and maintenance areas and the prevailing southwesterly wind direction in the area, GHG emissions are not anticipated to deteriorate the current nonattainment/maintenance status. Accordingly, air emissions from continued operation of the plant and associated impacts on ambient air quality would not be expected to change during the license renewal period.
Water Resources Groundwater	SMALL	Although Davis-Besse has not withdrawn groundwater since construction-phase dewatering, 60 percent of all Ottawa County residents rely on groundwater. Groundwater quality in the vicinity of the site may be affected by point source pollution, such as industries or septic tanks, and nonpoint source pollution, such as agricultural chemical usage and lawn chemicals. Other operational or planned projects or industries, could affect groundwater quality but likely would not result in significant, widespread groundwater impacts, especially within several miles of Davis-Besse.
Water Resources Surface Water	SMALL to MODERATE	Precipitation is expected to increase slightly in the winter and spring, with more intense rainstorms year round. The average level of Lake Erie could decrease more than a foot (more than 0.3 m) due to increased evaporation caused by the warmer temperatures, resulting in a decrease of the lake's volume. Warmer lake water would result in increased cooling water use by power plants
Aquatic Resources	LARGE	The impact on aquatic resources from only the Davis-Besse license renewal has been determined to be SMALL. However, factors, such as invasive species, fishing, energy development, urbanization and shoreline development have led to LARGE cumulative impacts to Lake Erie aquatic resources.
Terrestrial Resources	MODERATE	The cumulative impact of the historical draining of wetlands and loss of forested swamps—when added to present conditions and future impacts from urban development, habitat fragmentation, and climate change—will result in loss of habitat and a decline in species diversity.
Human Health—Radiological	SMALL	The cumulative radiological impacts from all uranium fuel cycle facilities in proximity to each other are limited to the radiation protection standards in 10 CFR Part 20 and 40 CFR Part 190.
Human Health— Microbiological Organisms	MODERATE	Some species of cyanobacteria, for instance *Microcystis aeruginosa*, release toxins into the water. Humans can be affected by these toxins with symptoms such as, skin irritation, stomach cramps, vomiting, nausea, diarrhea, fever, sore throat, headache, muscle and joint pain, blisters of the mouth and liver damage. Partaking in recreational activities including and similar to swimming in water bodies, where the toxins are present, may result in allergic reactions, such as asthma, eye irritation, rashes, and blisters around the mouth and nose.
Human Health— Electromagnetic Fields	SMALL	The cumulative impacts from Davis-Besse's transmission would be SMALL.

Resource Area	Impact	Discussion
Socioeconomics	SMALL	FENOC has no plans to hire additional workers during the license renewal term, overall expenditures and employment levels at Davis-Besse 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.
Historic & Archaeological	SMALL	Prior to any ground disturbing activity in an undisturbed area, it is expected that the applicant would evaluate the potential for impacts according to their procedures and in consultation with the SHPO and appropriate Native American Tribes, as required under Section 106 of the NHPA.
Environmental Justice	SMALL	FENOC has no plans to hire additional workers during the license renewal term, employment levels at Davis-Besse would remain relatively constant with no additional demand for housing or increased traffic.

4.16 References

10 CFR Part 20. *Code of Federal Regulations*, Title 10, *Energy*, Part 20, “Standards for Protection Against Radiation.”

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

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

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

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

50 CFR Part 22. *Code of Federal Regulations*, Title 50, *Wildlife and Fisheries*, Part 22, “Eagle Permits.”

59 FR 7629. Executive Order 12898, “Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations,” *Federal Register*, Vol. 59(32): 7629–7634 February 16, 1994.

61 FR 28467. U.S. Nuclear Regulatory Commission, “Environmental Review for Renewal of Nuclear Power Plant Operating Licenses.” *Federal Register* 61(109): 28467–28497. June 5, 1996.

69 FR 52040. U.S. Nuclear Regulatory Commission, “Policy Statement on the Treatment of Environmental Justice Matters in NRC Regulatory and Licensing Actions,” *Federal Register* 69(163): 52040-52048. August 24, 2004.

79 FR 73705. U.S. Fish and Wildlife Service. “Endangered and threatened wildlife and plants; listing determination for the rufa red knot (Calidris canutus rufa).” *Federal Register* 79(238): 73705-73748. December 11, 2014.

[ACE] U.S. Army Corps of Engineers, "Great Lakes Habitat Restoration Initiative Database Query," 2011, Available URL: <http://gis.glin.net/dropbox/query.php> (accessed June 11, 2011).

[ACHP] Advisory Council on Historic Preservation. 2008. "National Register Evaluation Criteria," Available URL: <http://www.achp.gov/nrcriteria.html> (accessed 4 May 2011).

[AEC] U.S. Atomic Energy Commission. 1973. *Final Environmental Statement Related to the Construction of Davis-Besse Nuclear Power Station*, *Docket No, 50-346*. Washington, D.C., March 1973, ADAMS Accession No. ML110140258.

Bald and Golden Eagles Protection Act of 1940, as amended, 16 U.S.C. § 668–668c.

Brannan, S., "Cause and Effect: Sediment Plume Creates Perfect Incubator for Microcystis Bloom," *Twinline*, Volume 31, No. 3, pp. 3–5, 2009.

[CAPS] University of Missouri Circular Area Profiling System. 2012. Census population in a 20- and 50-mile radius around the Davis-Besse Station (41.596944 Lat., –83.087778 Long.). Available URL: <http://mcdc.missouri.edu/websas/caps10c.html> (accessed 17 September 2012).

[CE] Consumers Energy. 2011. J.R. Whiting Generating Plant. Available URL: <http://www.consumersenergy.com/uploadedFiles/CEWEB/SHARED/J.R.WhitingGeneratingPlant.pdf> (accessed 6 May 2011).

[CEQ] Council on Environmental Quality. 1997. *Environmental Justice: Guidance Under the National Environmental Policy Act.* December 10. Available URL: <http://ceq.hss.doe.gov/nepa/regs/ej/justice.pdf>.

[DTE] DTE Energy. 2011a. DTE Energy News Room, Detroit Edison History. Available URL: <http://www.consumersenergy.com/uploadedFiles/CEWEB/SHARED/J.R.WhitingGeneratingPlant.pdf> (accessed 6 May 2011).

[DTE] DTE Energy. 2011b. DTE Energy—Detroit Edison Fermi 3 COLA (Environmental Report), Revision 3. ADAMS Accession No. ML110600498.

[EFETAC] Eastern Forest Environmental Threat Assessment Center. 2011. "Ohio Threat Summary." Available URL: <http://threatsummary.forestthreats.org/browse.cfm?stateSearch=OH#1> (accessed 11 June 2011).

Endangered Species Act of 1973, as amended. 16 U.S.C. §1531 et seq.

[EIA] U.S. Energy Information Administration. 2012. "State Electricity Profiles 2010," DOE/EIA-0348/(01)/2. January 27, 2012.

[EPA] U.S. Environmental Protection Agency. 1999. Consideration of Cumulative Impacts in EPA Review of NEPA Documents. EPA-315-R-99-002. Office of Federal Activities (2252A), Washington, D.C.

[EPA] U.S. Environmental Protection Agency. 2008. "2008 Lake Erie Lakewide Management Plan," Available URL: <http://www.epa.gov/glnpo/lamp/le_2008/le_2008.pdf> (accessed 12 January 2011).

[EPA] U.S. Environmental Protection Agency. 2011a. "Clean Energy, eGRID," eGRID2010 Version 1.0. Available URL: <http://www.epa.gov/cleanenergy/energy-resources/egrid/index.html> (accessed 16 May 2011).

[EPA] U.S. Environmental Protection Agency. 2011b. "Energy CO_2 Emissions by State, 1990–2008." Available URL: <http://www.epa.gov/statelocalclimate/documents/pdf/CO2FFC_2008.pdf> (accessed 15 May 2011).

[EPA] U.S. Environmental Protection Agency. 2011c. "Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2009," EPA 430-R-11-005. April 15. Available URL: <http://www.epa.gov/climatechange/emissions/usinventoryreport.html> (accessed 15 May 2011).

[EPA] U.S. Environmental Protection Agency. 2011d. "Great Lakes Restoration Initiative. Great Lakes National Program Office. Available URL: <http://www.greatlakesrestoration.us/index.html> (accessed 28 March 2011).

[EPA] U.S. Environmental Protection Agency. 2011e. "Great Lakes: Invasive Species." Updated May 13, 2011. Available URL: <http://www.epa.gov/glnpo/invasive/> (accessed June 8, 2011).

[EPA] U.S. Environmental Protection Agency. 2012. "Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2010," EPA-430-R-12-001, April 15, 2012. Available at: <http://www.epa.gov/climatechange/ghgemissions/usinventoryreport.html> (accessed 17 August 2012).

Executive Order 12898. 1994. "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," *Federal Register,* Volume 59 (32), Washington, D.C. February 16.

[FEco] FirstEnergy Company. 2007. Bay Shore Plant, Facts at a glance. Available URL:<http://www.firstenergycorp.com/environmental/files/Fact_Sheets/Bay_Shore_Plant_FS_%2808-2007%29.pdf> (accessed 6 May 2011).

[FENOC] FirstEnergy Nuclear Operating Company. 2009a. Davis-Besse, Unit 1. Final Monthly Progress Report—Radiological Environmental Monitoring Program for the Davis-Besse Nuclear Power Station—Reporting Period January-December 2008. Oak Harbor, Ohio. ADAMS Accession No. ML091480342.

[FENOC] FirstEnergy Nuclear Operating Company. 2009b. Davis-Besse, Unit 1. "2008 Annual Radiological Environmental Operating Report Including the Radiological Effluent Release Report." Oak Harbor, Ohio. ADAMS Accession No. ML091480342.

[FENOC] FirstEnergy Nuclear Operating Company. 2010a. "Davis-Besse Nuclear Power Station License Renewal Application," Toledo, OH, August 2010, ADAMS Accession No. ML102450572.

[FENOC] FirstEnergy Nuclear Operating Company. 2010b. Davis-Besse, Unit 1. Final Monthly Progress Report—Radiological Environmental Monitoring Program for the Davis-Besse Nuclear Power Station—Reporting Period January–December 2009. Oak Harbor, Ohio. ADAMS Accession No. ML101410510.

[FENOC] FirstEnergy Nuclear Operating Company. 2010c. Davis-Besse, Unit 1. "2009 Annual Radiological Environmental Operating Report Including the Radiological Effluent Release Report." Oak Harbor, Ohio. ADAMS Accession No. ML101410508.

[FENOC], FirstEnergy Nuclear Operating Company. 2010d. *Updated Safety Analysis Report (USAR), Davis-Besse Nuclear Power Station No. 1, Docket No. 50-346, License No: NPF-3, Revision 27*. June 2010 (2010b).

[FENOC] FirstEnergy Nuclear Operating Company. 2011a. Davis-Besse, Unit 1. Final Monthly Progress Report—Radiological Environmental Monitoring Program for the Davis-Besse Nuclear Power Station—Reporting Period January–December 2010. Oak Harbor, Ohio. ADAMS Accession No. ML11168A164.

[FENOC] FirstEnergy Nuclear Operating Company. 2011b. Davis-Besse, Unit 1. "2010 Annual Radiological Environmental Operating Report Including the Radiological Effluent Release Report." Oak Harbor, Ohio. ADAMS Accession No. ML11168A163.

[FENOC] FirstEnergy Nuclear Operating Company. 2012a. *Davis-Besse, Unit 1. Final Monthly Progress Report—Radiological Environmental Monitoring Program for the Davis-Besse Nuclear Power Station—Reporting Period January–December 2011*. Oak Harbor, Ohio. ADAMS Accession No. ML12174A094.

[FENOC] FirstEnergy Nuclear Operating Company. 2012b. *Davis-Besse, Unit 1. 2011 Annual Radiological Environmental Operating Report Including the Radiological Effluent Release Report*. Oak Harbor, Ohio. ADAMS Accession No. ML12174A090.

[FENOC] FirstEnergy Nuclear Operating Company. 2013a. *Davis-Besse, Unit 1. Final Monthly Progress Report—Radiological Environmental Monitoring Program for the Davis-Besse Nuclear Power Station—Reporting Period January–December 2012*. Oak Harbor, Ohio. ADAMS Accession No. ML13169A111.

[FENOC] FirstEnergy Nuclear Operating Company. 2013b. *Davis-Besse, Unit 1, 2012 Annual Radiological Environmental Operating Report Including the Radiological Effluent Release Report*. Oak Harbor, Ohio. ADAMS Accession No. ML13169A109.

[FENOC] FirstEnergy Nuclear Operating Company. 2014a. *Davis-Besse, Unit 1. Final Monthly Progress Report—Radiological Environmental Monitoring Program for the Davis-Besse Nuclear Power Station—Reporting Period January–December 2013*. Oak Harbor, Ohio. ADAMS Accession No. ML14140A286.

[FENOC] FirstEnergy Nuclear Operating Company. 2014b. *Davis-Besse, Unit 1, 2013 Annual Radiological Environmental Operating Report Including the Radiological Effluent Release Report*. Oak Harbor, Ohio. ADAMS Accession No. ML14140A215.

[FWS] U.S. Fish and Wildlife Service. 2003. "Common flaws in developing an effect determination." Prepared by the FWS Raleigh Field Office. December 2003. Available URL: <http://www.fws.gov/raleigh/pdfs/BA-BE_Common_Flaws.pdf> (accessed 17 June 2014).

[FWS] U.S. Fish and Wildlife Services. 2009. Letter from Knapp, M., FWS, Field Supervisor, to B. Allen, FENOC, Subject: Comments on the Proposed Davis-Besse License Renewal. December 16, ADAMS Accession No. ML102450568.

[FWS] U.S. Fish and Wildlife Service. 2010. Letter from Knapp, M., FWS, Field Supervisor, to C. Bladey, NRC. Subject: Scoping Comments on the Davis-Besse License Renewal Application Review." December 16. ADAMS Accession No. ML110060289.

[FWS] U.S. Fish and Wildlife Service. 2011. "Ottawa National Wildlife Refuge, Partners for Fish and Wildlife." Available at <http://www.fws.gov/midwest/ottawa/PFW.htm> (accessed 11 June 2011).

[FWS] U.S. Fish and Wildlife Service. 2014. Letter from F. Clark, Acting Field Supervisor, U.S. Fish and Wildlife Service Columbus, Ohio Ecological Services Office, to D. Wrona, Branch Chief, NRC. Subject: Concurrence with NRC's effect determinations regarding Federally listed species and other comments on the draft supplemental environmental impact statement. September 30, 2014. ADAMS Accession No. ML14296A559.

[FWS and NMFS] U.S. Fish and Wildlife Service and National Marine Fisheries Service. 1998. "Endangered Species Consultation Handbook: Procedures for Conducting Consultation and Conference Activities under Section 7 of the Endangered Species Act." March 1998. 315 p. Available URL: <http://www.fws.gov/endangered/esa-library/pdf/esa_section7_handbook.pdf> (accessed 17 June 2014).

[GLC] Great Lakes Commission. 2006. *Annual Report of the Great Lakes Regional Water Use Database Repository Representing 2004 Water Use Data in Gallons*. The Great Lakes Commission. November 13, 2006. 105 p.

[GLFC] Great Lakes Fishery Commission. 2000. *Sea Lamprey: A Great Lakes Invader*, Available URL: <http://www.seagrant.umn.edu/downloads/x106.pdf> (accessed 20 March 2011).

[GLRC] Great Lakes Regional Collaboration. 2009. "Ohio Projects in the Great Lakes Habitat Restoration Database." Updated January 1, 2009. Available at <http://www.glrc.us/documents/habitatworkshops/pdf/OHWorkshop/OH%20Projects%20090101.pdf> (accessed 11 June 2011).

Graham, G.W., N.M. N'Jie, and L.C. Brown, "Water Resources of Ottawa County, Ohio State University Fact Sheet: Food, Agricultural, and Biological Engineering," Report No. AEX-480.62-98, Columbus, OH, 1997, Available URL: <http://ohioline.osu.edu/aex-fact/0480_62.html> (accessed May 18, 2011).

Hartig, J.H., M.A. Zarull, J.J.H. Ciborowski, J.E. Gannon, E. Wilke, G. Norwood, and A. Vincent (eds.). 2007. "State of the Strait: Status and Trends of Key Indicators. Occasional Publication No. 5." Great Lakes Institute for Environmental Research, University of Windsor. Ontario, Canada.

[IEEE] Institute of Electrical and Electronics Engineers. 1997. National Electrical Safety Code, New York.

[IPCC] Intergovernmental Panel on Climate Change. 2007. "Climate Change 2007: Impacts, Adaptation and Vulnerability." Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson (eds.)]. Cambridge University Press, Cambridge, UK.

[IPCC] Intergovernmental Panel on Climate Change. 2013. "Climate Change 2013: The Physical Science Basis." [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Mackey, SD. 2012. "Great Lakes Nearshore and Coastal Systems." U.S. National Climate Assessment Midwest Technical Input Report. Available URL: <http://glisa.umich.edu/media/files/NCA/MTIT_Coastal.pdf>.

[MHR] Midwest High-Speed Rail. 2011. Official Web site of Midwest High-Speed Rail Map. Available URL: <http://www.connectthemidwest.com/map/> (accessed 24 February 2011).

Migratory Bird Treaty Act of 1981, as amended. 16 U.S.C. §§ 703–712.

National Environmental Policy Act of 1969. 42 U.S.C. § 4321, et seq.

National Historic Preservation Act of 1966. 16 U.S.C. § 470, et seq.

[NIEHS] National Institute of Environmental Health Sciences. 1999. *NIEHS Report on Health Effects from Exposure to Power-Line Frequency Electric and Magnetic Fields*, Publication No. 99-4493, Research Triangle Park, North Carolina.

[NMFS] National Marine Fisheries Service. 2010. Letter from Colligan, M.A., NMFS, Northeast Assistant Regional Administrator, to D. Wrona, Branch Chief, NRC. Subject: *Reply to Request for Species List at Davis-Besse*. December 21. ADAMS Accession No. ML110140230.

[NOAA] National Oceanic and Atmospheric Administration. 2013. "Regional Climate Trends and Scenarios for the U.S. National Climate Assessment, Part 3. Climate of the Midwest." NOAA Technical Report NESDIS 142-3. January 2013. Available URL: <http://www.nesdis.noaa.gov/technical_reports/NOAA_NESDIS_Tech_Report_142-3-Climate_of_the_Midwest_U.S.pdf>.

[NRC] U.S. Nuclear Regulatory Commission. 1975. *Final Environmental Statement related to the Operation of Davis-Besse Nuclear Power Station, Unit 1*. Washington, DC: NRC. October 1975. ADAMS Accession No. ML110140258.

[NRC] U.S. Nuclear Regulatory Commission. 1996. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*, NUREG-1437, Washington, D.C., May. ADAMS Accession Nos. ML040690705 and ML040690738.

[NRC] U.S. Nuclear Regulatory Commission. 1999a. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Main Report*, NUREG-1437, Section 6.3, Table 9.1, Volume 1, Addendum 1, Washington, D.C.

[NRC] U.S. Nuclear Regulatory Commission. 1999b. *Standard Review Plans for Environmental Reviews for Nuclear Power Plants, Supplement 1: Operating License Renewal*, NUREG-1555, Washington, D.C., October 1999, ADAMS Accession No. ML003702019.

[NRC] U.S. Nuclear Regulatory Commission. 2000. "Event Reporting Guidelines: 10 CFR 50.72 and 50.73," Revision 2. October 2000. ADAMS Accession No. ML003762595.

[NRC] U.S. Nuclear Regulatory Commission. 2001. Davis-Besse Nuclear Power Plant—Environmental Assessment and Finding of No Significant Impact of the Spent Fuel Pool Modification, Washington, D.C., ADAMS Accession No. ML012410395.

[NRC] U.S. Nuclear Regulatory Commission. 2010a. Letter from Wrona D, Branch Chief, to Graham D, Division of Wildlife, ODNR. Subject: Request for list of species at Davis-Besse. November 23, 2010. ADAMS Accession No. ML102980688.

[NRC] U.S. Nuclear Regulatory Commission. 2010b. Letter from Wrona D, Branch Chief, to Mitch B, Environmental Review Manager, ODNR. Subject: Request for list of species at Davis-Besse. November 23, 2010. ADAMS Accession No. ML102980430.

[NRC] U.S. Nuclear Regulatory Commission. 2010c. Letter from David J. Wrona, Chief, Projects Branch 2, Division of License Renewal, Office of Nuclear Regulation, NRC, Washington, D.C., to R. Nelson, Office of Federal Agency Programs, Advisory Council on Historic Preservation, Washington, DC. Re: Davis-Besse, license renewal environmental review, dated November 22, 2010. ADAMS Accession No. ML102980140.

[NRC] U.S. Nuclear Regulatory Commission. 2010d. Letter from David J. Wrona, Chief, Projects Branch 2, Division of License Renewal, Office of Nuclear Regulation, NRC, Washington, D.C., to Mark Epstein, State Ohio Historic Preservation Office, Columbus, Ohio, Re: Davis-Besse, License Renewal Environmental Review, dated December 7, 2010. ADAMS Accession No. ML102980687.

[NRC] U.S. Nuclear Regulatory Commission. 2010e. Letters from David J. Wrona, Chief, Projects Branch 2, Division of License Renewal, Office of Nuclear Regulation (NRC), Washington, DC, to Eight Tribes. Re: Request for comments concerning the Davis-Besse, license renewal application review, dated November 23, 2010. ADAMS Accession No. ML103000164.

[NRC] U.S. Nuclear Regulatory Commission. 2011a. Letter from Wrona D, Branch Chief, to Knapp M, Field Supervisor, U.S. Fish and Wildlife Service. Subject: Request for list of Federally protected species at Davis-Besse. June 1, 2011. ADAMS Accession No. ML11131A176.

[NRC] U.S. Nuclear Regulatory Commission. 2011b. "Summary of Site Audit Related to Review of the Davis-Besse License Renewal Application," June 3. ADAMS Accession No. ML110820276.

[NRC] U.S. Nuclear Regulatory Commission. 2013a. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*. Washington, DC: NRC. NUREG–1437, Revision 1. June 2013. ADAMS Accession No. ML13107A023.

[NRC] U.S. Nuclear Regulatory Commission. 2013b. *Event Reporting Guidelines: 10 CFR 50.72 and 50.73*. Washington, DC: NRC. NUREG-1022. Revision 3. January 2013. 107 p. ADAMS Accession No. ML13032A220.

[NRC] U.S. Nuclear Regulatory Commission. 2013c. *Standard Review Plans for Environmental Reviews for Nuclear Power Plants, Supplement 1: Operating License Renewal*. Washington, DC: NRC. NUREG–1555, Supplement 1, Revision 1. June 2013. ADAMS Accession No. ML13106A246.

[NRC] U.S. Nuclear Regulatory Commission. 2014a. Letter from D. Wrona, NRC, to T. Melius, FWS Midwest Regional Director. Subject: Request for concurrence on the effects of the proposed Davis-Besse license renewal on threatened and endangered species. February 27, 2014. ADAMS Accession No. ML13177A030.

[NRC] U.S. Nuclear Regulatory Commission. 2014b. E-mail from B. Grange, NRC, to J. Finfera, FWS. Assessment of impacts to proposed species: northern long-eared bat (*Myotis septentrionalis*) and red knot (*Calidris canutus rufa*). May 6, 2014. ADAMS Accession No. ML14139A000.

[NRC] U.S. Nuclear Regulatory Commission. 2014c. E-mail from B. Grange, NRC, to J. Finfera, FWS. Assessment of impacts to Kirtland's warbler (*Setophaga kirtlandii*), northern long-eared bat (*Myotis septentrionalis*), and red knot (*Calidris canutus rufa*). June 17, 2014. ADAMS Accession No. ML14168A616.

[NRC] U.S. Nuclear Regulatory Commission. 2014d. Memorandum from B. Grange, NRC, to File. Summary of teleconference call held on July 18, 2014, between the NRC, FWS, and FENOC concerning Endangered Species Act section 7 consultation for the Davis-Besse license renewal. August 21, 2014. ADAMS Accession No. ML14213A002.

[ODD] Ohio Department of Development. 2011. "Senate Bill 221—Alternative Energy Portfolio Standard and Energy Efficiency Portfolio Standard." Available URL: <http://www.development.ohio.gov/Energy/Tools/Policy.htm> (accessed 18 May 2011).

[ODNR] Ohio Department of Natural Resources. 2010. Letter from Mitch B, Environmental Review Manager, to Custer CI, FENOC. Subject: Reply to request for information on threatened or endangered species at the Davis-Besse Station. January 4, 2010, in (FENOC 2010a). ADAMS Accession No. ML102450568.

[OEPA] Ohio Environmental Protection Agency. 2013. National Ambient Air Quality Standards-Attainment Status. Available URL: <http://www.epa.state.oh.us/dapc/general/naaqs.aspx> (accessed 4 June 2013).

[OPSB] Ohio Power Siting Board. 2003. Ohio Power Siting Board, 2003 Annual Report. Available URL: <http://www.puco.ohio.gov/emplibrary/files/media/OPSB/2003OPSBAR.pdf> (accessed 6 May 2011).

[OPSB] Ohio Power Siting Board. 2011a. 00-1527-EL-BGN: Fremont Energy Center, 540 MW Generating Facility. Available URL: <http://www.opsb.ohio.gov/opsb/index.cfm/cases/00-1527-el-bgn-fremont-energy-center-540-mw-generating-facility/ > (accessed 24 February 2011).

[OPSB] Ohio Power Siting Board. 2011b. Ohio Power Siting Board 09-0750-EL-BSB: BP-Husky Refining, LLC, Toledo Refinery 138_69 kV Substation Project. Available URL: <http://dis.puc.state.oh.us/DocumentRecord.aspx?DocID=a74e33ab-d08b-461b-aafa-95529c4dc687> (accessed 7 June 2011).

Peoria Tribe of Indians of Oklahoma. 2010. Letter from John P. Froman, Chief, Peoria Tribe of Indians of Oklahoma, Miami, Oklahoma to Tribal Historic Preservation Officer, Osage Nation, Pawhuska, Oklahoma, to NRC, Washington, DC. Re: Request for Davis-Besse plant scoping comments, dated December 8, 2010. Adams Accession No. ML103570365.

[PUCO] Ohio Public Utility Commission. 2011. "Where Does Ohio's Electricity Come From?," Updated January 3. Available URL: <http://www.puco.ohio.gov/emplibrary/files/media/Publications/Fact_Sheets/where%20does%20ohio's%20electricity%20come%20from.pdf> (accessed 15 May 2011).

Sovacool, B.K., "Valuing the Greenhouse Gas Emissions from Nuclear Power: A Critical Survey," *Energy Policy*, 36:2940–2953, 2008.

Tagaris E, Liao KJ, Delucia AJ, Deck L, Amar P, Russel AG. 2009. "Potential Impact of Climate Change on Air Pollution Related Human Health Effects." *Environmental Science and Technology* 43:4979–4988. Available URL: <http://pubs.acs.org/doi/pdf/10.1021/es803650w> (accessed 2 June 2014).

[USGCRP] U.S. Global Change Research Program. 2009. "Global Climate Change Impacts in the United States." Available URL: <http://www.globalchange.gov/publications/reports/scientific-assessments/us-impacts/download-the-report> (accessed 3 June 2011).

[USGCRP] U.S. Global Change Research Program. 2014. "Climate Change Impacts in the United States." Melillo JM, Richmond TC, Yohe GW (eds). May. ADAMS Accession No. ML14129A233.

[USCB] U.S. Census Bureau. 2012. "American FactFinder, Census 2010 and 2009–2011, 3-Year Estimate, American Community Survey, State and County QuickFacts on Lucas, Ottawa, Sandusky, and Wood Counties, Ohio, and Housing Characteristics for 2010 and 2009–2011, 3-Year Estimate," Available URL: <http://factfinder.census.gov> and <http://quickfacts.census.gov> (accessed July and November 2012).

[USGS] U.S. Geological Survey. 1999. National Water Resources Summary on Wetland Resources. Washington, DC: USGS. Water Supply Paper 2425. February 1999. Available URL: <http://water.usgs.gov/nwsum/WSP2425/index.html> (accessed 11 June 2011).

[UT] University of Toledo. Undated. “Ohio Wetlands.” Available URL: <http://www.wetlands.utoledo.edu/Pages/Ohiowet.html> (accessed 11 June 2011).

[WHO] World Health Organization. 1999. “Toxic Cyanobacteria in Water: A Guide to their Public Health Consequences, Monitoring and Management” Geneva, Switzerland, 2007, Available URL: <http://www.who.int/water_sanitation_health/resourcesquality/toxcyanchap4.pdf> (accessed 17 August 2011).

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 are evaluated in the generic environmental impact statement (GEIS). These are design-basis accidents (DBAs) and severe accidents. Table 5–1 notes the issues related to postulated accidents.

Table 5–1. Issues Related to Postulated Accidents

Two issues related to postulated accidents are evaluated under National Environmental Policy Act (NEPA) in the license renewal review, DBAs, and severe accidents.

Issue	Category
DBAs	1
Severe accidents	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 the plant design meets the Commission’s regulations and requirements and includes, in part, the nuclear plant design and its anticipated response to an accident.

DBAs are those accidents that both the applicant and the NRC staff evaluate to ensure that the plant can withstand normal and abnormal transients, and a broad spectrum of postulated accidents, without undue hazard to the health and safety of the public. Many 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* (CFR) Part 50 (10 CFR Part 50) and 10 CFR Part 100.

The environmental impacts of DBAs are evaluated during the initial licensing process, and the ability of the plant to withstand these accidents is demonstrated to be acceptable before issuance of the operating license. The results of these evaluations are found in applicant 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). An applicant is required to maintain the acceptable design and performance criteria throughout the life of the plant, including any extended-life operation. The consequences for these events are evaluated for the hypothetical maximum exposed individual; as such, changes in the plant environment will not affect these evaluations. Because of the requirements that continuous acceptability of the consequences and aging management programs be in effect for 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 those accidents were not examined further in the GEIS.

The Commission has determined that the environmental impacts of DBAs are of SMALL significance for all plants because the plants were designed to successfully withstand these accidents. Therefore, for the purposes of license renewal, 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 applicant 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 significant information related to DBAs was identified during the review of the Davis-Besse Nuclear Power Station's (Davis-Besse's) Environmental Report (ER) (FENOC 2010), the site audit, the scoping process, or the evaluation of other available information. Therefore, there are no impacts related to these issues beyond those discussed in the GEIS.

5.2 Severe Accidents

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

Severe accidents initiated by external phenomena such as tornadoes, floods, earthquakes, fires, and sabotage have not traditionally been discussed in quantitative terms in FESs and were not specifically considered for the Davis-Besse site in the GEIS (NRC 1996). However, the GEIS did evaluate existing impact assessments performed by NRC and by the industry at 44 nuclear plants in the United States and concluded that the risk from beyond design basis earthquakes at existing nuclear power plants is SMALL. The GEIS for license renewal performed a discretionary analysis of terrorist acts in connection with license renewal and concluded that the core damage and radiological release from such acts would be no worse than the damage and release expected from internally initiated events. In the GEIS, the Commission concludes that the risk from sabotage and beyond design-basis earthquakes at existing nuclear power plants is SMALL and, additionally, that the risks from other external events are adequately addressed by a generic consideration of internally initiated severe accidents (NRC 1996).

Based on information in the GEIS, the staff found the following to be true:

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

The staff identified no new and significant information related to postulated accidents during the review of Davis-Besse's ER (FENOC 2010), the site audit, the scoping process, or the evaluation of other available information. Therefore, there are no impacts related to these issues beyond those discussed in the GEIS. However, in accordance with

10 CFR 51.53(c)(3)(ii)(L), the staff has reviewed severe accident mitigation alternatives (SAMAs) for Davis-Besse. The results of the review are discussed in Section 5.3.

5.3 Severe Accident Mitigation Alternatives

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

5.3.1 Overview of SAMA Process

This section presents a summary of the SAMA evaluation for Davis-Besse conducted by FirstEnergy Nuclear Operating Company, LLC (FENOC), and the NRC staff's review of that evaluation. The NRC staff performed its review with contract assistance from Pacific Northwest National Laboratory (PNNL). The NRC staff's review is available in full in Appendix F, and the SAMA evaluation is available in full in Appendix E of the FENOC ER.

The SAMA evaluation for Davis-Besse was conducted with a four-step approach. In the first step, FENOC 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, FENOC examined the major risk contributors and identified possible ways (SAMAs) of reducing that risk. Common ways of reducing risk are changes to components, systems, procedures, and training. FENOC identified 168 potential SAMAs for Davis-Besse. FENOC performed an initial screening to determine if any SAMAs could be eliminated for the following reasons:

- The SAMA has design differences or has already been implemented at Davis-Besse.
- The SAMA is not applicable to Davis-Besse.
- The SAMA has estimated implementation costs that would exceed the dollar value associated with eliminating all severe accident risk at Davis-Besse.
- The SAMA is related to a non-risk significant system and, therefore, has a very low benefit.
- The SAMA is similar in nature and could be combined with another SAMA candidate.

Based on this screening, 153 SAMAs were eliminated, leaving 15 candidate SAMAs for further evaluation.

In the third step, FENOC estimated the benefits and the costs associated with each of the 15 candidate 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. The cost of implementing the proposed SAMAs was also estimated.

Finally, in the fourth step, the cost and benefit of each of the remaining SAMAs were compared to determine whether the SAMA was cost-beneficial, meaning the benefits of the SAMA were

greater than the cost (a positive cost benefit). FENOC concluded in its ER that SAMA AC/DC-03, adding a portable, diesel-driven battery charger to the existing DC system, would be potentially cost-beneficial. SAMA AC/DC-03 does not relate to adequately managing the effects of aging during the period of extended operation; therefore, it need not be implemented as part of license renewal pursuant to 10 CFR Part 54. FENOC's SAMA analyses and the NRC's review are discussed in more detail below.

5.3.2 Estimate of Risk

FENOC submitted an assessment of SAMAs for Davis-Besse as part of the ER. This assessment was based on the most recent Davis-Besse 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 Davis-Besse individual plant examination (IPE) (Centerior Energy 1993) and individual plant examination of external events (IPEEE) (Centerior Energy 1996).

The baseline core damage frequency (CDF) for the purpose of the SAMA evaluation is approximately 1×10^{-5} per year for internal events including internal flooding events. FENOC accounted for the potential risk reduction benefits associated with external events by applying a multiplier to the estimated benefits for internal events. FENOC used a multiplier of 5.6 to account for external events, which assumes a seismic CDF of 6.7×10^{-6} per year, a fire CDF of 2.9×10^{-5} per year, and a high winds, tornadoes, external floods, and other external events CDF of 1.0×10^{-5} per year (FENOC 2011).

The breakdown of CDF by initiating event is provided in Table 5–2. As shown in this table, loss of offsite power (LOOP), loss of component cooling water (CCW), and reactor or turbine trips are the dominant contributors to the CDF. Anticipated transient without scram (ATWS) sequences are modeled as a failure to trip after an initiating event; ATWS sequences contribute approximately 1 percent to CDF. Station blackout (SBO) sequences involve a LOOP (as the initiating event or following an initiating event), along with subsequent failure of power to both safety buses (i.e., a loss of both emergency diesel generators (EDGs) and the SBO diesel generator). SBO sequences contribute approximately 5 percent to CDF and are dominated by sequences initiated by a LOOP. Column totals in Table 5–2 may differ due to round off.

FENOC estimated the dose to the population within 50 miles (mi) (80 kilometers (km)) of the Davis-Besse site to be approximately 0.023 person-sievert (Sv) (2.3 person-rem) per year for internal events (FENOC 2011). The breakdown of the total population dose by containment release mode is summarized in Table 5–3. SGTR and interfacing system LOCA (ISLOCA), both containment bypass events, dominate the population dose risk for internal events at Davis-Besse. Column totals in Table 5–3 may differ due to round off.

Table 5–2. Davis-Besse Internal Events Core Damage Frequency

Initiating Event	CDF (per year)	% Contribution to CDF
Loss of offsite power (LOOP)	1.9×10^{-6}	19
Loss of component cooling water (CCW) pump(s)	1.7×10^{-6}	18
Reactor or turbine trip	1.3×10^{-6}	13
Steam generator tube rupture (SGTR)	6.2×10^{-7}	6
Loss of main feedwater	5.7×10^{-7}	6
Loss of main feedwater flow control	5.1×10^{-7}	5
Reactor vessel (RV) rupture	5.0×10^{-7}	5
Small loss-of-coolant accident (LOCA)	4.3×10^{-7}	4
Flooding in CCW pump room from service water	2.0×10^{-7}	2
Medium LOCA	1.5×10^{-7}	2
Loss of service water pump room ventilation	1.3×10^{-7}	1
Loss of direct current (DC) power from Bus d2p	1.1×10^{-7}	1
Flooding in turbine building from circulating water	8.8×10^{-8}	1
Loss of non-nuclear instrumentation cabinets 1-4 (NNIX) DC power supply	8.2×10^{-8}	1
Other	1.5×10^{-6}	15
Total CDF (internal events)	$9.8\times10^{-6*}$	100*

*Column totals may differ due to round off errors.

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

Containment Release Mode	POPULATION dose (person-rem per year)	% Contribution
SGTR	1.35	64
ISLOCA	0.35	17
Large containment isolation failure	0.02	1
Small containment isolation failure	0.06	3
Large early release	0.03	1
Sidewall failure (early)	0.03	1
Late containment failure	0.06	3
Basemat failure	0.21	10
No containment failure	0.02	1
Total	2.12*	100*

*Column totals may differ due to round off errors.

The NRC staff has reviewed FENOC'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 NRC staff based its assessment of offsite risk on the CDF and offsite doses reported by FENOC.

5.3.3 Potential Plant Improvements

FENOC's process for identifying potential plant improvements (SAMAs) consisted of the following elements:

- review of the dominant cutsets and most significant basic events from the current, plant-specific PRA,
- review of potential plant improvements identified in the Davis-Besse IPE and IPEEE,
- review of SAMA candidates identified for license renewal applications (LRAs) for representative pressurized-water reactor (PWR) plants, and
- review of other industry documentation discussing potential plant improvements.

Based on this process, an initial set of 168 candidate SAMAs was identified. FENOC performed a qualitative screening of the initial list of SAMAs using the following criteria:

- The SAMA has design differences or has already been implemented at Davis-Besse.
- The SAMA is not applicable to Davis-Besse.
- The SAMA has estimated implementation costs that would exceed the dollar value associated with eliminating all severe accident risk at Davis-Besse.
- The SAMA is related to a non-risk significant system and, therefore, has a very low benefit.
- The SAMA is similar in nature and could be combined with another SAMA candidate.

Based on this screening, 153 SAMAs were eliminated, leaving 15 for further evaluation. A detailed cost-benefit analysis was performed for each of the remaining SAMAs.

The NRC staff concludes that FENOC used a systematic and comprehensive process for identifying potential plant improvements for Davis-Besse, and the set of SAMAs evaluated in the ER, together with those evaluated in response to NRC staff inquiries, is reasonably comprehensive and, therefore, acceptable.

5.3.4 Evaluation of Risk Reduction and Costs of Improvements

FENOC evaluated the risk-reduction potential of the remaining candidate 15 SAMAs. The SAMA evaluations were performed in a bounding fashion in that the SAMA was assumed to eliminate the risk associated with the proposed enhancement. FENOC also provided the risk-reduction potential of six additional SAMAs identified in response to requests for additional information (RAIs) using the same bounding approach. This bounding approach overestimates the benefit and is conservative.

The NRC staff reviewed FENOC'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 FENOC's risk reduction estimates.

The staff also 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 applicants' analyses of SAMAs for other operating 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 FENOC are sufficient and appropriate for use in the SAMA evaluation.

5.3.5 Cost-Benefit Comparison

The methodology used by FENOC was based on NRC's guidance for performing cost-benefit analysis (i.e., NUREG/BR-0184, *Regulatory Analysis Technical Evaluation Handbook* (NRC 1997a)). The guidance involves determining the net value for each SAMA. If the net present value of a SAMA is negative, the cost of implementing the present SAMA is larger than the benefit associated with the SAMA, and it is not considered cost-beneficial. FENOC's derivation of each of the associated costs is summarized in Appendix F. Revision 4 of NUREG/BR-0058 states that two sets of estimates should be developed, one at a 3 percent discount rate and one at a 7 percent discount rate (NRC 2004). FENOC provided a base set of results using the 7 percent discount rate and a sensitivity study using the 3 percent discount rate (FENOC 2010, 2011).

FENOC developed plant-specific costs of implementing the 15 candidate SAMAs. The NRC staff asked FENOC to describe the level of detail used to develop the cost estimates and to clarify whether the cost estimates accounted for inflation, contingency costs associated with unforeseen implementation obstacles, replacement power during extended outages, and maintenance and surveillance costs during plant operation (NRC 2011a). In response to the RAI, FENOC clarified that the cost estimates conservatively did not include inflation, contingency costs associated with unforeseen implementation obstacles, or the cost of replacement power during extended outages required to implement the modifications (FENOC 2011).

The NRC staff reviewed the bases for the applicant's cost estimates. 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 applicants' analyses of SAMAs for operating 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.

FENOC's SAMA analysis determined that SAMA AC/DC-03 would be potentially cost-beneficial. This SAMA would increase battery capacity and, therefore, increase the time available for recovery of offsite or onsite power by adding a portable, diesel-driven battery charger to the existing DC system. This SAMA candidate would provide longer battery lifetime during SBO events. FENOC states in Section E.9 of the ER that SAMA AC/DC-03, which was determined to be potentially cost-beneficial in both the baseline analysis and the sensitivity analysis, will be considered for implementation through the normal processes for evaluating possible plant modifications.

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

5.3.6 Conclusions

The NRC staff reviewed FENOC's 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 FENOC are reasonable and sufficient for the license renewal submittal.

Based on its review of the SAMA analysis, the NRC staff agrees with FENOC'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 SAMA. Given the potential for cost-beneficial risk reduction, the NRC staff agrees that further evaluation of SAMA AC/DC-03 by FENOC is warranted. However, this SAMA does not relate to adequately managing the effects of aging during the period of extended operation. Therefore, it need not be implemented as part of license renewal pursuant to 10 CFR Part 54.

5.4 References

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

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

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

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

Centerior Energy. 1993. Letter from Donald C. Shelton (Centerior Energy) to NRC Document Control Desk. Subject: "Individual Plant Examination (IPE) for Severe Accident Vulnerabilities for the Davis-Besse Nuclear Power Station, Unit 1 (Response to NRC Generic Letter 88-20)," February 26, 1993.

Centerior Energy. 1996. Letter from John K. Wood (Centerior Energy) to NRC Document Control Desk. Subject: "Individual Plant Examination for External Events for Severe Accident Vulnerabilities for the Davis-Besse Nuclear Power Station, Unit 1 (Response to NRC Generic Letter 88-20, Supplement 4)," December 16, 1996.

[FENOC] FirstEnergy Nuclear Operating Company. 2010. "Davis-Besse Nuclear Power Station License Renewal Application," Toledo, OH, August 2010, Agencywide Documents Access and Management System (ADAMS) Accession No. ML102450572.

[FENOC] FirstEnergy Nuclear Operating Company. 2011. Letter from Kendall W. Byrd, FENOC, to NRC Document Control Desk. Subject: Reply to Request for Additional Information for the Review of the Davis-Besse Nuclear Power Station, Unit No. 1, License Renewal Application (TAC No. ME4613) Environmental Report Severe Accident Mitigation Alternatives Analysis, and License Renewal Application Amendment No. 10 (L-11-154). June 24. ADAMS Accession No. ML11180A233.

[NRC] U.S. Nuclear Regulatory Commission. 1996. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*, NUREG-1437, Washington, D.C., May. ADAMS Accession Nos. ML040690705 and ML040690738.

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

[NRC] U.S. Nuclear Regulatory Commission. 1999. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Main Report*, NUREG-1437, Section 6.3, Table 9.1, Volume 1, Addendum 1, Washington, D.C.

[NRC] U.S. Nuclear Regulatory Commission. 2011a. Letter from Paula E. Cooper, U.S. NRC, to Barry S. Allen, FENOC. Subject: Requests for Additional Information for the Review of the Davis-Besse Nuclear Power Station, Unit 1, License Renewal Application. Washington, D.C. April 20, 2011. ADAMS Accession No. ML110910566.

[NRC] U.S. Nuclear Regulatory Commission. 2011b. Memo from John G. Parillo, U.S. NRC, to Travis L. Tate, U.S. NRC. Subject: Request For Additional Information Response Clarifications From Davis-Besse Nuclear Power Station In Support Of License Renewal Application Review (TAC No. ME4613). Washington, D.C. August 15, 2011. ADAMS Accession No. ML112270139.

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

6.1 The Uranium Fuel Cycle

This chapter addresses issues related to the uranium fuel cycle and solid waste management during the period of extended operation (listed in Table 6–1). 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 potential impacts of the radiological and nonradiological environmental impacts of the uranium fuel cycle and transportation of nuclear fuel and wastes are described in detail in the Generic Environmental Impact Statement (GEIS) (NRC 1996, 1999, 2013). They are based, in part, on the generic impacts provided in Title 10, Part 51.51(b) of the *Code of Federal Regulations* (10 CFR 51.51(b)), Table S-3, “Table of Uranium Fuel Cycle Environmental Data,” and in 10 CFR 51.52(c), Table S-4, “Environmental Impact of Transportation of Fuel and Waste to and from One Light-Water-Cooled Nuclear Power Reactor.”

Table 6–1. Issues Related to the Uranium Fuel Cycle and Solid Waste Management

There are nine generic issues related to the fuel cycle and waste management. There are no site-specific issues.

Issues	GEIS Sections[(a)]	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
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

[(a)] NRC 1996

The NRC staff's evaluation of the environmental impacts associated with spent nuclear fuel is addressed in two issues in Table 6–1, "Offsite radiological impacts (spent fuel and high-level waste disposal)" and "Onsite spent fuel." However, as explained later in this chapter, the scope of the evaluation of these two issues in this final supplemental environmental impact statement (FSEIS) has been revised from the discussion in the February 2014 draft SEIS (DSEIS) (NRC 2014a).

For the term of license renewal, the NRC staff did not find any new and significant information related to the remaining uranium fuel cycle and solid waste management issues listed in Table 6–1 during its review of the Davis-Besse Environmental Report (ER) (FENOC 2010), the site visit, 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 SMALL, except for the issue, "Offsite radiological impacts (collective effects)," which the NRC has not assigned an impact level. This issue assesses the 100-year radiation dose to the U.S. population (i.e., collective effects or collective dose) from radioactive effluents released as part of the uranium fuel cycle for a nuclear power plant during the license renewal term compared to the radiation dose from natural background exposure. It is a comparative assessment for which there is no regulatory standard to base an impact level.

The NRC's findings regarding the environmental impacts associated with the renewal of a power reactor operating license are contained in Table B-1, "Summary of Findings on NEPA Issues for License Renewal of Nuclear Power Plants." The table is located in Appendix B to Subpart A of 10 CFR Part 51, "Environmental Effect of Renewing the Operating License of a Nuclear Power Plant"[1] (Table B-1). In 1996, as part of the 10 CFR Part 51 license renewal rulemaking, the NRC determined that offsite radiological impacts of spent nuclear fuel and high-level waste disposal would be a Category 1 (generic) issue with no impact level assigned (61 FR 28467, 28495; June 5, 1996). The NRC analyzed the U.S. Environmental Protection Agency (EPA) generic repository standards and dose limits in existence at the time and concluded that offsite radiological impacts warranted a Category 1 determination (61 FR 28467, 28478; June 5, 1996). In its 2009 proposed rule, the NRC stated its intention to reaffirm that determination (74 FR 38117, 38127; July 31, 2009).

For the offsite radiological impacts resulting from spent fuel and high-level waste disposal and the onsite storage of spent fuel, which will occur after the reactor has been permanently shutdown, the NRC's Waste Confidence Decision and Rule historically represented the Commission's generic determination that spent fuel can continue to be stored safely and without significant environmental impacts for a period of time after the end of the licensed life for operation. This generic determination meant that the NRC did not need to consider the storage of spent fuel after the end of a reactor's licensed life for operation in National Environmental Policy Act (NEPA) documents that support its reactor and spent fuel storage application reviews.

The NRC first adopted the Waste Confidence Decision and Rule in 1984. The NRC amended the decision and rule in 1990, reviewed them in 1999, and amended them again in 2010, as published in the *Federal Register* (FR) (49 FR 34694, 55 FR 38474, 64 FR 68005, and 75 FR 81032 and 81037). The Waste Confidence Decision and Rule are codified in 10 CFR 51.23.

[1] The Commission issued Table B-1 in June 1996 (61 FR 28467; June 5, 1996). The Commission issued an additional rule in December 1996 that made minor clarifying changes to, and added language inadvertently omitted from, Table B-1 (61 FR 66537; December 18, 1996). The NRC revised Table B-1 and other regulations in 10 CFR Part 51, relating to the NRC's environmental review of a nuclear power plant's license renewal application in a 2013 rulemaking (78 FR 37282; June 20, 2013).

On December 23, 2010, the Commission published in the *Federal Register* a revision of the Waste Confidence Decision and Rule to reflect information gained from experience in the storage of spent fuel and the increased uncertainty in the siting and construction of a permanent geologic repository for the disposal of spent nuclear fuel and high-level waste (75 FR 81032 and 81037). In response to the 2010 Waste Confidence Decision and Rule, the States of New York, New Jersey, Connecticut, and Vermont—along with several other parties—challenged the Commission's NEPA analysis in the decision, which provided the regulatory basis for the rule. On June 8, 2012, the United States Court of Appeals, District of Columbia Circuit in New York v. NRC, 681 F.3d 471 (D.C. Cir. 2012) vacated the NRC's Waste Confidence Decision and Rule after finding that it did not comply with NEPA.

In response to the court's ruling, the Commission, in CLI-12-16 (NRC 2012a), determined that it would not issue licenses that rely upon the Waste Confidence Decision and Rule until the issues identified in the court's decision are appropriately addressed by the Commission. In CLI-12-16, the Commission also noted that the decision not to issue licenses only applied to final license issuance; all licensing reviews and proceedings should continue to move forward.

In addition, the Commission directed in SRM-COMSECY-12-0016 (NRC 2012b) that the NRC staff proceed with a rulemaking that includes the development of a generic environmental impact statement (EIS) to support a revised Waste Confidence Decision and Rule and to publish both the EIS and the revised decision and rule in the *Federal Register* within 24 months (by September 2014). The Commission indicated that both the EIS and the revised Waste Confidence Decision and Rule should build on the information already documented in various NRC studies and reports, including the existing environmental assessment that the NRC developed as part of the 2010 Waste Confidence Decision and Rule. The Commission directed that any additional analyses should focus on the issues identified in the court's decision. The Commission also directed that the NRC staff provide ample opportunity for public comment on both the draft EIS and the proposed Waste Confidence Decision and Rule.

As discussed above, in *New York* v. *NRC*, 681 F.3d 471 (D.C. Cir. 2012), the court vacated the Commission's Waste Confidence Decision and Rule (10 CFR 51.23). In response to the court's vacatur, the Commission developed a revised rule and associated "Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel" (NUREG-2157, NRC 2014b). Before the issuance of the revised rule and associated GEIS, the NRC issued the 2013 final license renewal rule, which amended Table B-1—along with other 10 CFR Part 51 regulations. The NRC stated that upon finalization of the revised Waste Confidence Rule and accompanying technical analyses,[2] the agency would make any necessary conforming amendments to Table B-1 (78 FR 37282, 37293; June 20, 2013).

The Continued Storage Rule[3] and accompanying technical analyses were not finalized before the Davis-Besse DSEIS was published. Thus, the environmental impacts for two issues, "Onsite spent fuel" and "Offsite radiological impacts (spent fuel and high-level waste disposal)"[4] were not completed before the February 2014 publication of the license renewal DSEIS for Davis-Besse (NRC 2014a). These two issues, which were contained in the NRC's generic findings for license renewal of nuclear power plants codified in Table B-1, relied on the Commission's previous Waste Confidence Decision and Rule (10 CFR 51.23), which was

[2] At the time of 2013 final license renewal rule, the Continued Storage Rule was referred to as Waste Confidence.

[3] For the purposes of this discussion, the Staff will generally refer to the Continued Storage Rule unless it is specifically referencing an earlier version of the rule.

[4] These two issues were renamed ''Onsite storage of spent nuclear fuel" and ''Offsite radiological impacts of spent nuclear fuel and high-level waste disposal,'' respectively, by the 2013 license renewal rule. See "Revisions to Environmental Review for Renewal of Nuclear Power Plant Operating Licenses," 78 FR 37282–37324 (June 20, 2013).

vacated in *New York* v. *NRC*, 681 F.3d 471 (D.C. Cir. 2012). Therefore, the Davis-Besse DSEIS did not have an analysis of or make an impact determination on the environmental impacts associated with the onsite storage of spent nuclear fuel for the period after the licensed life for operation of a reactor and the offsite impacts of spent nuclear fuel and high-level waste disposal, including possible disposal in a deep geologic repository. Instead, the Davis-Besse DSEIS stated that it would rely on the revised 10 CFR 51.23 and its supporting GEIS to provide the NEPA analyses of the environmental impacts of spent fuel storage at the reactor site or at an away-from-reactor storage facility beyond the licensed life for reactor operations.

On August 26, 2014, the Commission approved a revised rule at 10 CFR 51.23 and associated "Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel" (NUREG-2157, NRC 2014b). Subsequently, on September 19, 2014, the NRC published the revised rule (79 FR 56238) in the *Federal Register,* along with NUREG-2157 (79 FR 56263). The revised rule adopts the generic impact determinations made in NUREG-2157 and codifies the NRC's generic determinations regarding the environmental impacts of continued storage of spent nuclear fuel beyond a reactor's operating license (i.e., those impacts that could occur as a result of the storage of spent nuclear fuel at at-reactor or away-from-reactor sites after a reactor's licensed life for operation and until a permanent repository becomes available). As directed by 10 CFR 51.23(b), the impacts assessed in NUREG-2157 regarding continued storage are deemed incorporated by rule into this Davis-Besse license renewal FSEIS.

In the revised 10 CFR 51.23 Continued Storage Rule, the NRC made conforming changes to the two environmental issues in Table B-1 that were impacted by the vacated Waste Confidence Rule: "Onsite spent fuel" and "Offsite radiological impacts (spent fuel and high-level waste disposal)." Although NUREG-2157 (the technical basis for revised 10 CFR 51.23) does not include high-level waste disposal in the analysis of impacts, it does address the technical feasibility of a repository in Appendix B of NUREG-2157 and concludes that a geologic repository for spent fuel is technically feasible. It also concluded that the same analysis applies to the feasibility of geologic disposal for high-level waste.

The Commission revised the Table B-1 finding for "Onsite storage of spent nuclear fuel" to add the phrase "during the license renewal term" to make clear that the SMALL impact is for the license renewal term only. Some minor clarifying changes are also made to the paragraph. The first paragraph of the column entry now reads, "During the license renewal term, SMALL. The expected increase in the volume of spent nuclear fuel from an additional 20 years of operation can be safely accommodated on site during the license renewal term with small environmental impacts through dry or pool storage at all plants." In addition, a new paragraph is added to address the impacts of onsite storage of spent fuel during the continued storage period. The second paragraph of the column entry reads, "For the period after the licensed life for reactor operations, the impacts of onsite storage of spent nuclear fuel during the continued storage period are discussed in NUREG-2157 and as stated in § 51.23(b), shall be deemed incorporated into this issue." The changes reflect that this issue covers the environmental impacts associated with the storage of spent nuclear fuel during the license renewal term, as well as the period after the licensed life for reactor operations.

In addition, the Table B-1 entry for "Offsite radiological impacts of spent nuclear fuel and high-level waste disposal" was revised to reclassify the impact determination as a Category 1 issue with no impact level assigned. The finding column entry for this issue includes reference to EPA's radiation protection standards for the high-level waste and spent nuclear fuel disposal component of the fuel cycle. Although the status of a repository, including a repository at Yucca Mountain, is uncertain and outside the scope of the generic environmental analysis conducted to support the revised 10 CFR 51.23, the NRC believes that the current radiation standards for Yucca Mountain are protective of public health and safety and the environment.

The changes to these two issues finalize the Table B-1 entries that the NRC had intended to issue in its 2013 license renewal rulemaking but was unable to because the 2010 Waste Confidence Rule had been vacated.

NUREG-2157 concludes that deep geologic disposal remains technically feasible, while the bases for the specific conclusions in Table B-1 are found elsewhere (e.g., the 1996 rule that issued Table B-1 and the 1996 license renewal GEIS, which provided the technical basis for that rulemaking, as reaffirmed by the 2013 rulemaking and final license renewal GEIS). Based on the revised 10 CFR 51.23, the NRC revised these two issues accordingly in Table B-1.

CLI-14-08: Holding that Revised 10 CFR 51.23 and NUREG-2157 Satisfy the NRC's NEPA Obligations for Continued Storage and Directing Staff to Account for Environmental Impacts in NUREG-2157

In CLI-14-08 (NRC 2014c), the Commission held that the revised 10 CFR 51.23 and associated NUREG-2157 cure the deficiencies identified by the court in *New York* v. *NRC*, 681 F.3d 471 (D.C. Cir. 2012) and stated that the rule satisfies the NRC's NEPA obligations with respect to continued storage for initial, renewed, and amended licenses for reactors.

Therefore, the February 2014 Davis-Besse DSEIS, which by rule now incorporates the impact determinations in NUREG-2157 regarding continued storage, contains an analysis for the generic issues of "Onsite storage of spent nuclear fuel" and "Offsite radiological impacts of spent nuclear fuel and high-level waste disposal" that satisfies NEPA. As the Commission noted in CLI-14-08, the NRC staff must account for these environmental impacts before finalizing its licensing decision in this proceeding.

To account for the revised 10 CFR 51.23 and associated NUREG-2157, as well as the impact determinations in NUREG-2157 regarding continued storage that are deemed incorporated into a SEIS for a renewed license, the staff analyzed whether the revised 10 CFR 51.23 and NUREG-2157 present new and significant information such that it could alter the staff's license renewal recommendation. As part of evaluating whether the information would alter the staff license renewal recommendation, the staff examined whether a supplement to the Davis-Besse DSEIS is required under 10 CFR 51.72(a)(2). To merit a supplement, information must be both new and significant and it must bear on the proposed action or its impacts.

Requirements for Supplementing an EIS

As required by 10 CFR 51.72(a), the staff will prepare a supplement to the Davis-Besse DSEIS if the proposed action (issuance of a renewed operating licenses) has not been taken and:

(1) there are substantial changes in the proposed action that are relevant to environmental concerns; or

(2) there are significant new circumstances or information relevant to environmental concerns and bearing on the proposed action or its impacts.

The applicant for the Davis-Besse renewed license has not proposed any changes to the proposed action in this case. Therefore, a supplement is not required under 10 CFR 51.72(a)(1).

The Commission has stated that new information would be considered significant if it presents "a seriously different picture of the environmental impact of the proposed project from what was previously envisioned." Union Electric Co. (Callaway Plant, Unit 2), CLI-11-5, 74 NRC 141, 167-68 (2011); Hydro Resources, Inc. (2929 Coors Road, Suite 101, Albuquerque, NM 87120), CLI-99-22, 50 NRC 3, 14 (1999) (citing Marsh v. Oregon Natural Resources Council, 490 U.S. 360, 373 (1989); Sierra Club v. Froehlke, 816 F.2d 205, 210 (5th Cir. 1987)).

In determining whether new information meets this "seriously different picture" standard, the NRC staff looks to, among other things: previous Commission decisions on claimed new and significant information, previous environmental analyses done for the proposed action at issue, and Marsh, which provides that agency decisions regarding the need to supplement an EIS based on new and significant information are subject to the "rule of reason."

In other proceedings, the Commission explained that if it found any new information that presents a significant new environmental impact that should be addressed in site-specific environmental analyses, the Commission would supplement or otherwise incorporate the information into the environmental analyses, as warranted. See CLI-12-15 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML12159A152). In doing so, the Commission will have provided access to the relevant information and the agency decisionmakers will have considered that information before a final decision on the matter is reached—Hydro Resources, Inc. (2929 Coors Road, Suite 101, Albuquerque, NM 87120), CLI-99-22, 50 NRC 3, 14 (1999).

<u>Analysis of Whether Revised 10 CFR 51.23 and NUREG-2157 Are New and Significant Information</u>

As discussed above, the NRC staff did not evaluate or make an impact determination on the impacts of continued storage of spent fuel beyond the licensed life for reactor operations in the February 2014 Davis-Besse DSEIS. Instead, the NRC staff stated in that DSEIS that it would rely on the revised 10 CFR 51.23 and its supporting GEIS (i.e., NUREG-2157) to provide the NEPA analyses of the environmental impacts of spent fuel storage at the reactor site or at an away-from-reactor storage facility beyond the licensed life for reactor operations. By virtue of revised 10 CFR 51.23, the Davis-Besse FSEIS now incorporates the impact determinations in NUREG-2157 regarding continued storage such that there is a complete analysis of the environmental impacts associated with spent fuel storage beyond the licensed life for reactor operations. The NRC staff has determined that the findings in NUREG-2157 do not paint a seriously different picture from what was previously presented and analyzed in the Davis-Besse DSEIS for the license renewal term. Instead, NUREG-2157 does exactly what the Davis-Besse DSEIS indicated it would do. As discussed above, the public extensively participated in the 10 CFR 51.23 rulemaking process following the court's remand in *New York* v. *NRC*.

The NRC staff also considered whether the revised rule and NUREG-2157 altered the NRC staff's recommendation in the February 2014 Davis-Besse DSEIS that the adverse environmental impacts of license renewal for Davis-Besse are not great enough to deny the option of license renewal for energy planning decisionmakers. After analyzing the impact determinations in NUREG-2157, discussed below, the staff concludes that they do not alter the NRC staff's license renewal recommendation.

<u>At-Reactor Storage</u>

The analysis in NUREG-2157 concludes that the potential impacts of at-reactor storage during the short-term timeframe (the first 60 years after the end-of-licensed life for operations of the reactor) would be SMALL (see Section 4.20 of NUREG-2157). Furthermore, the analysis in NUREG-2157 states that disposal of the spent fuel by the end of the short-term timeframe is the most likely outcome (see Section 1.2 of NUREG-2157). Thus, the potential impacts of at-reactor continued storage during the short-term timeframe are consistent with the evaluation in the Davis-Besse FSEIS regarding the impacts of onsite storage of spent fuel during the license renewal term.

However, the analysis in NUREG-2157 also evaluated the potential impacts of continued storage if the fuel is not disposed of by the end of the short-term timeframe. The analysis in

NUREG-2157 determined that the impacts to historic and cultural resources from at-reactor storage during the long-term timeframe (the 100-year period after the short-term timeframe) and the indefinite timeframe (the period after the long-term timeframe) are dependent on factors that are unpredictable this far in advance. Therefore, the analysis in NUREG-2157 concluded those impacts would be SMALL to LARGE (see Section 4.12 of NUREG-2157).

Among other things, as discussed in NUREG-2157, the NRC cannot accurately determine at this time what resources may be present or discovered at a continued storage site a century or more in the future and whether those resources will be historically or culturally significant to future generations. Additionally, impacts greater than SMALL could occur if the activities to replace an independent spent fuel storage installation (ISFSI) and the dry transfer system (DTS) adversely affect cultural or historic resources, and the effects cannot be mitigated. As discussed in NUREG-2157, given the minimal size of an ISFSI and DTS, and the large land areas at nuclear power plant sites, licensees should be able to locate these facilities away from historic and cultural resources. Potential adverse effects on historic properties or impacts on historic and cultural resources could also be minimized through development of agreements, license conditions, and implementation of the licensee's historic and cultural resource management plans and procedures to protect known historic and cultural resources and address inadvertent discoveries during construction and replacement of these facilities. However, it may not be possible to avoid adverse effects on historic properties under the National Historic Preservation Act of 1966 (NHPA), as amended, or impacts on historic and cultural resources under NEPA. Therefore, the analysis in NUREG-2157 concluded that impacts would be SMALL to LARGE (see Section 4.12.2 of NUREG-2157).

The analysis in NUREG-2157 also concludes that the impacts of nonradioactive waste in the indefinite timeframe would be SMALL to MODERATE, with the higher impacts potentially occurring if the waste from repeated replacement of the ISFSI and DTS exceeds local landfill capacity (see Section 4.15 of NUREG-2157). Although the NRC concluded that nonradioactive waste disposal would not be destabilizing (or LARGE), the range reflects uncertainty regarding whether the volume of nonradioactive waste from continued storage would contribute to noticeable waste management impacts over the indefinite timeframe when considered in the context of the overall local volume of nonradioactive waste.

As previously discussed, the NRC found in NUREG-2157 that disposal of the spent fuel is most likely to occur by the end of the short-term timeframe. Therefore, disposal during the long-term timeframe is less likely, and the scenario depicted in the indefinite timeframe—continuing to store spent nuclear fuel indefinitely—is unlikely. As a result, the most likely impacts of the continued storage of spent fuel are those considered in the short-term timeframe. In the unlikely event that fuel remains on site into the long-term and indefinite timeframes, the associated impact ranges in NUREG-2157 reflect the accordingly greater uncertainties regarding the potential impacts over these very long periods of time. Taking into account the impacts that the NRC considers most likely, which are SMALL; the greater uncertainty reflected in the ranges in the long-term and indefinite timeframes compared to the greater certainty in the SMALL findings; and the relative likelihood of the timeframes, the staff finds that the impact determinations for at-reactor storage presented in NUREG-2157 do not present a seriously different picture of the environmental impacts compared with the staff's analysis in Section 6.1, The Uranium Fuel Cycle, of the Davis-Besse DSEIS, regarding the impacts from spent fuel storage during the license renewal term. The staff concludes that the environmental impacts from at-reactor storage do not alter the NRC staff's license renewal recommendation.

Away-From-Reactor Storage

In NUREG-2157, the NRC concluded that a range of potential impacts could occur for some resource areas if the spent fuel from multiple reactors is shipped to a large (roughly 40,000 Metric Tons Uranium) away-from-reactor ISFSI (see Section 5.20 of NUREG-2157). The ranges for some resources are driven by the uncertainty regarding the location of such a facility and the local resources that would be affected.

For away-from-reactor storage, the unavoidable adverse environmental impacts for most resource areas is SMALL across all timeframes, except for air quality, terrestrial resources, aesthetics, waste management, and transportation, where the impacts are SMALL to MODERATE. Socioeconomic impacts range from SMALL (adverse) to LARGE (beneficial), and historic and cultural resource impacts could be SMALL to LARGE across all timeframes. The potential MODERATE impacts on air quality, terrestrial wildlife, and transportation are based on potential construction-related fugitive dust emissions, terrestrial wildlife direct and indirect mortalities, terrestrial habitat loss, and temporary construction traffic impacts. The potential MODERATE impacts on aesthetics and waste management are based on noticeable changes to the viewshed from constructing a new away-from-reactor ISFSI and the volume of nonhazardous solid waste generated by assumed facility ISFSI and DTS replacement activities for the indefinite timeframe, respectively. The potential LARGE beneficial impacts on socioeconomics are due to local economic tax revenue increases from an away-from-reactor ISFSI.

The potential impacts to historic and cultural resources during the short-term storage timeframe would range from SMALL to LARGE. The magnitude of adverse effects on historic properties and impacts on historic and cultural resources largely depends on where facilities are sited, what resources are present, the extent of proposed land disturbance, whether the area has been previously surveyed to identify historic and cultural resources, and if the licensee has management plans and procedures that are protective of historic and cultural resources. Even a small amount of ground disturbance (e.g., clearing and grading) could affect a small but significant resource. In most instances, placement of storage facilities on the site can be adjusted to minimize or avoid impacts on any historic and cultural resources in the area. However, the NRC recognizes that this may not always be possible. The NRC's site-specific environmental review and compliance with the NHPA process could identify historic properties, identify adverse effects, and potentially resolve adverse effects on historic properties and impacts on other historic and cultural resources. Under the NHPA, mitigation does not eliminate a finding of adverse effect on historic properties.

The potential impacts to historic and cultural resources during the long-term and indefinite storage timeframes would also range from SMALL to LARGE. This range takes into consideration routine maintenance and monitoring (i.e., no ground-disturbing activities), the absence or avoidance of historic and cultural resources, and potential ground-disturbing activities that could affect historic and cultural resources. The analysis also considers uncertainties inherent in analyzing this resource area over long timeframes. These uncertainties include any future discovery of previously unknown historic and cultural resources; resources that gain significance within the vicinity and the viewshed (e.g., nomination of a historic district) due to improvements in knowledge, technology, and excavation techniques and changes associated with predicting resources that future generations will consider significant. If construction of a DTS and replacement of the ISFSI and DTS occurs in an area with no historic or cultural resource present or construction occurs in a previously disturbed area that allows avoidance of historic and cultural resources, then impacts would be SMALL. By contrast, a MODERATE or LARGE impact could result if historic and cultural resources are present at a

site and, because they cannot be avoided, are impacted by ground-disturbing activities during the long-term and indefinite timeframes.

Impacts on Federally listed species, designated critical habitat, and essential fish habitat would be based on site-specific conditions and determined as part of consultations required by the Endangered Species Act and the Magnuson-Stevens Fishery Conservation and Management Act.

Continued storage of spent nuclear fuel at an away-from-reactor ISFSI is not expected to cause disproportionately high and adverse human health and environmental effects on minority and low-income populations. As indicated in the Commission's policy statement on environmental justice, should the NRC receive an application for a proposed away-from-reactor ISFSI, a site-specific NEPA analysis would be conducted. This analysis would include consideration of environmental justice impacts. Thus, the staff finds that the impact determinations for away-from-reactor storage presented in NUREG-2157 do not present a seriously different picture of the environmental impacts compared to the NRC staff's analysis in Section 6.1, The Uranium Fuel Cycle, of the Davis-Besse DSEIS regarding the impacts from spent fuel storage during the license renewal term. The staff concludes that the environmental impacts from away-from-reactor storage do not alter the NRC staff's license renewal recommendation.

Cumulative Impacts

NUREG-2157 examines the incremental impact of continued storage on each resource area analyzed in NUREG-2157 in combination with other past, present, and reasonably foreseeable future actions. NUREG-2157 indicates ranges of potential cumulative impacts for multiple resource areas (see Section 6.5 of NUREG-2157). However, these ranges are primarily driven by impacts from activities other than the continued storage of spent fuel at the reactor site. The impacts from these other activities would occur regardless of whether spent nuclear fuel is stored during the continued storage period. In the short-term timeframe, which is the most likely timeframe for the disposal of the fuel, the potential impacts of continued storage for at-reactor storage are SMALL and would, therefore, not be a significant contributor to the cumulative impacts. In the longer timeframes for at-reactor storage, or in the less likely case of away-from-reactor storage, some of the impacts from the storage of spent nuclear fuel could be greater than SMALL.

As noted in NUREG-2157, other Federal and non-Federal activities occurring during the longer timeframes include uncertainties as well. It is primarily these uncertainties (i.e., ones associated with activities other than continued storage) that contribute to the ranges of potential cumulative impacts discussed throughout Chapter 6 of NUREG-2157 and summarized in Table 6-4 of NUREG-2157. Because, as stated above, the impacts from these other activities would occur regardless of whether continued storage occurs, the overall cumulative impact conclusions in NUREG-2157 would still be the stated ranges, regardless of whether there are impacts of continued storage from any individual licensing action.

Taking into account the impacts that the NRC considers most likely, which are SMALL; the uncertainty reflected by the ranges in some impacts; and the relative likelihood of the timeframes, the staff finds that NUREG-2157 does not present a seriously different picture of the environmental impacts compared to the NRC staff's analysis regarding the cumulative impacts of relicensing Davis-Besse from radiological wastes from the fuel cycle (which includes the impacts associated with spent nuclear fuel storage). The staff concludes that the cumulative environmental impacts do not alter the NRC staff's license renewal recommendation.

Overall Conclusion

The NRC staff analyzed the revised 10 CFR 51.23 and the conclusions in NUREG-2157 to determine whether they present a seriously different picture of the environmental impacts that were discussed in the Davis-Besse DSEIS.

The Davis-Besse DSEIS indicated that it would rely on the revised rule and GEIS for its consideration of the environmental impacts of spent fuel storage and the offsite radiological impacts of spent nuclear fuel and high-level waste disposal. The Commission conducted a rulemaking, which involved extensive public participation, and it has now adopted a revised rule and made generic determinations with respect to those issues, which are discussed in NUREG-2157 and incorporated into the Davis-Besse FSEIS. As previously stated, the Commission held in CLI-14-08 that the revised 10 CFR 51.23 and associated NUREG-2157 satisfy the NRC's NEPA obligations with respect to continued storage as it relates to the issues, "Onsite storage of spent nuclear fuel" and "Offsite radiological impacts of spent nuclear fuel and high level waste disposal" for a renewed license for Davis-Besse. Therefore, the Davis-Besse FSEIS incorporates the generic impact determination codified in the revised rule and supporting NUREG-2157 and does not need to be supplemented.

The revised rule and NUREG-2157 also do not change the NRC staff's determination in the Davis-Besse DSEIS that the adverse environmental impacts of license renewal for Davis-Besse are not great enough to deny the option of license renewal for energy planning decisionmakers. The analysis in NUREG-2157 supports the conclusion that the most likely impacts of continued storage are those discussed for at-reactor storage. For continued at-reactor storage, impacts in the short-term timeframe would be SMALL. Over the longer timeframes, impacts to certain resource areas would be a range (for historic and cultural resources during both the long-term and indefinite timeframes the range is SMALL to LARGE and for nonradioactive waste during the indefinite timeframe the range is SMALL to MODERATE). In NUREG-2157, the NRC stated that disposal of the spent fuel before the end of the short-term timeframe is most likely. There are inherent uncertainties in determining impacts for the long-term and indefinite timeframes, and, with respect to some resource areas, those uncertainties could result in impacts that, although less likely, could be larger than those that are to be expected at most sites and have, therefore, been presented as ranges rather than as a single impact level. Those uncertainties exist, however, regardless of whether the impacts are analyzed generically or site-specifically. As a result, these impact ranges provide correspondingly more limited insights to the decisionmaker in the overall picture of the environmental impacts from the proposed action (i.e., license renewal).

The NRC staff concludes that when weighed against the array of other fuel cycle impacts presented in the February 2014 Davis-Besse DSEIS, and the more likely impacts of continued storage during the short-term timeframe in NUREG-2157, which are SMALL, the uncertainties associated with the impact ranges for the long-term and indefinite timeframes do not present a seriously different picture of the direct, indirect, and cumulative environmental impacts compared to the NRC staff's analysis of the impacts from issuance of a renewed operating license for Davis-Besse attributable to the uranium fuel cycle and waste management (which includes the impacts associated with spent fuel storage). Additionally, for the reasons discussed above, continued at-reactor storage is not expected to contribute noticeably to cumulative impacts. In addition, the revised rule and the impact determinations contained in NUREG-2157 also do not alter the NRC staff's recommendation in the February 2014 Davis-Besse DSEIS that the adverse environmental impacts of license renewal for Davis-Besse are not great enough to deny the option of license renewal for energy planning decisionmakers.

6.2 Greenhouse Gas Emissions

This section discusses the potential impacts from greenhouse gases (GHGs) emitted from 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 done. Additionally, considerable debate exists among researchers regarding the relative effects of nuclear and other forms of electricity generation on GHG emissions. Existing studies on GHG emissions from nuclear power plants generally take one of the following forms:

- qualitative discussions of the potential to use nuclear power to reduce GHG emissions and mitigate global warming or
- 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 on whether an expansion of nuclear power is likely to be a technically, economically, or politically workable means of achieving global GHG reductions. Studies found by the U.S. Nuclear Regulatory Commission (NRC) staff during the subsequent literature search include the following:

- Evaluations determined if 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 (IAEA 2000; NEA 2002; Schneider 2000). 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 were developed to assist governments, including the U.S. Government, in making long-term investment and public policy decisions in nuclear power (Hagen et al. 2001; Keepin 1988; MIT 2003).

Although the qualitative studies sometimes reference and analyze 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 to address 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 (2008), Fritsche (2006), Parliamentary Office of Science and Technology (POST) (2006), Atomic Energy Authority (AEA) (2006), Weisser (2006), Dones (2007), and Fthenakis and Kim (2007).

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

- 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. For example, a full lifecycle analysis will typically address plant construction, operations, resource extraction (for fuel and construction materials), and decommissioning. 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 above-mentioned 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 supply 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 Table 6–2, Table 6–3, and Table 6–4, the NRC staff presents the results of the above-mentioned quantitative studies to supply 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 show 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.

6.2.1.3 Summary of Nuclear Greenhouse Gas Emissions Compared to Coal

Considering that coal fuels the largest share of electricity generation in the U.S., and that its burning results in the largest emissions of GHGs for any of the likely alternatives to nuclear power generation (including Davis-Besse), 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. This table does not include all existing studies, but it gives an illustrative range of estimates developed by various sources.

Table 6–2. Nuclear GHG Emissions Compared to Coal

Source	GHG Emission Results
Mortimer (1990)	Nuclear—230,000 tons CO_2/year Coal—5,912,000 tons CO_2/year Note: Future GHG emissions from nuclear will increase because of declining ore grade to less than 0.01% uranium oxide.
Andseta et al. (1998)	Nuclear energy produces 1.4% 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—2.5–5.7 grams (g) of carbon equivalent per kilowatt hour (C_{eq}/kWh) Coal—264–357 g C_{eq}/kWh
Storm van Leeuwen & Smith (2008)	Authors did not evaluate nuclear versus coal.
Fritsche (2006) (Values estimated from graph in Figure 4)	Nuclear—33 g C_{eq}/kWh Coal—950 g C_{eq}/kWh
POST (2006) (Nuclear calculations from AEA 2006)	Nuclear—5 g C_{eq}/kWh Coal—>1000 g C_{eq}/kWh Note: Decrease of uranium ore grade to 0.03% would increase nuclear to 6.8 g C_{eq}/kWh. Future improved technology and carbon capture and storage could reduce coal-fired GHG emissions by 90%.
Weisser (2006) (Compilation of results from other studies)	Nuclear—2.8–24 g C_{eq}/kWh Coal—950–1250 g C_{eq}/kWh
Fthenakis & Kim (2007)	Authors did not evaluate nuclear versus coal.
Dones (2007)	Author did not evaluate nuclear versus coal.

6.2.1.4 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 combined cycle-fired plant, are presented in Table 6–3. This table does not include all existing studies, but it gives an illustrative range of estimates developed by various sources.

Table 6–3. Nuclear GHG Emissions Compared to Natural Gas

Source	GHG Emission Results
Mortimer (1990)	Author did not evaluate nuclear versus natural gas.
Andseta et al. (1998)	Author did not evaluate nuclear versus natural gas.
Spadaro (2000)	Nuclear—2.5–5.7 g C_{eq}/kWh Natural Gas—120–188 g C_{eq}/kWh
Storm van Leeuwen & Smith (2008)	Nuclear fuel cycle produces 20–33% of the GHG emissions compared to natural gas (at high ore grades). Note: Future nuclear GHG emissions will increase because of ore grade declining to less than 0.01% uranium oxide.
Fritsche (2006) (Values estimated from graph in Figure 4)	Nuclear—33 g C_{eq}/kWh Cogeneration Combined Cycle Natural Gas—150 g C_{eq}/kWh
POST (2006) (Nuclear calculations from AEA 2006)	Nuclear—5 g C_{eq}/kWh Natural Gas—500 g C_{eq}/kWh Note: Decrease of uranium ore grade to 0.03% would increase nuclear to 6.8 g C_{eq}/kWh. Future improved technology and carbon capture and storage could reduce natural gas GHG emissions by 90%.
Weisser (2006) (Compilation of results from other studies)	Nuclear—2.8–24 g C_{eq}/kWh Natural Gas—440–780 g C_{eq}/kWh
Fthenakis & Kim (2007)	Authors did not evaluate nuclear versus natural gas.
Dones (2007)	Author analyzed methods and assumptions of Storm van Leeuwen and Smith (2008) and concluded that the nuclear fuel cycle produces 15–27% of the GHG emissions of natural gas.

6.2.1.5 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. As noted in Section 6.2.1.2, the following table does not include all existing studies, but it gives an illustrative range of estimates developed by various sources.

Table 6–4. Nuclear GHG Emissions Compared to Renewable Energy Sources

Source	GHG Emission Results
Mortimer (1990)	Nuclear—230,000 tons CO_2/year Hydropower—78,000 tons CO_2/year Wind power—54,000 tons CO_2/year Tidal power—52,500 tons CO_2/year Note: Future GHG emissions from nuclear will increase because of declining ore grade to less than 0.01% uranium oxide.
Andseta et al. (1998)	Author did not evaluate nuclear versus renewable energy sources.
Spadaro (2000)	Nuclear—2.5–5.7 g C_{eq}/kWh Solar Photovoltaic (PV)—27.3–76.4 g C_{eq}/kWh Hydroelectric—1.1–64.6 g C_{eq}/kWh Biomass—8.4–16.6 g C_{eq}/kWh Wind—2.5–13.1 g C_{eq}/kWh
Storm van Leeuwen & Smith (2008)	Author did not evaluate nuclear versus renewable energy sources.
Fritsche (2006) (Values estimated from graph in Figure 4)	Nuclear—33 g C_{eq}/kWh Solar PV—125 g C_{eq}/kWh Hydroelectric—50 g C_{eq}/kWh Wind—20 g C_{eq}/kWh
POST (2006) (Nuclear calculations from AEA 2006)	Nuclear—5 g C_{eq}/kWh Biomass—25–93 g C_{eq}/kWh Solar PV—35–58 g C_{eq}/kWh Wave/Tidal—25–50 g C_{eq}/kWh Hydroelectric—5–30 g C_{eq}/kWh Wind—4.64–5.25 g C_{eq}/kWh Note: Decrease of uranium ore grade to 0.03% would increase nuclear to 6.8 g C_{eq}/kWh.
Weisser (2006) (Compilation of results from other studies)	Nuclear—2.8–24 g C_{eq}/kWh Solar PV—43–73 g C_{eq}/kWh Hydroelectric—1–34 g C_{eq}/kWh Biomass—35–99 g C_{eq}/kWh Wind—8–30 g C_{eq}/kWh
Fthenakis & Kim (2007)	Nuclear—16–55 g C_{eq}/kWh Solar PV—17–49 g C_{eq}/kWh
Dones (2007)	Author did not evaluate nuclear versus renewable energy sources.

6.2.2 Conclusions: Relative Greenhouse Gas Emissions

The sampling of data presented in Table 6–2, Table 6–3, and Table 6–4 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 methods 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 show a consensus that nuclear power currently produces fewer GHG emissions than fossil-fuel-based electrical generation. 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 1,250 g C_{eq}/kWh) and natural gas plants (120 to 780 g C_{eq}/kWh). The studies

also give 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 show no consensus regarding future relative GHG emissions from nuclear power and other sources of electricity. There is substantial disagreement among the various authors about the GHG emissions associated with declining uranium ore concentrations, future uranium enrichment methods, and other factors to include changes in technology. Similar disagreement exists about 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 it 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 actually occur.

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

- As shown in Table 6–2 and Table 6–3, the current estimates of GHG emissions from the nuclear fuel cycle are far below those for fossil-fuel-based energy sources.
- License renewal of a nuclear power plant like Davis-Besse will involve continued GHG emissions due to uranium mining, processing, and enrichment, but it 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).
- A few studies (e.g., Mortimer 1990, Storm van Leeuwen and Smith 2008) predict that nuclear lifecycle GHG emissions will exceed those of fossil fuels as a result of declining ore grade; however, it is not expected for nuclear lifecycle GHG emissions to exceed those of fossil fuels within the timeframe that includes the period of extended operation of Davis-Besse.

With respect to comparison of GHG emissions among the proposed Davis-Besse license renewal action and renewable energy sources, it appears likely that there will be future technology improvements and changes in the type of energy used for mining, processing, and constructing facilities of all types. Currently, the lifecycle GHG emissions associated with nuclear power and renewable energy sources are of comparable magnitude. It is likely that GHG emissions from renewable energy sources and those associated with Davis-Besse will remain comparable during the period of extended operation.

The NRC staff also supplies an additional discussion about the contribution of GHG to cumulative air quality impacts in Section 4.11.2 of this supplemental environmental impact statement (SEIS).

6.3 References

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

49 FR 34658. U.S. Nuclear Regulatory Commission. "Waste Confidence Decision and Requirements for Licensee Actions Regarding the Disposition of Spent Fuel Upon Expiration of Reactor Operating Licenses; Final Rules." *Federal Register* 49 (171):34658–34696. August 31, 1984.

55 FR 38472. U.S. Nuclear Regulatory Commission. "Consideration of Environmental Impacts of Temporary Storage of Spent Fuel after Cessation of Reactor Operation; and Waste Confidence Decision Review; Final Rules." *Federal Register* 55 (181):38472–38514. September 18, 1990.

61 FR 28467. U.S. Nuclear Regulatory Commission. "Environmental Review for Renewal of Nuclear Power Plant Operating Licenses. Final Rule." *Federal Register* 61 (109):28467–28497. June 5, 1996.

61 FR 66537. U.S. Nuclear Regulatory Commission. "Environmental Review for Renewal of Nuclear Power Plant Operating Licenses." *Federal Register* 61 (244):66537–66544. December 18, 1996.

64 FR 68005. U.S. Nuclear Regulatory Commission. "Waste Confidence Decision Review: Status." *Federal Register* 64 (233):68005–68007. December 6, 1999.

74 FR 38117. U.S. Nuclear Regulatory Commission. "Revisions to Environmental Review for Renewal of Nuclear Power Plant Operating Licenses." Proposed Rule. *Federal Register* 74 (146):38117–38140. July 31, 2009.

75 FR 81032. U.S. Nuclear Regulatory Commission. "Consideration of Environmental Impacts of Temporary Storage of Spent Fuel after Cessation of Reactor Operation." *Federal Register* 75 (246):81032–81037. December 23, 2010.

75 FR 81037. U.S. Nuclear Regulatory Commission. "Waste Confidence Decision Update." *Federal Register* 75 (246):81037–81076. December 23, 2010.

78 FR 37282. U.S. Nuclear Regulatory Commission. "Revisions to Environmental Review for Renewal of Nuclear Power Plant Operating Licenses." *Federal Register* 78 (119):37282–37324. June 20, 2013.

79 FR 56238. U.S. Nuclear Regulatory Commission. "Continued Storage of Spent Nuclear Fuel." *Federal Register* 79 (182):56238–56263. September 19, 2014.

79 FR 56263. U.S. Nuclear Regulatory Commission. "Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel." *Federal Register* 79 (182):56263–56264. September 19, 2014.

[D.C. Circuit 2012] New York v. NRC (State of New York et al. v. U.S. Nuclear Regulatory Commission). 681 F.3d 471 (D.C. Cir. 2012). Agencywide Documents Access and Management System (ADAMS) Accession No. ML12191A407.

[AEA] Atomic Energy Authority Technology. 2006. "Carbon Footprint of the Nuclear Fuel Cycle, Briefing Note," Prepared for British Energy, March 2006.

Andseta et al. 1998. "CANDU Reactors and Greenhouse Gas Emissions," Canadian Nuclear Association, 11th Pacific Basin Nuclear Conference, Banff, Alberta, Canada, May.

Dones, R. 2007. “Critical Note on the Estimation by Storm Van Leeuwen J.W., and Smith P. of the Energy Uses and Corresponding CO_2 Emissions for the Complete Nuclear Energy Chain,” Paul Sherer Institute, April.

Endangered Species Act of 1973, as amended. 16 U.S.C. §1531–1544.

[FENOC] FirstEnergy Nuclear Operating Company. 2010. “Davis-Besse Nuclear Power Station License Renewal Application,” Toledo, OH, August 2010. ADAMS Accession No. ML102450572.

Fritsche, U.R. 2006. “Comparison of Greenhouse-Gas Emissions and Abatement Cost of Nuclear and Alternative Energy Options from a Life-Cycle Perspective,” Oko-Institut, Darmstadt Office, January.

Fthenakis, V.M. and H.C. Kim. 2007. “Greenhouse-Gas Emissions from Solar-Electric and Nuclear Power: A Life Cycle Study,” *Energy Policy*, Volume 35, Number 4.

Hagen, R.E. et al. 2001. “Impact of U.S. Nuclear Generation on Greenhouse Gas Emissions,” IAEA, Vienna, Austria, November.

[IAEA] International Atomic Energy Agency. 2000. “Nuclear Power for Greenhouse Gas Mitigation under the Kyoto Protocol: The Clean Development Mechanism (CDM),” November.

Keepin, B. 1988. “Greenhouse Warming: Efficient Solution of Nuclear Nemesis?,” Rocky Mountain Institute, Joint Hearing on Technologies for Remediating Global Warming, Subcommittee on Natural Resources, Agriculture Research and Environment and Subcommittee on Science, Research and Technology, U.S. House of Representatives, June.

Magnuson–Stevens Fishery Conservation and Management Act, as amended (MSFCMA). 16 U.S.C. §1801–1884.

[MIT] Massachusetts Institute of Technology. 2003. “The Future of Nuclear Power: An Interdisciplinary MIT Study,” 2003.

Mortimer, N. 1990. “World Warms to Nuclear Power,” *SCRAM Safe Energy Journal*, December 1989 and January. Available URL: <http://www.no2nuclearpower.org.uk/articles/mortimer_se74.php> (accessed 15 July 2010).

National Environmental Policy Act of 1969, as amended (NEPA). 42 U.S.C. §4321 et seq.

National Historic Preservation Act of 1966 (NHPA). 16 U.S.C. §470 et seq.

[NEA] Nuclear Energy Agency. 2002. *Nuclear Energy and the Kyoto Protocol*, Organization for Economic Co-Operation and Development.

[NRC] U.S. Nuclear Regulatory Commission. 1996. G*eneric Environmental Impact Statement for License Renewal of Nuclear Plants*, NUREG-1437, Washington, D.C., May. ADAMS Accession Nos. ML040690705 and ML040690738.

[NRC] U.S. Nuclear Regulatory Commission. 1999. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Main Report*, NUREG-1437, Section 6.3, Table 9.1, Volume 1, Addendum 1, Washington, D.C.

[NRC] U.S. Nuclear Regulatory Commission. 2012a. “Commission, Memorandum and Order CLI-12-16.” August 7, 2012. ADAMS Accession No. ML12220A094.

[NRC] U.S. Nuclear Regulatory Commission. 2012b. “SRM-COMSECY-12-0016—Approach for Addressing Policy Issues Resulting from Court Decision To Vacate Waste Confidence Decision and Rule.” September 6, 2012. ADAMS Accession No. ML12250A032.

[NRC] U.S. Nuclear Regulatory Commission. 2013. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*. Washington, DC: NRC. NUREG–1437, Revision 1. June 2013. ADAMS Accession No. ML13107A023.

[NRC] U.S. Nuclear Regulatory Commission. 2014a. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Supplement 52: Regarding Davis-Besse Nuclear Power Station, Draft Report for Comment*. Washington, DC: NRC. NUREG-1437, Supplement 52. February 2014. ADAMS Accession No. ML14050A290.

[NRC] U.S. Nuclear Regulatory Commission. 2014b. *Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel*. Washington, DC: NRC. NUREG–2157, Volumes 1 and 2. September 2014. ADAMS Accession Nos. ML14196A105 and ML14196A107.

[NRC] U.S. Nuclear Regulatory Commission. 2014c. "Commission, Memorandum and Order CLI-14-08." August 26, 2014. ADAMS Accession No. ML14238A242.

[POST] Parliamentary Office of Science and Technology. 2006. "Carbon Footprint of Electricity Generation," Postnote, No. 268, October.

Schneider, M. 2000. *Climate Change and Nuclear Power*, World Wildlife Fund for Nature, April.

Spadaro, J.V., et al. 2000. "Greenhouse Gas Emissions of Electricity Generation Chains: Assessing the Difference," *IAEA Bulletin 42/2/2000*, Vienna, Austria.

Storm van Leeuwen, J.W. and P. Smith. 2008. *Nuclear Power—The Energy Balance*, Chaam, Netherlands: Ceedata Consultancy. February 2008. Available URL: <http://www.stormsmith.nl/> (accessed 22 May 2012).

Weisser, D. 2006. "A Guide to Life-Cycle Greenhouse Gas (GHG) Emissions from Electric Supply Technologies," Available URL: <http://www.iaea.org/OurWork/ST/NE/Pess/assets/GHG_manuscript_pre-print_versionDanielWeisser.pdf> (accessed 24 November 2010).

7.0 ENVIRONMENTAL IMPACTS OF DECOMMISSIONING

Environmental impacts from the activities associated with the decommissioning of any reactor before, or at the end of, an initial or renewed license are evaluated in the *Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities: Supplement 1, Regarding the Decommissioning of Nuclear Power Reactors*, NUREG 0586, Supplement 1 (NRC 2002). The U.S. Nuclear Regulatory Commission (NRC) staff's evaluation of the environmental impacts of decommissioning—presented in NUREG 0586, Supplement 1—notes a range of impacts for each environmental issue.

Additionally, the incremental environmental impacts associated with decommissioning activities resulting from continued plant operation during the renewal term are discussed in NUREG-1437, *Generic Environmental Impact Statement (GEIS) for License Renewal of Nuclear Plants* (NRC 1996, 1999, 2013). The GEIS includes a determination of whether the analysis of the environmental issues could be applied to all plants and whether additional mitigation measures would be warranted. The NRC staff then assigned these issues a Category 1 or a Category 2 designation. Section 1.4 of this SEIS explains the criteria for Category 1 and Category 2 issues and defines the impact designations of SMALL, MODERATE, and LARGE. The NRC staff analyzed site-specific issues (Category 2) for the Davis-Besse Nuclear Power Station, Unit No. 1 (Davis-Besse) and assigned them a significance level of SMALL, MODERATE, or LARGE, or not applicable to Davis-Besse because of site characteristics or plant features. The NRC staff determined that there are no Category 2 issues related to decommissioning, only the Category 1 issues discussed below.

Regarding the offsite radiological impacts resulting from spent fuel and high-level waste disposal and the onsite storage of spent fuel, which will occur after the reactors have been permanently shut down, the NRC's Waste Confidence Rule (i.e., Title 10 of the *Code of Federal Regulations* (10 CFR) 51.23) represented the Commission's generic determination that spent fuel can continue to be stored safely and without significant environmental impacts for a period of time after the end of the licensed life for operation. This generic determination meant that the NRC did not need to consider the storage of spent fuel after the end of a reactor's licensed life for operation in National Environmental Policy Act (NEPA) documents that support the NRC's reactor and spent fuel storage application reviews.

However, as discussed in Chapter 6 of this SEIS, the Commission's Waste Confidence Rule was vacated on June 8, 2012, by the United States Court of Appeals, District of Columbia. In response to the court's ruling, the Commission directed the NRC staff to proceed with a rulemaking that includes the development of a generic environmental impacts statement (EIS) to support a revised Waste Confidence Rule.

On August 26, 2014, the Commission approved a revised rule at 10 CFR 51.23 and associated "Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel" (NUREG-2157, NRC 2014). Subsequently, on September 19, 2014, the NRC published the revised rule in the *Federal Register* (FR) (79 FR 56238) along with NUREG-2157 (79 FR 56263). The revised rule adopts the generic impact determinations made in NUREG-2157 and codifies the NRC's generic determinations regarding the environmental impacts of continued storage of spent nuclear fuel beyond a reactor's operating license (i.e., those impacts that could occur as a result of the storage of spent nuclear fuel at at-reactor or away-from-reactor sites after a reactor's licensed life for operation and until a permanent repository becomes available). As directed by 10 CFR 51.23(b), the impacts assessed in NUREG-2157 regarding continued storage are deemed incorporated by rule into this Davis-Besse license renewal FSEIS.

The issue of spent nuclear fuel and the Continued Storage Rule is discussed in more detail in Chapter 6 of this SEIS.

Table 7–1 lists the Category 1 issues in Table B-1 of Appendix B to Subpart A of 10 CFR Part 51 that apply to Davis-Besse decommissioning following the proposed renewal term.

Table 7–1. 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

Source: 61 FR 28467, June 5, 1996

Decommissioning would occur regardless of whether Davis-Besse is shut down at the end of its current operating license or at the end of the proposed period of extended operation. There are no site-specific (Category 2) issues related to decommissioning.

A brief description of the NRC staff's review and the GEIS (NRC 1996, 1999) conclusions—as codified in Table B-1 of 10 CFR Part 51—for each of the issues follows:

- Radiation doses. Based on information in the GEIS, the NRC noted that "[d]oses 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 person rem (1 person mSv) caused by buildup of long lived radionuclides during the license renewal term."
- Waste management. Based on information in the GEIS, the NRC noted that "[d]ecommissioning 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. Based on information in the GEIS, the NRC noted that "[a]ir 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. Based on information in the GEIS, the NRC noted that "[t]he 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. Based on information in the GEIS, the NRC noted that "[d]ecommissioning 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. Based on information in the GEIS, the NRC noted that "[d]ecommissioning would have some short term socioeconomic impacts. The impacts would not be increased by delaying decommissioning until the

end of a 20 year relicense period, but they might be decreased by population and economic growth."

The NRC staff has not identified any new and significant information, as it relates to decommissioning, during the review of the FirstEnergy Nuclear Operating Company's (FENOC's) environmental report (ER) (FENOC, 2010), 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 the issues listed in Table 7.1-1 above, the GEIS concluded that the impacts are SMALL.

7.1 References

10 CFR Part 51. *Code of Federal Regulations*, Title 10, *Energy*, Part 51, "Environmental protection regulations for domestic licensing and related regulatory functions."

61 FR 28467. U.S. Nuclear Regulatory Commission. "Environmental Review for Renewal of Nuclear Power Plant Operating Licenses." *Federal Register* 61(109):28467–28497. June 5, 1996.

79 FR 56238. U.S. Nuclear Regulatory Commission. "Continued Storage of Spent Nuclear Fuel." *Federal Register* 79 (182):56238–56263. September 19, 2014.

79 FR 56263. U.S. Nuclear Regulatory Commission. "Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel." *Federal Register* 79(182):56263–56264. September 19, 2014.

[FENOC] FirstEnergy Nuclear Operating Company. 2010. "Davis-Besse Nuclear Power Station License Renewal Application," Toledo, OH, August 2010, Agencywide Documents Access and Management System (ADAMS) Accession No. ML102450572.

[NRC] U.S. Nuclear Regulatory Commission. 1996. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*, Washington, DC: NRC. NUREG-1437, May 1996. ADAMS Accession Nos. ML040690705 and ML040690738.

[NRC] U.S. Nuclear Regulatory Commission. 1999. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Main Report*, Washington, DC: NRC. NUREG-1437, Section 6.3, Table 9.1, Volume 1, Addendum 1, August 1999. ADAMS Accession No. ML04069720.

[NRC] U.S. Nuclear Regulatory Commission. 2002. *Generic Environmental Impact Statement for Decommissioning of Nuclear Facilities: Supplement 1, Regarding the Decommissioning of Nuclear Power Reactors*, Washington, DC: NRC. NUREG-0586, November 2002. ADAMS Accession Nos. ML023500395 and ML023500223.

[NRC] U.S. Nuclear Regulatory Commission. 2013. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*. Washington, DC: NRC. NUREG–1437, Revision 1, June 2013. ADAMS Accession No. ML13107A023.

[NRC] U.S. Nuclear Regulatory Commission. 2014. *Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel*. Washington, DC: NRC. NUREG–2157, Volumes 1 and 2, September 2014. ADAMS Accession Nos. ML14196A105 and ML14196A107.

8.0 ENVIRONMENTAL IMPACTS OF ALTERNATIVES

The National Environmental Policy Act (NEPA) requires that Federal agencies consider reasonable alternatives to the proposed action in an environmental impact statement (EIS). In this case, the proposed action is issuance of a renewed license for the Davis-Besse Nuclear Power Station (Davis-Besse), which will allow the plant to operate for 20 years beyond its current license expiration date.

An operating license, however, is just one of many authorizations that an applicant must obtain in order to operate a nuclear plant. Energy-planning decisionmakers and the owners of the nuclear power plant ultimately decide whether the plant will continue to operate, and economic and environmental considerations play important roles in this decision. In general, the U.S. Nuclear Regulatory Commission's (NRC's) responsibility is to ensure the safe operation of nuclear power facilities and not to formulate energy policy or encourage or discourage the development of alternative power generation.

The license renewal review process is designed to assure safe operation of the nuclear power plant during the license renewal term. Under the NRC's environmental protection regulations in Title 10, Part 51, of the *Code of Federal Regulations* (10 CFR Part 51), which implement Section 102(2) of NEPA, renewal of a nuclear power plant operating license also requires the preparation of an EIS.

To support the preparation of these EISs, the NRC prepared the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants (GEIS)*, NUREG-1437, in 1996. The NRC prepared the 1996 GEIS to assess the environmental impacts associated with the continued operation of nuclear power plants during the license renewal term, disposition environmental issues that result in essentially the same impact at all nuclear power plants (or all plants with similar characteristics), and identify issues that require a plant-specific analysis to determine impacts. The NRC addressed plant-specific issues in a supplemental environmental impact statement (SEIS).

NRC regulations in 10 CFR 51.91(d) require that the NRC staff documents the following in a final SEIS:

> ….include a final analysis and a final recommendation on the action to be taken.

In this chapter, the NRC staff examines the potential environmental impacts of alternatives to license renewal for Davis-Besse and, where applicable, considers alternatives that may reduce or avoid adverse environmental impacts from the proposed license renewal.

While the 1996 GEIS reached generic conclusions regarding many environmental issues associated with license renewal, it did not determine which alternatives are reasonable, and it did not reach conclusions about site-specific environmental impact levels for alternatives. As such, the NRC must evaluate the environmental impacts of alternatives on a site-specific basis.

As stated in Chapter 1 of this document, alternatives to the proposed action of license renewal for Davis-Besse must meet this purpose and need for the proposed action; they must do the following (NRC 1996):

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

The NRC ultimately makes no decision about which alternative (or the proposed action) to carry out because that decision falls to utility, state, or other Federal officials. Comparing the environmental effects of these alternatives, however, will help the NRC decide whether the adverse environmental impacts of license renewal are so great as to deny the option of license renewal for energy-planning decisionmakers (10 CFR 51.95(c)(4)). If the NRC acts to issue a renewed license, then all of the alternatives, including the proposed action, will be available to energy-planning decisionmakers. If the NRC decides not to renew the license (or takes no action at all), then energy-planning decisionmakers may no longer elect to continue operating Davis-Besse and will have to resort to another alternative—which may or may not be one of the alternatives considered in this section—to meet their energy needs now being satisfied by Davis-Besse.

Alternatives Evaluated In-Depth:

- natural gas-fired combined-cycle (NGCC);
- combination alternative (wind, solar, NGCC, and compressed air energy storage); and
- coal-fired power.

Other Alternatives Considered:

- wind power,
- wind power with compressed air energy storage,
- solar power,
- solar power with compressed air energy storage,
- wood waste,
- conventional hydroelectric power,
- ocean wave and current energy,
- geothermal power,
- municipal solid waste (MSW),
- biofuels,
- oil-fired power,
- fuel cells,
- energy conservation and energy efficiency, and
- purchased power.

In evaluating alternatives to license renewal, the NRC staff considers energy technologies or options that are 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 Davis-Besse operating license expires on April 22, 2017. Reasonable alternatives must be available (constructed, permitted, and connected to the grid) by the time the current license expires to be considered likely to become available. Because the applicant submitted the license renewal application more than 5 years prior to the expiration date of the current operating license as specified in 10 CFR Part 2, then the current operating license will remain in effect, and thus will be deemed not to have expired, until the NRC has completed the review and made the final decision to either deny the application or issue a new operating license for the period of extended operation. Alternatives that cannot meet future system needs by providing amounts of baseload power equivalent to Davis-Besse's current generating capacity and, in some cases, those alternatives whose costs or benefits do not justify inclusion in the range of reasonable alternatives were eliminated from detailed study. The remaining alternatives were evaluated and are discussed in depth in this chapter. Each alternative eliminated from detailed study is briefly discussed, and a basis for its removal is provided at the end of this section. In total, 17 energy technology options and alternatives to the proposed action were considered (see text box) and then narrowed to the three alternatives considered in Sections 8.1 through 8.3. A summary of these alternatives considered in depth is provided in Table 8–1.

Table 8–1. Summary of Alternatives Considered in Depth

	Natural Gas (NGCC) Alternative	Combination Alternative	Supercritical Pulverized Coal (SCPC) Alternative
Summary of Alternative	Two NGCC units for a total of 910 MW	Wind: 1,500 MW of installed wind capacity (315 MW for baseload; 360 MW to power CAES facility) Solar: 400 MW of installed solar PV (75 MW for baseload; 75 MW to power CAES) NGCC: One 305 MW unit	Two to three SCPC units for a total of 910 MW
Location	Davis-Besse; maximum use of existing transmission and cooling system infrastructures; Some pipeline transmission system upgrades may be required	Wind: Onshore wind projects would be spread across multiple sites throughout Ohio and CAES would be located at Norton Energy Storage Project in Norton, Ohio Solar: PV facility would likely be located on agricultural land in Ohio; CAES would be located at Norton Energy Storage Project in Norton, Ohio NGCC: Plant would be located at Davis-Besse site and use existing transmission and cooling system infrastructures	Alternative location due to space limitations at Davis-Besse site (FENOC 2011); Preferably an existing power plant site or brownfield site
Cooling System	Closed-cycle with one natural draft cooling tower; Consumptive water use would be less than Davis-Besse (FENOC 2011)	Wind/Solar: CAES would use small-scale cooling towers; NGCC: Plant would use closed-cycle cooling with one natural draft cooling tower; Total: Consumptive water use from CAES and NGCC unit considerably less than Davis-Besse	Closed-cycle cooling system with one natural draft cooling tower; Consumptive water use would be similar to Davis-Besse (FENOC 2011)
Land Requirements	110 ac (40.5 ha) land needed for the plant; 150 ac (61 ha) land needed for 25-mi pipeline (NRC 1996)	Wind: 75,000 ac (30,000 ha), with construction disturbance of 3,750 ac (1,517 ha) (FENOC 2011) Solar: 2,400 ac (970 ha) (NREL 2008) NGCC: Plant would require approximately 1/3 less than NGCC alternative; Pipeline would require 150 ac (61 ha)	1,547 ac (626 ha) for the plant (FENOC 2011)
Work Force	1,092 to 2,275 during construction; 137 during operations (FENOC 2011)	Wind: 200 during construction; 50 during wind farm operations Solar: 200 during construction; 50 for PV facility operations CAES: 50 to 100 workers for CAES facility operations (FENOC 2011) NGCC: 150 to 500 during construction; 91 during operations	1,092 to 2,275 during construction; 228 during operations (FENOC 2011)

The 1996 GEIS presents an overview of some energy technologies but does not reach any conclusions about which alternatives are most appropriate for a given license renewal. Since 1996, many energy technologies have evolved significantly in capability and cost while regulatory structures have changed to either promote or impede development of particular alternatives.

As a result, the analyses include updated information from the following sources:

- Energy Information Administration (EIA),
- other offices within the Department of Energy (DOE),
- U.S. Environmental Protection Agency (EPA),
- industry sources and publications, and
- information submitted by FirstEnergy Nuclear Operating Company (FENOC) in its Environmental Report (ER).

The evaluation of each alternative considers the environmental impacts across seven impact categories: (1) air quality, (2) groundwater use and quality, (3) surface water use and quality, (4) ecology, (5) human health, (6) socioeconomics, and (7) waste management. A three-level standard of significance—SMALL, MODERATE, or LARGE—is used to indicate the intensity of environmental effects for each alternative undergoing in depth evaluation. The order of presentation is not meant to imply increasing or decreasing level of impact, and it does not imply that an energy-planning decisionmaker would select one or another alternative.

In some cases, the NRC considers the environmental effects of locating an alternative at the existing plant site. Selecting the existing plant site allows for the maximum use of existing transmission and cooling system infrastructures and minimizes the overall environmental impact. However, in the case of Davis-Besse, there may not be sufficient land available to site some of the alternatives evaluated here while, at the same time, allowing the continued operation of the reactor until its license expiration date.

To ensure that the alternatives analysis was consistent with state or regional energy policies, the NRC reviewed energy related statutes, regulations, and policies within the State of Ohio, including, for example, State renewable portfolio standards (RPS).

The Ohio Edison Company, the Cleveland Electric Illuminating Company, and the Toledo Edison Company are FirstEnergy Service Company's electric utility operating companies that provide electric service in the State of Ohio. The NRC staff considered the current generation capacity and electricity production within these three service areas as well as the rest of the State of Ohio. Ohio is much more dependent on coal-fired generation than the U.S. as a whole. In 2010, coal-fired generators produced 82.1 percent of electricity in Ohio, compared to 44.7 percent nationwide. Other forms of generation were smaller contributors than in the rest of the U.S., with natural gas providing 5 percent of production in the State, versus 23.9 percent nationwide. Nuclear accounted for 11 percent in Ohio (versus 19.6 percent in the nation as a whole). Production from renewable sources was the area in which Ohio diverged most as a proportion from national averages—renewable generation provided 0.49 percent of electricity in the State compared to 4.1 percent nationwide. Electricity production from petroleum-fired generators was virtually the same for both Ohio and the nation at 1 percent (EIA 2012a).

Although it is one of the nation's top generators of electricity, Ohio is a net importer of power. Ohio's total electricity consumption is high due to the State's energy-intensive industrial sector, which accounts for more than one-third of the State's electricity consumption (EIA 2012a). The NRC concludes that since a loss of power from the Davis-Besse reactor would potentially

impact electricity consumers throughout Ohio, but the power would ultimately be replaced by FENOC's three electric operating companies, the evaluation of alternatives to the continued operation of the Davis-Besse reactor should consider alternatives located throughout these companies' service areas.

The State of Ohio has established an RPS that requires electricity providers to obtain a minimum percentage of their power through renewable energy resources or energy efficiency measures or both. The RPS requirement for Ohio was adopted in 2008 and requires at least 25 percent of all electricity sold in the State to come from renewable sources by 2025, at least half of which must be generated within the State. Half of the standard (12.5 percent of the electricity sold) must be met using renewable sources such as wind, solar, hydroelectric power, geothermal, and biomass. The other half can be met through alternative energy resources such as third-generation nuclear power plants, fuel cells, energy-efficiency programs, and clean coal technology (DSIRE 2013). In a compliance report filed with the Public Utilities Commission of Ohio on April 15, 2010, FENOC reported it had met its revised 2010 benchmarks for renewable energy credits (RECs) and out-of-state solar RECs, but fell slightly short in meeting its Ohio solar benchmark due to the insufficiency of Ohio-based solar energy resources (PUCO 2011).

Sections 8.1 through 8.5 describe the environmental impacts from alternatives to license renewal. These alternatives include a natural gas-fired combined-cycle (NGCC) in Section 8.1; a combination alternative that includes wind power, solar power, compressed air energy storage, and NGCC capacity in Section 8.2; and a coal-fired alternative in Section 8.3. In Section 8.4, alternatives considered but dismissed from detailed consideration are identified. Finally, the environmental effects that may occur if NRC takes no action and does not issue a renewed license for Davis-Besse are discussed in Section 8.5. Section 8.6 summarizes the impacts of each of the alternatives considered.

8.1 Natural Gas-Fired Combined-Cycle (NGCC) Alternative

Natural gas-fired combined-cycle (NGCC) systems represent the large majority of the total number of plants currently under construction or planned in the United States. Factors that contribute to NGCC's popularity include high capacity factors, low relative construction cost, low gas prices, and low air emissions. Development of new natural gas-fired plants may be affected by uncertainties regarding the continued availability and price of natural gas (though less so than in the recent past) and future regulations that may limit greenhouse gas (GHG) emissions. A gas-fired power plant, however, produces markedly fewer GHGs per unit of electrical output than a coal-fired plant of the same electrical output.

Combined cycle power plants differ significantly from most coal-fired and all existing nuclear power plants. Combined cycle plants derive the majority of their electrical output from a gas turbine and then generate additional power—without burning any additional fuel—through a second, steam turbine cycle. The exhaust gas from the gas turbine is still hot enough to boil water to steam. Ducts carry the hot exhaust to a heat recovery steam generator, which produces steam to drive a steam turbine and produce additional electrical power. The combined cycle approach is significantly more efficient than any one cycle on its own; thermal efficiency can exceed 60 percent versus 38 percent (NETL 2010; Siemens 2012). In addition, because the natural gas-fired alternative derives much of its power from a gas-turbine cycle, and because it wastes less heat than the existing Davis-Besse unit, it requires significantly less cooling water.

While nuclear reactors, on average, operate with capacity factors above 90 percent, an NGCC power plant would operate with roughly an 85 percent capacity factor. Nonetheless, a similarly sized NGCC facility would be capable of providing adequate replacement power for the

purposes of this NEPA analysis. Typical power trains for large-scale combined cycle power generation would involve one, two, or three combined cycle units, available in a variety of standard sizes. Appropriately sized units could produce electrical power in amounts equivalent to the Davis-Besse reactor. The combined cycle units are presumed to each be similar in operation to General Electric's (GE's) Advanced F Class design, equipped with dry-low-nitrogen oxide combustors to suppress nitrogen oxide formation and selective catalytic reduction (SCR) of the exhaust with ammonia for post-combustion control of nitrogen oxide emissions.

For the purpose of this analysis, the NRC staff will evaluate the impacts of a new 910 MW NGCC alternative. Installing the NGCC alternative on the Davis-Besse site would allow for the fullest use of existing infrastructure, such as transmission lines and cooling systems, and minimize construction impacts. Only a limited amount of buildable vacant land is available on the Davis-Besse site while allowing the reactor to continue operating until license expiration. However, the relatively modest footprint of an NGCC power plant, together with the expectation that the existing cooling tower and substation would be used to support the NGCC alternative, supports the conclusion that an NGCC facility could be installed on the Davis-Besse site. An NGCC alternative would also require a pipeline to deliver natural gas to the site. Depending on the availability of pipeline capacity, the existing pipeline transmission system may require some upgrades to support the new facility.

Natural gas fired power plants are feasible, commercially available options for providing electric generating capacity beyond Davis-Besse's current license expiration. Environmental impacts from the NGCC alternative are summarized in Table 8–2 and discussed in depth in Section 8.1.1-9.

Table 8–2. Summary of Environmental Impacts of the NGCC Alternative Compared to Continued Operation of the Existing Davis-Besse

	New NGCC at the Davis-Besse Site	Continued Operation of the Davis-Besse Reactor
Air quality	SMALL to MODERATE	SMALL
Groundwater	SMALL	SMALL
Surface water	SMALL	SMALL
Aquatic resources	SMALL	SMALL
Terrestrial resources	SMALL	SMALL
Human health	SMALL	SMALL
Land use	SMALL to MODERATE	SMALL
Socioeconomics	SMALL to MODERATE	SMALL
Transportation	SMALL to MODERATE	SMALL
Aesthetics	SMALL	SMALL
Historic & archeological resources	SMALL to MODERATE	SMALL to MODERATE
Waste management	SMALL	SMALL

8.1.1 Air Quality

Various Federal and State regulations aimed at controlling air pollution would impact a fossil fuel-fired power plant, including the NGCC alternative. Davis-Besse is located in Ottawa County, which is part of the Sandusky Intrastate Air Quality Control Region. Ottawa County is designated as an attainment area for carbon monoxide (CO), ozone (O_3), and particulate matter less than 2.5 μm ($PM_{2.5}$). The county is designated as an unclassifiable area for particulate matter less than 10 μm (PM_{10}), not designated for lead (Pb), better than the national air quality standards for sulfur dioxide (SO_2) and cannot be classified or is better than national standards for nitrogen dioxide (NO_2) (40 CFR 81.336). A new gas-fired 910 MWe (net) generating plant developed at the Davis-Besse site would qualify as a new major source of criteria pollutants (one with the potential to release more than 100 tons per year of any criteria pollutant) and require a New Source Review (NSR)/Prevention of Significant Deterioration (PSD) of Air Quality Review. The natural gas-fired plant would need to comply with the standards of performance for stationary gas turbines set forth in 40 CFR Part 60, Subpart KKKK.

Section 169A of the Clean Air Act (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 anthropogenic air pollution (pollution resulting from human activities). The Regional Haze Rule, promulgated by EPA in 1999 and last amended in October 2006 (71 FR 60631), requires states to demonstrate reasonable progress toward the national visibility goal established in 1977 to prevent future impairment of visibility due to anthropogenic pollution in Class I areas. The visibility protection regulatory requirements are contained in 40 CFR Part 51, Subpart P, including 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. If a gas-fired alternative were located close to a mandatory Class I area, additional air pollution control requirements would potentially apply; however, there are no Class I areas within 50 mi of the Davis-Besse site (EPA 2013).

EPA first promulgated the Clean Air Interstate Rule (CAIR) in 2005, permanently capping sulfur dioxide and nitrogen oxide emissions from stationary sources located in 28 states, including Ohio. However, the D.C. Circuit Court vacated the Federal rule on February 8, 2008. In December 2008, the U.S. Court of Appeals for the D.C. Circuit Court reinstated the rule, allowing it to remain in effect but also requiring EPA to revise both the rule and its implementation plan. On July 6, 2010, EPA instead proposed replacing CAIR with the Cross-State Air Pollution Rule (CSAPR) for control of sulfur dioxide and nitrogen oxide emissions that cross State lines. On July 16, 2011, the EPA finalized the CSAPR that requires 28 states to improve air quality by reducing power plant emissions that cross state lines. CSAPR required that the state of Ohio reduce annual SO_2, NO_x, and ozone emissions to assist in attaining clean air standards. However, on August 21, 2012, the U.S. Court of Appeals vacated the 2011 CSAPR. On April 29, 2014, the U.S. Supreme Court reversed the D.C. Circuit opinion vacating CSAPR. EPA is reviewing the opinion, and the 2005 CAIR rule remains in effect (EPA 2014). A new NGCC source constructed in Ohio would be subject to emission limits for sulfur dioxide and nitrogen oxide promulgated under CAIR.

Under the Federal Acid Rain Program, a new natural gas-fired plant would have to comply with Title IV of the CAA reduction requirements for sulfur dioxide and nitrogen oxide, which are the main precursors of acid rain and the major cause of reduced visibility. Title IV establishes maximum sulfur dioxide and nitrogen oxide emission rates from the existing plants and a system of the sulfur dioxide emission allowances that can be used, sold, or saved for future use by new plants.

Ohio is subject to nitrogen oxide State Implementation Plan (SIP) call regulations designed to reduce transport of ground-level ozone across State lines. A new NGCC alternative located in those states would be required to comply with those regulations limiting nitrogen oxide emissions (EPA 2009b).

In response to the Consolidated Appropriations Action of 2008 (Public Law 110-161), EPA promulgated final mandatory greenhouse gas (GHG) reporting regulations for major sources (emitting more than 25,000 tons/year (22,680 metric tons (MT)/year) of all GHGs), effective in December 2009 (EPA 2010a). This new NGCC plant would be subject to those reporting regulations.

On July 12, 2012, EPA issued a final rule tailoring the criteria that determine which stationary sources and modifications to existing projects become subject to permitting requirements for GHG emissions under the prevention of significant deterioration (PSD) or Title V Federal permit programs of the CAA (77 FR 41051). Beginning January 2, 2011, operating permits issued to major sources of GHG under the PSD or Title V programs[1] must contain provisions requiring the use of best available control technology (BACT) to limit the emissions of GHGs if those sources would be subject to PSD or Title V permitting requirements because of their non-GHG pollutant emission potentials and if their estimated GHG emissions are at least 75,000 tons/yr of CO_2 equivalents CO_2e[2]). If the NGCC alternative meets PSD or Title V permitting requirements for non-GHG pollutant emissions and the GHG emission thresholds established in the rule, then GHG emissions from this alternative would be regulated under the PSD and Title V permit programs.

Meeting permit limitations for GHG emissions may require installation of carbon capture and sequestration (CCS) devices on any new natural gas-fired power plant. Ohio EPA has adopted regulations equivalent to the Federal GHG Tailoring Rules (OEPA 2012).

8.1.1.1 Construction Impacts

Activities associated with the construction of the new natural gas-fired plant at the Davis-Besse site would cause air impacts as a result of emissions from construction equipment and fugitive dust from operation of the earth-moving and material handling equipment. Gas-fired power plants are constructed relatively quickly; construction lead times for NGCC plants are around 2 to 3 years (EIA 2011d; OECD/IEA, 2005).

Analogous impacts would occur in association with offsite pipeline construction. All such impacts would be temporary. Workers' vehicles and motorized construction equipment would generate temporary criteria pollutant emissions. Dust-control practices would reduce fugitive dust, which would be temporary in nature. Given the expected, relatively short construction period for both the NGCC facility and the pipeline, the NRC concludes that the impact of vehicle exhaust emissions, construction equipment, and fugitive dust from operation of earth-moving and material-handling equipment would be SMALL.

---

[1] On June 23, 2014, the U.S. Supreme Court issued a decision that the EPA may not treat GHGs as an air pollutant for purposes of determining whether a source is a major source required to obtain a PSD or Title V permit, but could continue to require PSD and Title V permits, otherwise required based on emissions of conventional pollutants. In July 2014, the EPA issued a memorandum in response to the Supreme Court's decision and acknowledged that while the decision is pending judicial action, the EPA will no longer require PSD or Title V permits for GHG-emitting sources that are not sources subject to PSD or Title V permits based on emissions of conventional pollutants (nitrogen oxides, carbon monoxide, etc.) (EPA 2014).

[2] Carbon dioxide equivalents (CO_2e) is a metric used to compare the emissions of GHG based on their global warming potential (GWP). GWP is a measure used to compare how much heat a GHG traps in the atmosphere. GWP is the total energy that a gas absorbs over a period of time, compared to carbon dioxide. Carbon dioxide equivalents are obtained by multiplying the amount of the GHG by the associated GWP. For example, the GWP of CH_4 is estimated to be 21; therefore, one ton of CH_4 emission is equivalent to 21 tons of CO_2 emissions.

8.1.1.2 Operating Impacts

Using data and algorithms published by EPA and EIA and performance guarantees provided by pollution control equipment vendors, the NRC staff projects the following emissions for an NGCC alternative to the Davis-Besse reactor:

- sulfur oxides—70 tons (64 MT) per year,
- nitrogen oxides—204 tons (185 MT) per year,
- particulate matter less than or equal to 10 μm—136 tons (123 MT) per year,
- carbon monoxide—309 tons (280 MT) per year, and
- carbon dioxide—2,270,000 tons (2,060,000 MT) per year.

Sulfur and Nitrogen Oxides. As stated above, the new natural gas-fired alternative would produce 70 tons (64 MT) per year of sulfur oxide and 204 tons (185 MT) per year of nitrogen oxide based on the use of the dry low nitrogen oxide combustion technology and use of selective catalytic reduction (SCR) in order to significantly reduce nitrogen oxide emissions.

The new plant would be subjected to the continuous monitoring and reporting requirements of sulfur dioxide, nitrogen oxides, and carbon dioxide specified in 40 CFR Part 75.

Particulates. The new natural gas-fired alternative would produce 136 tons (123 MT) per year of particulates, all of which would be emitted as PM_{10}. In addition to particulate emissions from the NGCC facility, small amounts of particulate would be released as drift from the cooling tower that supports the steam cycle. However, because the NGCC facility would have a smaller heat rejection demand than the reactor, the amount of drift presently being released from the tower as it supports the reactor is considered to be a bounding condition. FENOC estimated the release of particulates contained in cooling tower drift during reactor operation is 1.4 tons per year, assuming calculation of particulate emissions contained in drift based on an average total dissolved solids (TDS) concentration of 228 parts per million (ppm) (TRC 1995).

Carbon Monoxide. Based on EPA emission factors (EPA 1998), the NRC staff estimates that the total CO emissions would be approximately 309 tons (280 MT) per year.

Carbon Dioxide. The NRC estimates that uncontrolled emissions of CO_2 from operation of the NGCC alternative would amount to 2.27 million tons per year (2.06 MMT per year). Although natural gas combustion in the combustion turbines would be the primary source, other miscellaneous ancillary sources—such as truck and rail deliveries of materials to the site and commuting of the workforce—would make minor contributions.

The Tailoring Rule will require that BACT be applied to control CO_2 emissions. Carbon capture and sequestration (CCS) technologies can capture and remove as much as 90 percent of the CO_2 from the exhausts of combustion turbines (CT) (NETL 2010). However, such equipment imposes a significant parasitic load that will result in a power production capacity decrease of approximately 14 percent, a reduction in net overall thermal efficiency of the CTs studied from 50.8 percent to 43.7 percent, and a potential increase in the levelized cost of electricity produced in NGCC units so equipped by as much as 30 percent (NETL 2010). This can result in an increase in other air pollutants because more generation capacity would be necessary to supply the same electrical demand.

Hazardous Air Pollutants. In December 2000, the EPA issued regulatory findings (EPA 2000b) on emissions of hazardous air pollutants (HAPs) from electric utility steam-generating units, which identified that natural gas-fired plants emit hazardous air pollutants such as arsenic, formaldehyde, and nickel. The EPA stated that "[t]he 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." As a result, the NRC staff will not further address HAPs here.

In addition to the air quality impacts associated with operation of the NGCC facility, additional air quality impacts would result from vehicles used by the commuting operating workforce. However, the NGCC workforce is smaller than the current operating workforce at Davis-Besse, so a change to an NGCC alternative will result in reductions in commuting-related air emissions.

The impact from SO_2, CO, PM, and NO_X emissions during operation would be noticeable. Based on this information, the overall air quality impacts of operation of an NGCC plant located at the Davis-Besse site would be SMALL to MODERATE.

8.1.2 Groundwater Use and Quality

8.1.2.1 Construction

As described in Section 2.1.7.2, groundwater at the Davis-Besse site is unsuitable as a drinking water source. Private wells within 2 to 3 mi of the site are not used for drinking water, but rather for irrigation and sanitary purposes. The impacts associated with groundwater use during construction would be similar to those associated with the construction of Davis-Besse. All open excavations will require dewatering, which would have a minor, localized impact on groundwater levels and flow rate at the site. The NRC assumes that during construction, liquid construction wastes will either temporarily be retained in lined evaporation ponds or will be stored in drums for shipment to offsite disposal facilities. With the application of best management practices and the controls established in a General Stormwater Permit, no noticeable impacts on groundwater quality due to the construction of the NGCC alternative are expected. As a result, impacts to groundwater quality would be SMALL.

8.1.2.2 Operation

Groundwater is not used at the Davis-Besse facility. The NRC presumes groundwater will not be used to operate the NGCC alternative; thus, the impacts to the groundwater resource would be SMALL.

8.1.3 Surface Water Use and Quality

8.1.3.1 Construction

A minimal amount of surface water is expected to be used to construct the NGCC, primarily for fugitive dust control, cleaning, and concrete mixing. Some impacts on surface water quality may result in increased sediment loading to stormwater runoff from active construction zones or from the dewatering of excavations; however, the NRC expects that a Stormwater General Permit would require best management practices that would prevent or significantly mitigate such impacts. Best management practices include controlling drainage by ditches, berms, and sedimentation basins; prompt revegetation to control erosion; stockpiling and reusing excavated topsoil; and various other techniques used to control soil erosion and water pollution. As a result, surface water use and quality impacts during construction at Davis-Besse would be SMALL.

8.1.3.2 Operation

The gas-fired alternative would require much less cooling water than the existing Davis-Besse facility, because it operates at a higher thermal efficiency (nearly 60 percent) and because it requires much less water for steam cycle condenser cooling. The existing closed loop cooling

system now supporting the reactor would be able to support a natural gas alternative on the Davis-Besse site without any increase in its current capacity. It would be supported by using freshwater recovered from the existing cooling water intake canal and discharging the blowdown water through the existing cooling system discharge pipe into Lake Erie. Under such a configuration, the rate of withdrawal of freshwater to support steam cycle cooling would be reduced. In conclusion, the impacts on surface water due to the operation of an NGCC plant would be less than the impacts associated with the continued operation of Davis-Besse (as discussed in Section 2.4, "Surface Water Resources") and, thus, are considered to be SMALL.

8.1.4 Aquatic Ecology

8.1.4.1 Construction

Construction activities for the NGCC alternative would cause minimal impacts on aquatic resources in Lake Erie because construction would occur far enough inland to remove the likelihood of the erosion and sedimentation. Additionally, stormwater control measures, which would be required to comply with Ohio's NPDES permitting, would minimize the flow of disturbed soils into aquatic habitats.

8.1.4.2 Operation

During operations, the NGCC alternative would require less cooling water to be withdrawn from and discharged to Lake Erie than required for Davis-Besse. Therefore, thermal impacts would be less for the NGCC alternative than Davis-Besse. The cooling system for a new NGCC plant would have similar chemical discharges as Davis-Besse. Air emissions from the NGCC plant would emit particulates that would settle onto the lake surface and introduce a new source of pollutants. However, lake tides would likely dissipate and dilute the concentration of pollutants resulting in minimal exposure to aquatic biota.

Consultation under the ESA would be required to assess the occurrence and potential impacts to Federally protected aquatic species and habitats within affected surface waters. Coordination with State natural resource agencies would further ensure that the NGCC operator would take appropriate steps to avoid or mitigate impacts to State-listed species, habitats of conservation concern, and other protected species and habitats. The NRC relies on these consultations to reduce, or eliminate, potential impacts to protected aquatic species and habitats.

The impacts on aquatic ecology would be minor because construction activities would require BMPs and stormwater management permits. Also, surface water discharge for this alternative would be less than for Davis-Besse. Deposition of pollutants into aquatic habitats from the plant's air emissions would be minimal because the concentration of pollutants would be diluted with the lake tides. Therefore, the NRC staff concludes that impacts on aquatic ecology would be SMALL.

8.1.5 Terrestrial Ecology

8.1.5.1 Construction

Construction of an NGCC alternative would occur on the Davis-Besse site and would use existing transmission lines. Because the onsite land requirement is relatively small, the entire NGCC alternative construction footprint would likely be sited in already developed areas of the Davis-Besse site, which would minimize impacts to terrestrial habitats and species. However, the level of direct impacts would vary based on the specific location of new buildings and infrastructure on the site. Offsite construction would occur mostly on land where gas extraction is already occurring. Erosion and sedimentation, fugitive dust, and construction debris impacts

would be minor with implementation of BMPs. Construction noise could modify wildlife behavior; however, these effects would be temporary. Road improvements or construction of additional service roads to facilitate construction could result in the temporary or permanent loss of terrestrial habitat. Construction of gas pipelines along existing, previously disturbed utility corridors would result in temporary noise and displacement of wildlife, but would minimize the removal or destruction of undisturbed habitats. Impacts to terrestrial habitats and species from transmission line operation and corridor vegetation maintenance, and operation of the cooling towers would be similar in magnitude and intensity as those resulting from Davis-Besse and would, therefore, be SMALL.

As discussed under aquatic ecology impacts, consultation with the FWS under the ESA would ensure that the construction and operation of an NGCC alternative would not adversely affect any Federally listed species or adversely modify or destroy designated critical habitat. Coordination with state natural resource agencies would further ensure that the NGCC operator would take appropriate steps to avoid or mitigate impacts to state-listed species, habitats of conservation concern, and other protected species and habitats. The NRC assumes that these consultations would result in avoidance or mitigation measures that would minimize or eliminate potential impacts to protected terrestrial species and habitats. Consequently, the impacts of construction and operation of a new nuclear alternative on protected species and habitats would be SMALL.

8.1.5.2 Operation

Impacts on terrestrial species due to the operation of an NGCC plant would be similar to the impacts associated with the present operation of Davis-Besse. The monitoring of cooling-tower drift effects on terrestrial vegetation has shown no visible damage. In addition, where lines cross croplands and little or no vegetation control is required, impacts due to right-of-way (ROW) management on wildlife has all been determined to be small. As a result, the impacts on terrestrial resources from the operation of the NGCC alternative on the Davis-Besse site would be SMALL.

8.1.6 Human Health

8.1.6.1 Construction

Impacts on human health from construction of the NGCC alternative would be similar to impacts associated with the construction of any major industrial facility. Compliance with worker protection rules would control those impacts on workers at acceptable levels. Impacts from construction on the general public would be minimal since limiting active construction area access to authorized individuals is expected. Impacts on human health from the construction of the NGCC alternative would be SMALL.

8.1.6.2 Operation

Human health effects of gas-fired generation are generally low. However, in Table 8-2 of the GEIS (NRC 1996), the NRC staff identified cancer and emphysema as potential health risks from gas-fired plants. NO_x emissions contribute to ozone formation, which contributes to human health risks. Emission controls on the NGCC alternative can be expected to maintain NO_x emissions well below air quality standards established for the purposes of protecting human health, and emissions trading or offset requirements mean that overall NO_x releases in the region will not increase. Health risks for workers may also result from handling spent catalysts used for NO_x control that may contain heavy metals; however, appropriate handling precautions are expected to be followed. Impacts on human health from the operation of the NGCC alternative would be SMALL.

8.1.7 Land Use

The GEIS generically evaluates the impacts of constructing and operating various replacement power plant alternatives on land use, both on and off each power plant site. The analysis of land use impacts focuses on the amount of land area that would be affected by the construction and operation of a natural gas-fired combined-cycle power plant at the Davis-Besse site. Locating the new NGCC power plant at the Davis-Besse site would maximize the availability of support infrastructure and reduce the need for additional land.

8.1.7.1 Construction

Based on GEIS estimates, approximately 110 ac (40.5 ha) of land would be needed to support a new NGCC power plant (NRC 1996). This amount of land use would include other plant structures and associated infrastructure. Depending on the location and availability of existing natural gas pipelines, an additional 150 ac (61 ha) of land could be needed for a new 25-mi (41-km) gas supply pipeline.

In addition to onsite land requirements, land would be required offsite for natural gas wells and collection stations. Scaling from GEIS estimates, approximately 3,275 ac (1,325 ha) (based on 3,600 ac per 1,000 MWe and 910 MWe for NGCC) (NRC 1996) would be required for wells, collection stations, and pipelines to bring the gas to the plant. Most of this land requirement would occur on land where gas extraction already occurs. Therefore, land use impacts from land acquisition would be SMALL to MODERATE, depending on location of a new gas supply pipeline and off-site wells and collection stations.

8.1.7.2 Operation

The elimination of uranium fuel for Davis-Besse would partially offset some, but not all, of the land requirements for an NGCC alternative. Scaling from GEIS estimates, approximately 635 ac (256 ha) (based on 35 ac/yr disturbed per 1,000 MWe for 20 years) would no longer be needed for mining and processing uranium during the operating life of the plant (NRC 1996). Operational land use impacts from an NGCC power plant would be SMALL.

8.1.8 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 NGCC power plant could affect regional employment, income, and expenditures. Two types of jobs would be created by this alternative: (1) construction jobs, which are transient, short in duration, and less likely to have a long-term socioeconomic impact; and (2) power plant operations jobs, which have the greater potential for permanent, long-term socioeconomic impacts. Workforce requirements for the construction and operation of the NGCC power plant were evaluated to measure their possible effects on current socioeconomic conditions.

8.1.8.1 Construction

FENOC estimates a construction workforce ranging from 1,092 to 2,275 workers, which is consistent with GEIS estimates (FENOC 2011). During construction of the NGCC power plant, the communities surrounding the power plant site would experience increased demand for rental housing and certain public services. The relative economic impact of this many workers on the local economy and tax base would vary, with the greatest impacts occurring in the communities where the majority of construction workers would reside and spend their income. As a result, local communities could experience a short term economic “boom” from increased tax revenue and income generated by construction expenditures and the increased demand for

temporary (rental) housing and business services. Some construction workers could relocate in order to be closer to the construction work site. However, given the proximity of Davis-Besse to the Toledo metropolitan area, workers could commute to the construction site, thereby reducing the need for rental housing.

After completing the installation of the NGCC plant, local communities could experience a return to pre-construction economic conditions. The rental housing market could experience increased vacancies and decreased prices. Based on this information and given the number of construction workers, socioeconomic impacts during construction in communities near the new NGCC at the Davis-Besse site could range from SMALL to MODERATE.

8.1.8.2 Operation

FENOC estimates an operations workforce of 137 employees (FENOC 2011). FENOC's estimate appears to be reasonable and is consistent with trends toward lowering labor costs by reducing the size of power plant operations workforces. The reduction in employment at Davis-Besse from reactor shutdown and decommissioning could affect property tax revenue and income in local communities and businesses. In addition, the permanent housing market could also experience increased vacancies and decreased prices if operations workers and their families move out of the region. However, the amount of taxes paid under the NGCC alternative may increase if additional land is required offsite to support this alternative. Based on the above discussion, socioeconomic impacts during operations could range from SMALL to MODERATE.

8.1.9 Transportation

Commuting workers and truck deliveries of materials and equipment to the Davis-Besse site would cause transportation impacts during the construction and operation of the NGCC power plant.

8.1.9.1 Construction

During construction, 1,092 to 2,275 workers could be commuting daily to the construction site. Arriving by site access roads, the volume of traffic on nearby roads could increase substantially during shift changes. In addition to commuting workers, trucks would be transporting construction materials and equipment to the worksite, thus increasing the amount of traffic on local roads. Traffic volumes would peak during shift changes, resulting in temporary levels of service impacts and delays at intersections. Pipeline construction and modifications to existing natural gas pipeline systems could also have a temporary traffic impact. Some power plant components and materials could be delivered by train or barge. Train deliveries could cause additional traffic delays at railroad crossings. Overall, traffic-related transportation impacts during construction likely would be MODERATE.

8.1.9.2 Operation

Traffic-related transportation impacts would be greatly reduced after completing the installation of the NGCC alternative. Transportation impacts would include daily commuting by the operating workforce, equipment and materials deliveries, and the removal of commercial waste material by truck to offsite disposal or recycling facilities. Since fuel is transported by pipeline, the transportation infrastructure would experience little to no increased traffic from fuel operations. Overall, transportation impacts would be SMALL during plant operations.

8.1.10 Aesthetics

The analysis of aesthetic impacts focuses on the degree of contrast between the NGCC alternative and the surrounding landscape and the visibility of the new NGCC plant at the Davis-Besse site.

8.1.10.1 Construction

During construction, all of the clearing and excavation would occur on the existing Davis-Besse power plant site. These activities could be visible from offsite roads. Since the existing power plant site would already appear industrial, construction of the NGCC power plant would appear similar to other ongoing onsite activities. Aesthetic changes during construction would be limited to the immediate vicinity of the existing Davis-Besse site, and overall impacts would be SMALL.

8.1.10.2 Operation

The facility would be visible offsite during daylight hours, and some structures, such as the approximately 150 ft (45 m) high exhaust stacks or natural draft cooling tower, may require aircraft warning lights (FENOC 2011). During certain weather conditions, the plume from the cooling tower would be visible for long distances. In general, given the industrial appearance of the Davis-Besse site, an NGCC alternative would blend in with the surroundings if the existing Davis-Besse facility remains. In addition, the visible appearance of the NGCC power block could look similar to the existing Davis-Besse power block. Since the new NGCC power plant would appear similar to the existing Davis-Besse power plant, overall operational impacts would be SMALL.

8.1.11 Noise

Ambient noise conditions in the vicinity of Davis-Besse would be affected by the construction and operation of a new NGCC power plant.

8.1.11.1 Construction

Noise levels at the Davis-Besse site would increase during the construction of the new NGCC power plant. Noise during construction, however, would be intermittent and limited to the peak periods of activity and would diminish over distance. Noise impacts during construction of the NGCC power plant could range from SMALL to MODERATE.

8.1.11.2 Operation

Noise during NGCC power plant operations would be similar to noise generated during reactor operations and would be limited to those caused by normal industrial processes and communications. Pipelines delivering natural gas fuel could be audible near gas compressor stations. Noise impacts during NGCC power plant operations would be SMALL.

8.1.12 Historic and Archaeological Resources

The potential for impacts on historic and archaeological resources from the NGCC alternative would vary greatly depending on the location of the proposed plant on the Davis-Besse site. As the parcel of land on which Davis-Besse is situated has not been surveyed for historic and archaeological resources, plant operators would need to survey all areas associated with operation of the alternative (e.g., a new pipeline, roads, transmission corridors, other ROWs). If a previously disturbed area of the site was used, an inventory would still be necessary to verify the level of disturbance and evaluate the potential for intact subsurface resources. Any resources found in these surveys would need to be evaluated for eligibility on the National

Register of Historic Properties (NRHP), and mitigation of adverse effects would need to be addressed if eligible resources were encountered. Areas with the greatest sensitivity should be avoided. Visual impacts on significant cultural resources—such as the viewsheds of historic properties near the site—also should be assessed.

As the Davis-Besse site has not been previously surveyed, the level of impact to historic and archaeological resources would vary depending on the specific resources found to be present in the area of potential effect. However, given that the majority of the site is unusable marsh land and the preference is to use previously disturbed areas of the site and existing infrastructure, avoidance of significant historic and archaeological resources should be possible. Therefore, the impacts on historic and archaeological resources from the NGCC alternative would be SMALL to MODERATE.

8.1.13 Environmental Justice

The environmental justice impact analysis evaluates the potential for disproportionately high and adverse human health, environmental, and socioeconomic effects on minority and low-income populations that could result from the construction and operation of a new power plant. Minority and low-income populations are subsets of the general public living near the proposed power plant site.

Adverse health effects are measured in terms of the risk and rate of fatal or non-fatal 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. Disproportionately high environmental effects refer to impacts or risk of impact on the natural or physical environment in a minority or low-income community that are significant and appreciably exceed the environmental impact on the larger community. Such effects may include biological, cultural, economic, or social impacts. For example, increased demand for rental housing during replacement power plant construction could disproportionately affect low-income populations that rely on the previously inexpensive rental housing market.

8.1.13.1 Construction

Potential impacts to minority and low-income populations would mostly consist of environmental and socioeconomic effects during construction (e.g., noise, dust, traffic, employment, and housing impacts). Noise and dust impacts during construction would be short term and primarily limited to onsite activities. Minority and low-income populations residing along site access roads would be directly affected by increased commuter vehicle and truck traffic. However, because of the temporary nature of construction, these effects are unlikely to be high and adverse and would be contained to a limited time period during certain hours of the day. Increased demand for rental housing during construction could cause rental costs to rise disproportionately affecting low-income populations living near the site who rely on inexpensive housing. However, given the proximity of Davis-Besse to the Toledo metropolitan area, workers could commute to the construction site, thereby reducing the need for rental housing.

Based on this information and the analysis of human health and environmental impacts presented in Section 8.1 of this chapter, the construction of a new NGCC power plant would not have disproportionately high and adverse human health and environmental effects on minority and low-income populations.

8.1.13.2 Operation

Emissions from the operation of an NGCC plant could affect minority and low-income populations as well as the general population living in the vicinity of the new power plant. However, all would be exposed to the same potential effects from NGCC power plant operations, and any impacts would depend on the magnitude of the change in ambient air quality conditions. Permitted air emissions are expected to remain within regulatory standards.

Based on this information and the analysis of human health and environmental impacts presented in Section 8.1 of this chapter, the construction and operation of a new NGCC power plant would not have disproportionately high and adverse human health and environmental effects on minority and low-income populations.

8.1.14 Waste Management

8.1.14.1 Construction

During the construction stage of this alternative, land clearing and other construction activities would generate waste that can be recycled, disposed of onsite, or shipped to an offsite waste disposal facility. Because the NGCC alternative would most likely be constructed on the previously disturbed portions of the Davis-Besse site, the amounts of wastes produced during land clearing would be minimal. As a result, construction related impacts due to the construction of the NGCC alternative due to waste management would be SMALL.

8.1.14.2 Operation

This NGCC alternative would produce relatively little waste, primarily in the form of spent SCR catalysts used for control of NO_x emissions. The NRC staff presumes that the SCR technology employed would involve introducing ammonia into the exhaust ducts of the cooling towers where it combines with NO_x in a nickel catalyst bed to form zero valent nitrogen and water. Based on data provided by the Institute of Clean Air Companies, EPA acknowledges that typical SCR devices can demonstrate removal efficiencies of 70 to 90 percent (EPA 2000a).

Because the specific NO_x emission control equipment cannot be specified at this time, the amount of spent catalysts that would be generated during each year of operation of the NGCC alternative also cannot be calculated with precision. However, the amount would be modest. Domestic and sanitary wastes would be expected to decrease from amounts now generated during the operation of the reactors due to a reduced operational workforce for the NGCC alternative. According to the 1996 GEIS, a natural gas-fired plant would generate minimal waste; therefore, waste impacts from an NGCC facility at Davis-Besse would be SMALL.

8.1.15 Climate Change-Related Impacts of a Natural Gas-Fired Combined Cycle Alternative

Combustion of fossil fuels, including natural gas, is the greatest anthropogenic source of GHG emissions in the U.S. After a thorough examination of the scientific evidence and careful consideration of public comments, the EPA announced on December 7, 2009, that GHGs threaten the public health and welfare of the American people and meet the CAA definition of air pollutants. Carbon dioxide (CO_2) is the largest GHG emitted during fossil fuel combustion and is of primary concern for global climate change. Climate changes (in the U.S. and globally) have been observed over the past 50 years and future climate changes are expected to continue (USGCRP 2009). The observed global climate-related changes are primarily due to human-induced emissions of GHGs (USGCRP 2009). The extent and nature of climate change is not specific to where GHGs are emitted, as these emissions are transported and mixed in the

atmosphere. However, an NGCC alternative would contribute GHG emissions. This section presents an assessment of the potential impacts the construction and operation of an NGCC alternative will have on climate change.

8.1.15.1 Construction

Impacts to climate change from the construction of an NGCC alternative would result primarily from the consumption of fossil fuels in the engines of construction vehicles and equipment, workforce vehicles used in commuting to and from the work site, and delivery vehicles. Analogous impacts would occur in association with offsite pipeline construction. All such impacts, however, would be temporary.

Although natural gas combustion in the combustion turbines would be the primary source, other miscellaneous ancillary sources such as truck and rail deliveries of materials to the site and commuting of the workforce would make minor contributions.

Given an expected relatively short construction period for both the NGCC facility and the pipeline, the overall impact on climate change from the releases of GHGs during construction of the NGCC alternative would be SMALL.

8.1.15.2 Operation

The NRC estimates that emissions of carbon dioxide equivalent (CO_2e) from operation of the NGCC alternative would amount to 2.07 MMT (2.29 million tons) per year. GHG emissions resulting from operation would be noticeable. Estimated GHG emissions would be three times larger than the threshold in EPA's tailoring rule for GHG (75,000 tons (68,000 MT) per year of carbon dioxide equivalent). EPA reported that, in 2010, the total amount of (CO_2e) emissions related to electricity generation was 2,277.3 teragrams (2,277.3 MMT) (EPA 2012). EIA reported that, in 2010, electricity production in Ohio was responsible for 121 MMT of CO_2 emissions (123 MMT CO_2e) (EIA 2012). The estimated CO_2e emitted from operation of the NGCC alternative amount represents 0.099 percent and 1.7 percent, respectively, of 2010 U.S. and Ohio CO_2e emissions. This amount represents an increase of 1.7 percent over the 2010 Ohio CO_2e emissions. Although natural gas combustion in the combustion turbines would be the primary source, other miscellaneous ancillary sources—such as truck and rail deliveries of materials to the site and commuting of the workforce—would make minor GHG contributions.

As previously discussed, CCS will capture and remove as much as 90 percent of the CO_2 from the exhausts of combustion turbines (NETL 2010). With CCS in place, the NGCC alternative would release 0.21 MMT per year (0.23 million tons) of CO_2, and the impact on climate change from this alternative would be further reduced.

The impact of the operation of an NGCC facility on climate change would be SMALL to MODERATE.

8.2 Combination Alternative

The combination alternative consists of 1,500 MW of installed wind capacity spread out over multiple sites—315 MW effective capacity for baseload generation and 360 MW to power CAES facility, 400 MW of installed solar photovoltaic (PV) capacity (75 MW effective capacity for baseload generation and 75 MW to power CAES facility), and 305 MW of NGCC capacity to provide the balance needed to replace Davis-Besse. All wind projects would be land-based because there are currently no operating offshore wind projects in the U.S.

The feasibility of wind as a baseload power source depends on the availability, accessibility, and constancy of the wind resource within the region of interest. Ohio has approximately

55,000 MW of wind power potential (NREL 2011) and has approximately 449 MW of operating wind projects, 802 MW of OPSB-approved projects that have not yet started operations, and 524 MW of wind projects in review for a Certificate of Environmental Compatibility and Public Need (OPSB 2013). The largest wind project in Ohio history, Blue Creek Wind Farm, was recently completed in March 2012 and has an installed capacity of 304 MW.

Wind power installations, which may consist of several hundred turbines, produce variable amounts of electricity. Davis-Besse, however, produces electricity almost constantly. Because wind power installations deliver variable output when wind conditions change, wind power cannot substitute for existing baseload generation on a one-to-one basis. A study by Archer and Jacobsen (2007) found that an array of 19 sites spread across the American southwest (with approximately 850 km (530 mi) distance from east to west and north to south) could provide 21 percent of installed capacity 79 percent of the time. In other words, 21 percent of the array's capacity was essentially available as baseload generation. While wind power installations in Archer and Jacobsen's study, in most cases, accessed higher power-class wind resources than are available onshore in Ohio, the NRC staff will adopt Archer and Jacobsen's approach for the purpose of this analysis. For the combination alternative analysis, the NRC staff assumes that an array containing 1,500 MW installed wind capacity could potentially replace a portion—315 MW—of Davis-Besse's capacity. (The NRC staff is unable to find any determination for effective capacity factors from regional transmission organizations or independent system operators that are based on an interconnected array of wind installations, as none currently exists. The NRC staff also notes that it is possible that no interconnected arrays will exist in any state by 2017.)

Wind power, in general, cannot be stored without first being converted to electrical energy. There are limited energy storage opportunities available to overcome the variability of wind resource availability. CAES is a commercially viable technology for energy storage, though it is seldom used on a utility scale. In CAES, an electric motor uses excess electricity to pump air intro an underground, pressurized cavity. When electricity is needed, the compressed air is released through a gas turbine generator. The compressed air provides some power to the generator (essentially, reducing the need for compression by the turbine), and burning natural gas provides heat to increase the pressure and power the turbine. Thus, CAES is not solely an energy storage technology, but it also relies on additional fossil fuel. This technology is currently in use at one site in the U.S. and one site in Germany, with capacities of 110 MWe and 290 MWe, respectively.

For the combination alternative, the remaining 24 percent of the total 1,500 MW installed wind capacity—equivalent to 360 MW—will provide power to the Norton Energy Storage Project, a CAES facility that can supply power to the grid when the wind is not blowing. FENOC indicates that the Norton Energy Storage facility could have a maximum of 536 MW of capacity available by 2017 (although it has not committed to install this capacity in that time period) and the maximum potential storage capacity at the facility is 2,700 MWe. The NRC staff recognizes that wind dynamics, daily and seasonal variation, and Norton's operational characteristics may limit the ability to store and release energy to offset the wind's variability. CAES is less effective at offsetting seasonal wind variation than it is at offsetting intra-day or day-to-day variation. Offsetting month-to-month variations or seasonal variations would require very large air reservoirs. However, for the purposes of this analysis, the NRC staff will assume that Norton Energy Storage is capable of capturing the extra energy produced for purposes of this analysis and releasing it when needed.

In addition, the NRC staff considers 400 MW of installed PV capacity (150 MW effective capacity) as part of this combination alternative. Solar PV systems use the sun's energy to produce electricity at a utility scale, converting the energy contained in the photons of sunlight

incident to direct current electricity that is aggregated, converted to alternating current, and connected to the high-voltage transmission grid. Currently, Ohio's largest completed solar PV installation, the Wyandot Solar Farm, has 12 MW of capacity (PSEG Solar 2010), though the Turning Point Solar Facility is currently under construction, and will ultimately have 49.9 MW of solar capacity. Turning Point and Ohio Air Quality claim the Turning Point facility will be the largest solar facility east of the Mississippi, with the first 20 MW scheduled to come on-line in 2013 (OAQDA undated). In its supplement to the ER, FENOC indicated that the average capacity factors for solar projects were 24 percent based on an NREL publication from 2002 (FENOC 2011). The NRC staff notes that PJM Interconnection (PJM) (the regional transmission operator that manages most of Ohio's electricity market, though not the First Energy service territories) published more recent information that indicates that solar power within the PJM system has an effective capacity factor of 38 percent (PJM 2010). In order to achieve an effective capacity of 150 MW and relying on PJM's capacity factor, 400 MW of new installed solar PV capacity would be required by 2017. While this amount of PV capacity exceeds planned utility-scale installations in Ohio, this capacity may be achievable by 2017 given the short lead times necessary for PV installation and experience with facilities like Wyandot and Turning Point. Of the 150 MW effective capacity, 75 MW would be used immediately, and 75 MW would be used to power the Norton Energy Storage project, which could then run during times when the sun is not shining or is otherwise less intense.

Finally, this combination alternative contains a 305-MW NGCC unit capable of within-day cycling to provide the remaining 158 MW of Davis-Besse's capacity and to provide back-up capacity to the wind and solar installations with the remaining capacity. As needed, this alternative also provides additional output to the Norton Energy Storage project during times when the unit would otherwise function in a spinning-reserve or hot-standby mode. Such a unit is commercially available and operates with a relatively high thermal efficiency of 57 percent (Siemens 2011). The NRC staff notes that this NGCC unit would spend a substantial amount of time either generating electricity to account for variable wind and solar outputs or functioning as spinning reserve.

The NRC staff notes that Norton Energy Storage has an additional 29 MW of capacity that is not expressly accounted for in this alternative, but it is likely that this capacity would be fully used at some times given the variability of wind and solar energy outputs. The NRC staff also notes that Norton Energy Storage provides power from a mix of natural gas combustion and compressed air. The Norton Energy Storage Project, by using stored energy, acts like a natural gas combustion turbine with a 78 percent thermal efficiency. The stored energy in the Norton Energy Storage Project, however, cannot be released without combustion of natural gas.

Table 8–3 summarizes the environmental impacts of the combustion alternative compared to the continued operation of Davis-Besse.

Table 8–3. Summary of Environmental Impacts of the Combination Alternative Compared to Continued Operation of the Existing Davis-Besse

	Combination Alternative	Continued Operation of the Davis-Besse Reactor
Air quality	SMALL	SMALL
Groundwater	SMALL	SMALL
Surface water	SMALL	SMALL
Aquatic resources	SMALL	SMALL
Terrestrial resources	SMALL to MODERATE	SMALL
Human health	SMALL	SMALL
Land use	SMALL to LARGE	SMALL
Socioeconomics	SMALL to MODERATE	SMALL
Transportation	SMALL to MODERATE	SMALL
Aesthetics	SMALL to LARGE	SMALL
Historic & archeological resources	SMALL to LARGE	SMALL to MODERATE
Waste management	SMALL	SMALL

8.2.1 Air Quality

Air quality impacts from this alternative come primarily from the operation of the NGCC and Norton Energy Storage Project portions. Wind and solar power produce no direct air emissions during operations. During construction, wind and solar installations have the potential to create fugitive dust and emissions from equipment used during construction and installation. These impacts are limited in duration, however, and dust would be controlled by best management practices on construction sites. This section, then, focuses on the impacts that result from the NGCC portion of the alternative and from the Norton Energy Storage Project.

Various Federal and State regulations aimed at controlling air pollution would impact a fossil fuel-fired power plant, including the NGCC portion of this alternative located anywhere within FENOC's three Ohio service areas, and to the Norton Energy Storage Project. A new gas-fired 305 MWe (net) generating plant developed at the Davis-Besse site would qualify as a new major source of criteria pollutants (one with the potential to release more than 100 tons per year of any criteria pollutant) and require an New Source Review (NSR)/Prevention of Significant Deterioration (PSD) of Air Quality Review. The natural gas-fired plant would need to comply with the standards of performance for stationary gas turbines set forth in 40 CFR Part 60, Subpart KKKK.

Compressed air energy storage creates operational air-quality impacts because the Norton Energy Storage Project relies on gas-fired turbines to heat the air released from underground storage and, thus, provide some of the energy produced by the compressed air storage system. FENOC estimated emissions for the Norton Energy Storage Project based on a six combustion trains and one cooling tower, to match the amounts permitted by the Norton Energy Storage Project's air emissions permit. The NRC staff notes that this overestimates the air quality impacts from the four trains that FENOC indicates could be operational at the Norton Energy Storage Project by 2017. The NRC staff has scaled the air emissions from the Norton Energy

Storage Project to provide an estimate for four trains rather than six, while acknowledging that this estimate may slightly over or underestimate impacts of four trains, depending on their operational characteristics and whether additional trains benefit from efficiencies of scale or require additional support services. The Norton Energy Storage project would also be subject to the standards of performance for stationary gas turbines set forth in 40 CFR Part 60, Subpart KKKK.

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 anthropogenic air pollution. The Regional Haze Rule, promulgated by EPA in 1999 and last amended in October 2006 (71 FR 60631), requires states to demonstrate reasonable progress toward the national visibility goal established in 1977 to prevent future impairment of visibility due to anthropogenic pollution in Class I areas. The visibility protection regulatory requirements are contained in 40 CFR Part 51, Subpart P, including 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. If the gas-fired portion or the Norton Energy Storage project were located close to a mandatory Class I area, additional air pollution control requirements would potentially apply; however, there are no Class I areas within 50 mi of the Davis-Besse site or Norton, Ohio (EPA 2013).

A newly constructed natural gas-fired plant and the Norton Energy Storage project in Ohio would be subject to emission limits for sulfur dioxide and nitrogen oxide promulgated under CAIR.[3]

Under the Federal Acid Rain Program, the NGCC and the Norton Energy Storage project would have to comply with Title IV of the CAA reduction requirements for SO_2 and NO_x, which are the main precursors of acid rain and the major cause of reduced visibility. Title IV establishes maximum SO_2 and NO_x emission rates from the existing plants and a system of the SO_2 emission allowances that can be used, sold, or saved for future use by new plants.

Ohio is subject to NO_x SIP call regulations designed to reduce transport of ground-level ozone across state lines. A new NGCC alternative located in those states would be required to comply with those regulations limiting NO_x emissions (EPA 2009b).

In response to the Consolidated Appropriations Action of 2008 (Public Law 110-161), EPA promulgated final mandatory GHG reporting regulations for major sources (emitting more than 25,000 tons per year (22,680 MT per year) of all GHGs), effective in December 2009 (EPA 2010a). This new NGCC plant and Norton Energy Storage project would be subject to those reporting regulations. Future regulations may require control of CO_2 emissions.

On July 12, 2012, EPA issued a final rule tailoring the criteria that determine which stationary sources and modifications to existing projects become subject to permitting requirements for GHG emissions under the PSD and Title V Programs of the CAA (77 FR 41051). Beginning January 2, 2011, operating permits issued to major sources of GHG under the prevention of significant deterioration (PSD) or Title V Federal permit programs must contain provisions requiring the use of best available control technology (BACT) to limit the emissions of GHGs if those sources would be subject to PSD or Title V permitting requirements because of their non-GHG pollutant emission potentials and their estimated GHG emissions are at least 75,000 tons/yr of CO_2 equivalents (CO_2e). If the NGCC alternative-portion and the Norton

[3] On July 6, 2010, EPA proposed replacing CAIR with the Cross-State Air Pollution Rule (CSAPR) for control of sulfur dioxide and nitrogen oxide emissions that cross state lines, the regulations of which would be implemented in 2011 and finalized in 2012. However, CSAPR was vacated by the D.C. Circuit Court on August 21, 2012. On April 29, 2014, the U.S. Supreme Court reversed the D.C. Circuit opinion vacating CSAPR. EPA is reviewing the opinion, and CAIR remains in effect (EPA 2014).

Energy Storage project meets PSD or Title V permitting requirements for non-GHG pollutant emissions and the GHG emission thresholds established in the rule, then GHG emissions from this alternative would be regulated under the PSD and Title V permit programs. Meeting permit limitations for GHG emissions may require installation of carbon capture and sequestration (CCS). Ohio EPA has adopted regulations equivalent to the Federal GHG Tailoring Rules (OEPA 2012).

8.2.1.1 Construction Impacts

Activities associated with the construction of all portions of this alternative would result in emissions from construction equipment, installation, and fugitive dust from operation of the earth-moving material. Dust-control practices would reduce fugitive dust. Offsite pipeline construction activity would be temporary. Workers' vehicles and motorized construction equipment would generate criteria pollutant emissions. Given the expected relatively short construction period, the overall air quality impacts would be SMALL.

8.2.1.2 Operating Impacts

Operation of the NGCC and Norton Energy Storage project are the primary portions of the combination alternative that will result in emissions. Beyond maintenance of the wind turbines and solar PV (e.g., serving equipment or repairs), there would be no direct air emissions associated with operations from wind generation or from solar PV.

Using data and algorithms published by EPA and EIA and performance guarantees provided by pollution control equipment vendors, the NRC staff projects the following emissions for the NGCC portion of this alternative:

- sulfur oxide—24 tons (22 MT) per year,
- nitrogen oxide—105 tons (95 MT) per year,
- particulate matter less than or equal to 10 μm—47 tons (43 MT) per year,
- carbon monoxide—106 tons (96 MT) per year, and
- carbon dioxide—825,000 tons (748,000 MT) per year.

The NRC staff estimates that the Norton Energy Storage project would have the following emissions:

- sulfur oxide—28 tons (25 MT) per year,
- nitrogen oxide—62 tons (57 MT) per year,
- particulate matter less than or equal to 10 μm—31 tons (28 MT) per year,
- carbon monoxide—60 tons (55 MT) per year, and
- carbon dioxide—450,000 tons (410,000 MT) per year.

Sulfur and Nitrogen Oxides. The combination of the NGCC portion of this alternative and the Norton Energy Storage project would produce a combined 52 tons (47 MT) per year of SO_x and 167 tons (152 MT) per year of NO_x based on the use of the dry low NO_x combustion technology and the use of SCR in order to significantly reduce NO_x emissions.

The new plant would be subjected to the continuous monitoring and reporting requirements of SO_2, NO_x, and CO_2 specified in 40 CFR Part 75.

Particulates. The combination of the NGCC portion of this alternative and the Norton Energy Storage project would produce a combined 78 tons (71 MT) per year of particulates, all of which would be emitted as PM_{10}. In addition to particulate emissions from the NGCC facility, small

amounts of particulate would be released as drift from the cooling tower that supports the NGCC facility and the Norton Energy Storage project. The amount of drift released by the NGCC portion and Norton Energy Storage (which does not require water for steam condensing) would be less than that presently being released from the Davis-Besse tower as it supports the reactor since the cooling tower for a nuclear reactor has higher heat rejection demands and is considered to be a bounding condition.

Carbon Monoxide. Based on EPA emission factors (EPA 1998), NRC staff estimates that the total CO emissions would be approximately 166 tons (151 MT) per year.

Carbon Dioxide. The NRC estimates that uncontrolled emissions of CO_2 from operation of the NGCC alternative and Norton Energy Storage would amount to 1.28 million tons (approximately 1.16 million MT) per year. Although natural gas combustion in the combustion turbines at the NGCC facility and the Norton Energy Storage project would be the primary source, other miscellaneous ancillary sources—such as truck and rail deliveries of materials to the site and commuting of the workforce—would make minor contributions.

The Tailoring Rule will require that BACT be applied to control CO_2 emissions. Carbon capture and sequestration (CCS) technologies will eventually capture and remove as much as 90 percent of the CO_2 from the exhausts of combustion turbines (NETL 2010). However, NETL estimates that such equipment imposes a significant parasitic load that will result in a power production capacity decrease of approximately 14 percent, a reduction in net overall thermal efficiency of the CTs studied from 50.8 percent to 43.7 percent, and a potential increase in the levelized cost of electricity produced in NGCC units so equipped by as much as 30 percent (NETL 2010). The reduced efficiencies that would come with CCS, however, would necessitate that the facilities consume more fuel and emit larger amounts of other pollutants to provide the same output.

Hazardous Air Pollutants. In December 2000, the EPA issued regulatory findings (EPA 2000b) on emissions of HAPs from electric utility steam-generating units, which identified that natural gas-fired plants emit hazardous air pollutants such as arsenic, formaldehyde, and nickel. The EPA stated that "[t]he 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." As a result, the NRC staff will not further address HAPs here.

In addition to the air quality impacts associated with operation of the NGCC facility and Norton Energy Storage project, additional air quality impacts would result from vehicles used by the commuting operating workforce. However, the workforce employed by this combination alternative is smaller than the current operating workforce at Davis-Besse, so this alternative will result in reductions in commuting-related air emissions.

Based on this information, the overall air quality impacts of the combination alternative would be SMALL.

8.2.2 Groundwater Use and Quality

8.2.2.1 Construction

FENOC (2011) indicated that groundwater would be used during construction of wind turbines only if other potable water supplies are limited and that "minor" amounts may be necessary during operation if other supplies are unavailable. In addition, FENOC indicates that solar PV installation would not use groundwater for any purpose. The impacts from construction of wind and solar construction would be SMALL.

FENOC (2011) also indicates that a CAES facility would not rely on groundwater for cooling and that regulations for groundwater extraction for potable water would limit impacts. Further, state-level bodies would regulate potential impacts to groundwater resources. The NRC staff finds that impacts during construction of the Norton Energy Storage project would be SMALL.

The impacts associated with groundwater use during construction of the NGCC portion would be similar to, but smaller than, those discussed in Section 8.1 for the full NGCC alternative, which the NRC staff considered to be SMALL.

8.2.2.2 Operation

As the NRC staff indicated in the preceding section, wind turbines and solar PV installations do not rely on water for cooling, and the lack of onsite crews at wind installations means that installations do not generally require water to support staff activities (e.g., drinking, washing, sanitation). As a result, the NRC staff does not expect any noticeable impacts to groundwater from the wind or solar PV portions of this alternative; thus, the impact is SMALL.

As noted above, FENOC (2011) also indicates that a compressed air energy storage facility would not rely on groundwater for cooling and that regulations for groundwater extraction for potable water would limit impacts. The NRC staff agrees that groundwater would likely not be used for cooling and that consumption of groundwater for potable water supply would have a SMALL impact.

The NRC staff presumed that the NGCC alternative in Section 8.1 would not rely on groundwater for any purposes. The NRC staff notes that the NGCC portion of this combination alternative could rely on groundwater for some onsite usage but would likely not rely on groundwater for cooling or service water. The NRC staff finds that impacts to the groundwater resources from the NGCC portion of this alternative would be SMALL.

The NRC staff finds that the overall impact of this combination alternative on groundwater use and quality would be SMALL, and the widely scattered wind and solar PV sites would likely not impose noticeably cumulative effects on groundwater resources.

8.2.3 Surface Water Use and Quality

8.2.3.1 Construction

The use of minimal amounts of surface water is expected in the construction of all portions of this alternative, primarily for fugitive dust control, cleaning, and concrete mixing. Some impacts on surface water quality may result in increased sediment loading to stormwater runoff from active construction zones; however, the NRC expects that Stormwater General Permits would require best management practices that would prevent or significantly mitigate such impacts. Best management practices include controlling drainage by ditches, berms, and sedimentation basins; prompt revegetation to control erosion; stockpiling and reusing excavated topsoil; and various other techniques used to control soil erosion and water pollution. As a result, surface water use and quality impacts during construction would be SMALL.

8.2.3.2 Operation

The NGCC and Norton Energy Storage project are the primary users of surface water in this alternative. The NRC staff notes that the wind and solar PV portions of this alternative do not rely on water for cooling or operations and only affect surface water as a result of potential surface runoff and water consumption by crews during construction and during maintenance.

FENOC (2011) indicates that the Norton Energy Storage project would rely on cooling towers to dissipate the heat that the gas turbines and compressors create, though the cooling towers

would be much smaller than those typically used for coal and gas generation plants. FENOC (2011) indicates that cooling water makeup losses would be considerably less than those from Davis-Besse or an NGCC alternative, as would discharge flows. The NRC staff concludes that water consumption from the Norton Energy Storage Project will have a SMALL impact.

The gas-fired alternative would require much less cooling water than Davis-Besse because it operates at a higher thermal efficiency (nearly 60 percent) and because it requires much less water for steam cycle condenser cooling. In Section 8.1, the NRC staff noted that an NGCC alternative constructed at the Davis-Besse site would have SMALL impacts, and the NGCC portion of this alternative would use approximately one-sixth of the cooling water of the full NGCC replacement considered in the full-NGCC alternative. The impact to surface water from the operation of the NGCC portion of this alternative is SMALL.

Overall, the impacts from the combination of alternatives on surface water use and quality are SMALL.

8.2.4 Aquatic Ecology

8.2.4.1 Construction

Impacts from construction of wind installations and solar PV installations would be spread over wide areas and would have the ability to affect surface water as a result of runoff from disturbed lands. Impacts would likely be controlled by permit conditions and application of good management practices. Impacts to aquatic ecology would be short-lived and would cease after construction ceases. Impacts are likely to be SMALL.

Impacts on aquatic ecosystems from construction of the NGCC and Norton Energy Storage project portions of this alternative would be controlled through adherence to provisions of the aforementioned Stormwater General Permits and, as a result, would be SMALL.

Overall, the impact from the combination alternative on aquatic ecology during construction is SMALL.

8.2.4.2 Operation

Impacts from the wind installations and solar PV installations would not be noticeable as neither portion of the combination alternative would use water during operation, except for limited quantities during periodic maintenance. Impacts to aquatic ecology from the wind and solar portions would be SMALL.

FENOC (2011) indicated that water consumption and discharges at the Norton Energy Storage project would be regulated by NPDES limitations and provisions under Sections 316(a) and (b) of the Clean Water Act. As NRC staff established in the surface water use and quality discussion above, the Norton Energy Storage project would not have a noticeable effect on surface water and would use much less water than the NGCC alternative. Impacts from the Norton Energy Storage project would be SMALL

Aquatic ecosystems subject to blowdown from the NGCC's and Norton Energy Storage's cooling systems would be affected by the thermal and chemical characteristics of the discharge water, all of which would be controlled at accepted levels by an NPDES permit issued by State or local authorities. Aquatic ecology impacts during operations of the NGCC portion of this alternative would be SMALL.

Overall, the impact from the combination alternative on aquatic ecology during operation is SMALL.

8.2.5 Terrestrial Ecology

8.2.5.1 Construction

FENOC (2011) indicates that interconnected wind installations could have a LARGE impact on ecological resources, especially during construction as a result of land areas used by wind projects. Further, FENOC notes that wind installations could have noticeable impacts on migratory birds, eagles and raptors, and bats. FENOC indicates that wind installations in some parts of the U.S. have minor impacts, although FENOC also asserts that one cannot assume that similar impacts would occur in Ohio, particularly if any wind turbines are sited in or near Lake Erie. Given development efforts to date, the NRC staff does not expect offshore wind to significantly contribute to the wind power portion of this alternative.

FENOC (2011) indicates that best management practices and awareness of habitats would minimize impacts to ecological resources. The NRC staff notes that most land on which wind installations would be sited is likely to already be in agricultural use, given the predominant land use patterns in Ohio. As a result, surface disruptions and equipment are likely to affect only those ecological resources that exist on agricultural lands, which have already been substantially modified by human activities. Terrestrial impacts during construction are likely to be SMALL.

The NRC staff notes that most land on which solar installations would be sited is also likely to already be in agricultural use, given the predominant land use patterns in Ohio, so surface disruption and equipment are likely to affect only those ecological resources that exist on agricultural lands, which have already been substantially modified by human activities. The impact from the solar PV portion of this alternative is likely to be SMALL during construction.

FENOC (2011) indicates that the impacts from constructing the Norton Energy Storage project would be SMALL, given that it would only affect 92 ac of land surface. As this land has already been disturbed by historic mining activities, the NRC staff finds that the Norton Energy Storage project portion of this alternative would have a SMALL impact on terrestrial ecology during construction.

As indicated in Section 8.1, the NRC presumes that an NGCC alternative could be constructed on the existing Davis-Besse property. The reduced NGCC portion of this alternative (roughly one-third of the alternative considered in the previous section) could be located on previously disturbed industrialized portions currently maintained as parking lots or other paved surface or as landscaped areas that are regularly mowed. Because of this, no undisturbed terrestrial habitat would be affected by the construction of the NGCC plant at the Davis-Besse site. Some sediment transport or erosion may occur and some wildlife in neighboring marsh and grassland habitat would likely avoid habitat margins during construction due to increased noise and lighting. Edge species would be affected more than interior species. Offsite impacts will occur at the locations affected by the construction of the natural gas pipeline connecting the site to existing infrastructure, though long-linear projects can often be sited to minimize important resources. Dependent on the timing of construction activities, the nesting behavior of certain species could be adversely affected. NRC presumes protective measures, similar to those implemented by FENOC regarding the bald eagle, would continue during construction to prevent further impacts. Impacts on terrestrial resources from the construction of the NGCC alternative on the Davis-Besse site would be SMALL.

Overall, the construction impacts of this alternative are likely to be SMALL.

8.2.5.2 Operation

Interconnected wind installations could have operational impacts to birds and bats. Generally, however, the NRC staff finds that impacts will not destabilize any resources. The impact to ecological resources from an interconnected array of wind installations is, thus, SMALL to MODERATE.

FENOC (2011) indicates that development of solar PV installations could have major impacts on land resources, which could have significant impacts on terrestrial ecological resources. The NRC staff notes that most land on which solar installations would be sited is likely to already be in agricultural use given the predominant land use patterns in Ohio. As a result, operational impacts are likely to affect only those ecological resources that exist on agricultural lands. These impacts are unlikely to be noticeable on the scale of the solar PV portion of this alternative; thus, they are SMALL.

Air emissions from the Norton Energy Storage project, which have a SMALL impact to air quality, are unlikely to have a noticeable impact to terrestrial resources during operations. Further, operations at the Norton site will take place on area previously disturbed by mining activities. As a result, the impacts from the Norton Energy Storage project portion of this alternative are SMALL.

Impacts on terrestrial species due to the operation of an NGCC plant would be similar to the impacts associated with the present operation of Davis-Besse. The monitoring of cooling-tower drift effects on terrestrial vegetation has shown no visible damage. In addition, where lines cross croplands and little or no vegetation control is required, impacts due to ROW management on wildlife has also been determined to be small. As a result, the impacts on terrestrial resources from the operation of the NGCC alternative on the Davis-Besse site would be SMALL.

Overall operational impacts from this alternative are SMALL to MODERATE.

8.2.6 Human Health

8.2.6.1 Construction

FENOC (2011) indicates that the only major human health risk from construction and operation of an interconnected array of wind installations is accidents. FENOC indicated that compliance with applicable occupational safety and health regulations (those implemented by the Occupational Safety and Health Administration (OSHA)) would ensure that impacts are SMALL. The NRC staff agrees that impacts from construction and operation of an array of wind installations would be SMALL.

FENOC (2011) indicates that human health impacts from construction of solar PV installations would be regulated by OSHA; thus, they would be SMALL.

The Norton Energy Storage project poses some unique challenges, such as construction of an energy facility within and near a cavern, though OSHA standards would still apply. The NRC staff further finds that impacts on human health from the compressed air energy storage facility's air emissions would also not be noticeable. As a result, the NRC staff finds that human health impacts from this portion of the alternative would be SMALL.

Impacts on human health from construction of the NGCC alternative would be similar to impacts associated with the construction of any major industrial facility. Compliance with worker protection rules would control those impacts on workers at acceptable levels. Impacts from construction on the general public would be minimal since limiting active construction area

access to authorized individuals is expected. Impacts on human health from the construction of the NGCC alternative would be SMALL.

8.2.6.2 Operation

FENOC (2011) indicates that human health impacts from operation of solar PV would be regulated by the OSHA and would be SMALL. FENOC also indicates that accidents, the only potential human health impact from operation of wind turbines, would be mitigated by OSHA regulations and would be SMALL

FENOC (2011) indicates that OSHA regulation of the Norton Energy Storage project would prevent noticeable impacts on human health. The NRC staff further notes that human health effects of gas-fired generation are generally low, although in Table 8-2 of the GEIS (NRC 1996), the NRC staff identified cancer and emphysema as potential health risks from gas-fired plants. NO_x emissions contribute to ozone formation, which contributes to human health risks. Emission controls on the NGCC alternative can be expected to maintain NO_x emissions well below air quality standards established for the purposes of protecting human health, and emissions trading or offset requirements mean that overall NO_x releases in the region will not increase. Health risks for workers may also result from handling spent catalysts used for NO_x control that may contain heavy metals. Impacts on human health from the operation of the NGCC portion of the alternative would be SMALL.

8.2.7 Land Use

As discussed in Section 8.1.7, the GEIS (NRC 1996) generically discusses the impact of constructing and operating various replacement power plant alternatives on land use, both on and off each power plant site. The analysis of land use impacts here focuses on the amount of land area that would be affected by the construction and operation of a combination of wind turbines, solar PV installations, and an NGCC power plant at Davis-Besse.

8.2.7.1 Construction

Most of the wind farms would be located on an open agricultural cropland, which would remain largely unaffected by the presence of the wind turbines. As wind turbines require ample spacing between one another to avoid air turbulence, the footprint of a utility scale wind farm could be quite large. Under the wind portion of this alternative, land-based turbines would be located on multiple wind farms spread across approximately 75,000 ac (30,000 ha) of land as 50 ac (20 ha) of land would be required for each MW of capacity (FENOC 2011). A portion of this land, approximately 3,750 ac (1,517 ha), would be directly affected by the placement of the wind turbines (FENOC 2011). This land would be temporarily affected during the installation of the turbines and the construction of support facilities, and about one-third of the land across a very wide area would be permanently impacted during the operation. This amount of land disturbance would occur primarily on agriculture land and would be widely spread across Ohio (and perhaps into neighboring states to allow for adequate geographic dispersal).

Delivering heavy and oversized wind turbine components would also require the construction of temporary site access roads, some of which may require a circuitous route to their destination. However, once construction is completed, many temporary access roads can be reclaimed and replaced with more direct access to the wind turbines for maintenance purposes. Likewise, land used for equipment and material lay down areas, turbine assembly, and installation could be returned to its original state or some other compatible use, such as farming or grazing. As wind farms would require a substantial amount of open land, though only a small portion would be used for wind turbines, access roads, and infrastructure, land use impacts from the wind portion of this alternative would range from MODERATE to LARGE.

The solar PV portion of this alternative requires approximately 2,400 ac (970 ha) (NREL 2008). As indicated for the wind-powered portion of this alternative, the solar PV installations are also likely to occur on agricultural land. Land required for a standalone solar PV installation would alter the existing land use to energy production, and would preclude most other land uses from coexisting. Land would also be needed for transmission lines to connect solar PV installations to the electrical power grid and site access roads for maintenance purposes. Installing solar PV technologies on building rooftops would reduce the amount of land required for standalone solar. Based on this information, overall land-use impacts from the solar PV portion of this alternative would range from SMALL to LARGE, depending on the extent to which PV installations occur on existing buildings rather than standalone sites.

Land use impacts from the CAES portion of this alternative would be similar to the impacts described for an NGCC power plant (see Section 8.1.7). Only a minor amount of land would be needed above the geologic storage formation; however, additional land might be needed to connect the CAES to the electrical power grid, site access roads, or construction of a gas supply pipeline. If the Norton Energy Storage Project is used, no construction of an underground storage facility would be necessary. Therefore, land use impacts from the CAES portion of this alternative would be SMALL to MODERATE depending on location.

A new 305-MW NGCC plant would require approximately 74 ac (30 ha) of land and could be constructed largely within the existing developed industrial footprint of the Davis-Besse site. This amount of land use would include other plant structures and associated infrastructure. Similar to the NGCC replacement alternative considered in Section 8.1.7, an additional 150 ac (61 ha) of land could be needed for a new 25-mi (41-km) gas supply pipeline. In addition to onsite land requirements, land would be required offsite for natural gas wells and collection stations. Scaling from GEIS estimates, approximately 1,098 ac (444 ha) (based on 3,600 ac per 1,000 MWe and 305 MWe for NGCC) (NRC 1996) would be required for wells, collection stations, and pipelines to bring the gas to the plant. Most of this land requirement would occur on land where gas extraction already occurs. Therefore, land use impacts from the NGCC portion of this combination alternative at the Davis-Besse site could range from SMALL to MODERATE.

Based on this information, overall land use impacts from the construction and operation of a combination of wind turbine, solar, PV, CAES, and NGCC components of the combination alternative would range from SMALL to LARGE.

8.2.7.2 Operation

The elimination of uranium fuel for Davis-Besse would partially offset some, but not all, of the land requirements for this combination alternative. Scaling from GEIS estimates, approximately 635 ac (256 ha) (based on 35 ac/yr disturbed per 1,000 MWe for 20 years) would no longer be needed for mining and processed uranium during the operating life of the plant (NRC 1996). Operational land use impacts caused by the components of the combination alternative would be SMALL.

8.2.8 Socioeconomics

As previously explained in Section 8.1.8, two types of jobs would be created by this alternative: (1) construction jobs, which are transient, short in duration, and less likely to have a long-term socioeconomic impact; and (2) operations jobs, which have the greater potential for permanent, long-term socioeconomic impacts. Workforce requirements for the construction and operation of a combination of wind turbines, solar PV, NGCC and a CAES facility were evaluated in order to measure their possible effects on current socioeconomic conditions.

8.2.8.1 Construction

FENOC estimates that approximately 1,200 workers would be needed during construction of the wind turbine component of this alternative (FENOC 2011). FENOC's estimate appears to be overly conservative for the small size and megawattage of this construction project and inconsistent with recent license renewal reviews. Exelon's wind farm construction workforce estimate for a similar combination alternative to replace Limerick, Units 1 and 2, appears to be more reasonable and in line with current construction trends. Therefore, Exelon's estimate of approximately 200 construction workers (Exelon 2011) is used in this analysis.

In addition to constructing the wind farms, solar PV installations would also create temporary construction jobs, economic activity, and increased demand for short-term rental housing and public services in communities nearest to the construction sites. Exelon estimated 200 construction workers would be needed to install solar PV for a similar combination alternative to replace Limerick, Units 1 and 2 (Exelon 2011). However, given the smaller scale and megawattage of the wind farm and solar PV components, an even smaller construction workforce would likely be required than what was estimated for the Limerick, Units 1 and 2, combination alternative. Given the relatively small number of construction workers scattered over a large area at various construction sites, the relative socioeconomic impact of this many construction workers for these two components would be SMALL.

FENOC estimated approximately 728 to 1,517 workers would also be needed to construct the NGCC component of this alternative (FENOC 2011). FENOC's estimate appears to be overly conservative for the small size and megawattage of this construction project and inconsistent with recent license renewal reviews. Exelon's wind farm construction workforce estimate for a similar combination alternative to replace Limerick, Units 1 and 2, appears to be more reasonable and in line with current construction trends. Therefore, Exelon's estimate of approximately 200 construction workers (Exelon 2011) is used in this analysis.

The relative economic impact of this many workers on the local economy and tax base would vary, with the greatest impacts occurring in the communities where the majority of construction workers would reside and spend their income. As a result, local communities could experience a short-term economic "boom" from increased tax revenue and income generated by construction expenditures and the increased demand for temporary (rental) housing and business services. Some construction workers could relocate in order to be closer to the construction work site. However, given the proximity of Davis-Besse to the Toledo metropolitan area, workers could commute to the construction site, thereby reducing the need for rental housing. Given the small number of construction workers, socioeconomic impacts would be SMALL.

Construction of the CAES portion of this alternative would temporarily increase employment in the vicinity of the Norton Energy Storage project (approximately 85 mi east-southeast of Davis-Besse). Similar to the NGCC portion of this alternative, the relative economic impact of this many workers on the local economy and tax base would vary, with the greatest impacts occurring in the communities where the majority of construction workers would reside and spend their income. Some construction workers could relocate in order to be closer to the construction work site. However, given the proximity of the site to Akron and Cleveland, workers could commute to the construction site, thereby reducing the need for rental housing.

Given that the small number of construction workers would be scattered over a large area at various construction sites under this combination alternative, socioeconomic impacts would be SMALL and localized near the construction sites. After the installation of each component is completed, local communities could experience a return to pre-construction economic conditions. Based on this information, the combined overall socioeconomic impacts of

construction under the combination alternative could range from SMALL to MODERATE, due to overlapping effects should more than one construction activity occur within the same area.

8.2.8.2 Operation

FENOC (2011) estimated that 150 to 200 workers would be required to operate the wind power portion of this alternative (FENOC 2011). FENOC's estimate appears to be overly conservative for the small size and megawattage of this construction project and inconsistent with recent license renewal reviews. Exelon's wind farm construction workforce estimate for a similar combination alternative to replace Limerick, Units 1 and 2, appears to be more reasonable and in line with current construction trends. Therefore, Exelon's estimate of approximately 50 operations workers (Exelon 2011) is used in this analysis. Given the relatively small number of operations workers and potentially large area (i.e., 75,000 ac (30,000 ha)) covered by the wind power and solar PV installations at standalone sites and other locations, the relative economic impact of this many workers on local communities and the tax base would be SMALL and spread over a large region.

FENOC estimated the operations workforce for the NGCC portion of this alternative workforce to be approximately 91 workers (FENOC 2011). This estimate, while very conservative, appears to be reasonable. FENOC estimates that 50 to 100 workers would be needed for operations at the CAES facility. Increased demand for housing and public services caused by the relatively small number of operations workers would have a SMALL socioeconomic impact on the region around Davis-Besse.

The reduction in employment at Davis-Besse could affect property tax revenue and income in local communities and businesses. This alternative would result in the loss of approximately 825 relatively high-paying jobs at Davis-Besse, with a corresponding reduction in purchasing activity and tax contributions to the regional economy. In addition, the permanent housing market could also experience increased vacancies and decreased prices if operations workers and their families move out of the Davis-Besse region. However, the amount of property taxes paid by wind farms, solar PV installations, and CAES may offset some of the lost tax revenues from Davis-Besse because of the large amount of land required for wind farm and solar PV installations.

Overall, the socioeconomics of operation of this alternative would range from SMALL to MODERATE because of the small number of operations workers required to operate each component of this combination alternative and because of the reduction in employment at Davis-Besse and the potential overall net reduction of tax revenue from this combination alternative.

8.2.9 Transportation

Commuting workers and truck deliveries of materials and equipment would cause transportation impacts during the construction and operation of the wind farm, solar PV installations, CAES, and NGCC power plant.

8.2.9.1 Construction

Transportation impacts during the construction and operation of the wind, solar PV, NGCC, and CAES components of this combination alternative would be less than the overall impacts from the construction of a single replacement power plant (i.e., NGCC power plant). This is because the construction workforce for each component and the volume of materials and equipment needing to be transported to each respective construction site would be smaller than the concentrated effects at one power plant site. In other words, the transportation impacts would

not be as concentrated at Davis-Besse under the NGCC alternative (see Section 8.1.9), but spread out over a wider area under this combination alternative.

Commuting workers to each construction site would arrive by site access roads, and traffic volumes on nearby roads could increase during shift changes. In addition to commuting workers, trucks would be transporting construction materials and equipment to the worksite, thus increasing the amount of traffic on local roads near the construction site. The increase in vehicular traffic would peak during shift changes, resulting in temporary levels of service impacts and delays at intersections. Transporting heavy and oversized wind turbine components on local roads could have a noticeable impact over a larger area. Some components and materials could also be delivered by train or barge, depending on location. Train deliveries could cause additional traffic delays at railroad crossings. Based on this information, traffic-related transportation impacts during construction could range from SMALL to MODERATE depending on the location and concentration of wind farms, solar PV installations, NGCC power plant, and CAES; and road capacities.

8.2.9.2 Operation

During operations, transportation impacts would be less noticeable during shift changes and maintenance activities. Given the small number of operations workers needed for each component, the levels of service traffic impacts on local roads from the combination alternative would be SMALL.

8.2.10 Aesthetics

The analysis of aesthetic impacts focuses on the degree of contrast between the components of the combination alternatives and the surrounding landscape. In general, aesthetic changes would be limited to the immediate vicinity of the wind farms, solar PV installations, NGCC, and CAES facility.

8.2.10.1 Construction

During construction, all of the clearing and excavating would occur on the existing construction site. These activities could be visible from offsite roads. Wind turbines would have the greatest potential visual impact; wind turbines often dominate the view and become the major focus of attention. On flat terrain, wind turbines would be visible from miles away and would be the tallest manmade structures in rural settings. Because wind farms are generally located in rural or remote areas, the introduction of wind turbines will be in sharp contrast to the visual appearance of the surrounding environment. Similarly, the footprint of a solar PV installation would be quite large and could create a noticeable visual impact. Spread across a large site, a solar PV installation could dominate the view and would likely become the major focus of attention. The introduction of a solar PV installation would be in sharp contrast to the visual appearance of the surrounding environment. Installing solar PV technologies on building rooftops, although noticeable to a lesser degree, would reduce the amount of land required for standalone solar sites.

Aesthetic impacts from the NGCC plant component of the combination alternative would be essentially the same as those described for the NGCC alternative in Section 8.1.7.4., except there would be one unit rather than two. As the CAES component of this alternative would be sited at former industrial (mining) site, the aesthetic impacts would be similar to those of the NGCC alternative.

Construction of exhaust stacks and mechanical draft cooling towers would, however, impact the surrounding landscape.

The overall aesthetic impact would be SMALL to LARGE, depending on the location of wind farms, type of solar PV installation, and location of the NGCC and CAES component at industrial sites.

8.2.10.2 Operation

Wind turbines and solar PV technologies would be visible offsite during daylight hours, and some structures may require aircraft warning lights. During certain weather conditions, the plume from the NGCC cooling tower would be visible for long distances. In general, given the industrial appearance of the Davis-Besse site, an NGCC power plant would blend in with the surroundings if the existing Davis-Besse facility remains. In addition, the visual appearance of the NGCC power block could look similar to the existing Davis-Besse power block. Since the new NGCC power plant would appear similar to the existing Davis-Besse power plant, overall operational impacts would be SMALL.

8.2.11 Noise

Ambient noise conditions would be affected by the construction and operation of wind farms, solar PV installations, and the construction and operation of a single-unit NGCC power plant.

8.2.11.1 Construction

Noise levels would increase during wind farm, solar PV technology, and CAES installation and NGCC construction. Noises during construction, however, would be intermittent and limited to the peak periods of activity and would diminish over distance. Noise impacts during construction could range from SMALL to MODERATE.

8.2.11.2 Operation

Noise during wind farm, solar PV, and CAES component operations would be limited to those caused by normal industrial processes and communications. Wind turbines would also generate noise. Pipelines delivering natural gas fuel to the NGCC or CAES component could be audible offsite near gas compressor stations, but all noise would be within EPA established limits. Overall noise impacts would be SMALL.

8.2.12 Historic and Archaeological Resources

To consider effects on historic and archaeological resources, any areas potentially affected by the construction of the wind, solar PV, CAES, and NGCC components of this alternative would need to be surveyed to identify and record historic and archaeological resources. Any resources found in these surveys would need to be evaluated for eligibility on the NRHP, and mitigation of adverse effects would need to be addressed if eligible resources were encountered. The owner of the wind farms would need to survey all areas associated with operation of the alternative (e.g., roads, transmission corridors, other ROWs). Areas with the greatest sensitivity should be avoided. Visual impacts on significant cultural resources—such as the viewsheds of historic properties near the sites—also should be assessed.

The potential for impacts on historic and archaeological resources from the wind component of this alternative would vary greatly, depending on the location of the proposed sites. Areas with the greatest sensitivity could be avoided or effectively managed under current laws and regulations. However, construction of wind farms and their support infrastructure have the potential to notably impact historic and archaeological resources because of earthmoving activities (e.g., grading and digging) and the aesthetic changes they may bring to the viewshed of historic properties located nearby. Therefore, depending on the resource richness of the site

chosen for the wind farms and associated infrastructure, the impacts could range from SMALL to LARGE.

The impacts of the construction of a new solar PV alternative on historic and archaeological resources will vary depending on the form of the solar capacity installed. Rooftop installations minimize land disturbance and the modifications necessary to the transmission system, thereby minimizing impacts to historic and archaeological resources. Land-based installations are larger than rooftop installations and will require some degree of land disturbance for installation purposes, potentially causing greater impacts to historic and archaeological resources. Aesthetic changes caused by the installation of both forms could have a noticeable effect on the viewshed of nearby historic properties. Using previously disturbed sites for land-based installations and collocating any new transmission lines with existing right-of-ways could minimize impacts to historic and archaeological resources. Areas with the greatest sensitivity could be avoided or effectively managed under current laws and regulations. Therefore, depending on the resource richness of the sites chosen and the type of solar technology installed, the impacts could range from SMALL to LARGE.

The impacts to historic and archaeological resource are expected to be similar to the discussion of the NGCC alternative in Section 8.1.12. The NRC staff assumes that prior mining and industrial use of the 92-ac (37-ha) Norton Energy Storage site has removed or otherwise affected the historic and archaeological resources at the former mine site. As a result, the Norton Energy Storage project is likely to have SMALL impact on historic and archaeological resources.

Overall impacts to historic and archaeological resources for this alternative range from SMALL to LARGE.

8.2.13 Environmental Justice

The environmental justice impact analysis evaluates the potential for disproportionately high and adverse human health, environmental, and socioeconomic effects on minority and low-income populations that could result from the construction and operation of wind turbines, solar PV installations, an NGCC plant and a CAES facility. As previously discussed in Section 8.1.13, such effects may include human health, biological, cultural, economic, or social impacts. Some of these potential effects have been identified in resource areas discussed in this SEIS.

8.2.13.1 Construction

Potential impacts to minority and low-income populations would mostly consist of environmental and socioeconomic effects during construction of all components of this alternative (e.g., noise, dust, traffic, employment, and housing impacts). Noise and dust impacts during construction would be short term and primarily limited to onsite activities. Minority and low-income populations residing along site access roads would be affected by increased commuter vehicle and truck traffic. However, because of the temporary nature of construction, these effects would only occur during certain hours of the day and are unlikely to be high and adverse and would be contained to a limited time period during certain hours of the day. During construction, increased demand for rental housing in the vicinity of the site could affect low-income populations living near the alternatives. However, given the small number of construction workers and the possibility that workers could commute to the construction site, the need for rental housing would not be significant.

Based on this information and the analysis of human health and environmental impacts presented in Section 8.2 of this chapter, the construction of wind turbines, solar PV installations,

an NGCC plant, and CAES facility would not have disproportionately high and adverse human health and environmental effects on minority and low-income populations.

8.2.13.2 Operation

Minority and low-income populations living in close proximity to the wind farms, solar PV installations, and CAES facility could be disproportionately affected by operations. However, operational impacts would mostly be limited to noise and aesthetic effects. The general public living near the wind farms, solar PV installations, and CAES facility would also be exposed to the same effects. As discussed in Section 8.1.13, emissions from the operation of an NGCC plant could affect minority and low-income populations as well as the general population living in the vicinity of the new power plant. However, all would be exposed to the same potential effects from NGCC power plant operations, and any impacts would depend on the magnitude of the change in ambient air quality conditions. Permitted air emissions are expected to remain within regulatory standards.

Based on this information and the analysis of human health and environmental impacts presented in Section 8.2 of this chapter, the construction and operation wind turbines, solar PV installations, an NGCC plant, and CAES facility would not have disproportionately high and adverse human health and environmental effects on minority and low-income populations.

8.2.14 Waste Management

8.2.14.1 Construction

FENOC (2011) indicates that hazardous materials, such as cadmium and lead, are used in the manufacture of solar PV panels; thus, solar PV could create environmental impacts during manufacture and disposal. The NRC staff notes that no waste is generated during the lifetime of a solar PV project from the PV installation itself and that some land-clearing debris may be generated during installation. The NRC staff finds it likely that solar manufacturers would employ best practices to minimize release and disposal of hazardous wastes and recycle any commercially valuable quantities of waste items. Further, site crews are likely to manage land-clearing debris in accordance with best practices. As agricultural sites are likely already cleared and graded, the NRC staff expects impacts from the solar PV portion of this alternative to SMALL.

FENOC (2011) indicates that construction of an interconnected array of wind installations could result in generation of large amounts of land-clearing debris, but proper waste management activities would minimize these impacts. The NRC staff notes that most land used for wind installations is likely to already be in agricultural use; thus, it is already cleared and, in many cases, relatively flat. As such, the NRC staff finds that the impacts from waste management would be SMALL.

During construction of the NGCC portion of this alternative, land clearing and other construction activities would generate waste that can be recycled, disposed of onsite, or shipped to an offsite waste disposal facility. Because the NGCC portion of this alternative would likely be constructed on the previously disturbed portions of the Davis-Besse site, the amounts of wastes produced during land clearing would be minimal. As a result, construction related impacts due to the construction of the NGCC alternative due to waste management would be SMALL.

Construction of the Norton Energy Storage project would generate similar wastes to the NGCC portion of this alternative. Some wastes may be generated as a result of reservoir-preparation activities at the Norton site, though it is unlikely that these wastes will require offsite disposal. In general, the Norton Energy Storage project portion of this alternative will have SMALL waste disposal impacts.

8.2.14.2 Operation

Wind turbine installations and solar PV installations generate no appreciable waste during operations, except for occasional component replacements, wash water, and—for wind turbines—lubricants. Waste management effects from solar PV and wind installations are SMALL.

The NGCC portion of this alternative would produce relatively little waste, primarily in the form of spent SCR catalysts used to control NO_x emissions from the natural gas-fired plants. Domestic and sanitary wastes would be expected to decrease from amounts now generated during the operation of the reactors due to a reduced operational workforce for the NGCC portion of this alternative. The NRC staff established, in Section 8.1.8, that impacts from a full NGCC alternative would be SMALL, and the waste generated by the NGCC portion of this alternative will be smaller; therefore, waste impacts from an NGCC facility at Davis-Besse would be SMALL.

FENOC (2011) indicates that operation of the Norton Energy Storage project would generate minimal waste during operation, like other gas-fired facilities, and that its impact would also be SMALL. The NRC staff notes that the primary types of waste generated by gas-fired power plants are SCR catalysts and other operational wastes.

Overall, the NRC staff finds that a combination would have SMALL waste management impacts.

8.2.15 Climate Change-Related Impacts of the Combination Alternative

Combustion of fossil fuels, including natural gas, is the greatest anthropogenic source of GHG emissions in the U.S. After a thorough examination of the scientific evidence and careful consideration of public comments, the EPA announced on December 7, 2009, that GHGs threaten the public health and welfare of the American people and meet the CAA definition of air pollutants. Carbon dioxide (CO_2) is by far the largest GHG emitted during fossil fuel combustion. This section presents an assessment of the potential impacts the construction and operation of the combination alternative will have on climate change.

8.2.15.1 Construction

Impacts to climate change from the construction of components of this alternative would result primarily from the consumption of fossil fuels in the engines of construction vehicles and equipment, workforce vehicles used in commuting to and from the work site, and delivery vehicles. However, all such impacts would be temporary. Given the expected relatively short construction period for constructing the alternatives' components, the overall impact on climate change from the releases of GHGs during construction of the combination alternative would be SMALL.

8.2.15.2 Operation

Although natural gas combustion in the combustion turbines (at both the NGCC facility and Norton Energy Storage project) would be the primary source of GHG emissions, maintenance activities of wind turbines and solar PV, and other miscellaneous ancillary sources such as truck and rail deliveries of materials to the site and commuting of the workforce would make minor contributions.

The NRC estimates that operation of the NGCC alternative and Norton Energy Storage would amount to 1.29 million tons of carbon dioxide equivalent (CO_2e) (1.17 million MT of CO_2e) per year. EPA reported that, in 2010, the total amount of CO_2e emissions related to electricity generation was 2,277.3 teragrams (2,277.3 MMT) (EPA 2012). The EIA reported that, in 2010, electricity production in Ohio was responsible for 121 MMT of CO_2 emissions (123 MMT CO_2e)

(EIA 2012). Operation of the NGCC alternative and Norton Energy Storage would amount to less than 1 percent of Ohio's 2010 GHG emissions.

NETL estimates that CCS will capture and remove as much as 90 percent of the CO_2 from the exhausts of combustion turbines (NETL 2010). With CCS in place, the NGCC alternative would release 0.116 MMT per year (0.128 million tons) of CO_2, and the impact on climate would be further reduced. The impact on climate change from the operation of the combination alternative would be SMALL.

8.3 Coal-Fired Alternative

In this section, NRC evaluates the environmental impacts of a coal-fired alternative to Davis-Besse. In the State of Ohio, over 83 percent of electricity was generated using coal-fired power plants in 2009. As noted by EIA in its Annual Energy Outlook (EIA 2013), coal-fired generation has historically been the largest source of electricity and is expected to remain a large source through 2040, though coal's share of total U.S. generation is expected to decline from 42 percent in 2011 to 35 percent in 2040. Baseload coal units have proven their reliability and can routinely sustain capacity factors as high as 85 percent. Among the various boiler designs that are available, pulverized coal boilers producing supercritical steam (SCPC boilers) are the most likely variant for a coal-fired alternative given their generally high thermal efficiencies and overall reliability.

While nuclear reactors, on average, operate with capacity factors above 90 percent, the new SCPC coal-fired alternative would operate with roughly an 85 percent capacity factor. Despite the slightly lower capacity factor, an SCPC plant would be capable of providing adequate replacement power for a nuclear plant for the purposes of this NEPA analysis. The NRC staff notes that the lower capacity factor slightly reduces the level of air emissions and fuel consumption estimated for the coal-fired alternative. However, the NRC staff determined that none of the slight underestimates are significant enough to result in impact levels that are different from those described below for the coal-fired alternative. Further, the NRC staff notes that the average capacity factor from Davis-Besse has been lower in recent years than the nuclear fleet average, and by applying this capacity-factor approximation, the NRC staff avoids assigning excessive impacts to the coal-fired alternative.

A myriad of sizes of pulverized coal boilers and steam turbine generators are available; however, the NRC staff presumes that two equally sized boiler/STG powertrains, operating independently and simultaneously, would likely be used to match the power output of Davis-Besse. To complete this analysis, the NRC staff presumes that both powertrains would have the same features, operate at generally the same conditions, have similar impacts on the environment, and be equipped with the same pollution-control devices such that once all parasitic loads are overcome, the net power collectively available would be roughly equal to 908 MWe. The NETL has estimated that approximately 7.5 percent of an SCPC boiler's gross MW capacity is needed to supply typical parasitic loads (plant operation plus control devices for criteria pollutants to meet New Source Performance Standards). Introducing controls for GHG emissions (i.e., CCS) would cause the parasitic load to increase to 27 percent of the boiler's gross rated capacity (NETL 2010). NRC has elected to introduce a 5.2 percent performance penalty (50 MW in this case) on the MW rating of SCPC boilers to account for typical parasitic loads while still allowing net capacity equivalent to Davis-Besse. However, because of uncertainty regarding future GHG regulations and the limited real-world experience in CCS at utility-scale power plants, parasitic loads associated with CCS are not considered. Thus, the gross power required of the coal-fired alternative is 958 MWe.

Various bituminous coal sources are available to coal-fired power plants in Ohio. EIA reports that, in 2008, the State of Ohio produced electricity from coal with heating values of 11,444 British thermal units per pound (Btu/lb), sulfur content of 1.96 percent, and ash of 9.42 percent (EIA 2010b). For the purpose of this evaluation, NRC presumes that coal burned in 2008 will be representative of coal that would be burned in a coal-fired alternative regardless of where it was located. Approximately one-third of the coal burned in Ohio in 2008 came from mines in the Appalachian basin in the eastern part of the State. The remaining coal was brought in primarily by railcar and river barge from West Virginia, Wyoming, Kentucky, and Pennsylvania (EIA 2011b). Bituminous coals from Appalachian mines have CO_2 emission factors ranging from 202.8 to 210.2 lb per million Btu of heat input (Hong and Slatick 1994). As a conservative estimate, NRC used a CO_2 emission factor of 210.2 lb per million Btu for carbon dioxide calculations in this evaluation.

The boilers comprising the supercritical coal-fired alternative are presumed to have the following characteristics and be equipped with the following pollution control devices:

- dual wall-fired, dry-bottom boilers, configured to be New Source Performance Standards (NSPS)-compliant;
- overall thermal efficiency of 39 percent;
- capacity factor of 85 percent;
- collective rating of 976 MWe (gross), 908 MWe (net);
- supercritical steam (see text box);
- bituminous coal from Appalachian mines; caloric value 11,444 Btu/lb, ash 9.42 percent, sulfur 1.96 percent, CO_2 emission factor of 210.2 lb/million Btu, pulverized to more than 70 percent passing a 200-mesh sieve;
- fabric filter for particulate control, operating at 99.9 percent removal efficiency;
- wet calcium carbonate SO_2 scrubber operating at 95 percent removal efficiency; and
- low-NO_x burners with overfire air and selective catalytic reduction for nitrogen oxide controls capable of attaining a NO_x removal of 86 percent (or an emission rate less than or equal to 2.5 parts per million per volume (ppmv) (dry basis)).

In its ER, FENOC determined that the current Davis-Besse site was not viable to accommodate a coal-fired alternative with net generating capacity sufficient to meet the power production of Davis-Besse due to limited space on the Davis-Besse site, as explained in Chapter 8 (FENOC 2010). The NRC staff concurs with that assessment and its analysis of the impacts of the coal-fired alternative presumes that the SCPC coal-fired power plant would operate only at an alternative site.

> **Supercritical Steam**
>
> "Supercritical" refers to the thermodynamic properties of the steam being produced. Steam whose temperature and pressure is below water's "critical point" (3,200 pounds per square inch absolute (psia) and 705 °F) is subcritical. Subcritical steam forms as water boils and both liquid and gas phases are observable in the steam. The majority of coal boilers currently operating in the U.S. produce subcritical steam with pressures around 2,400 psia and temperatures as high as 1,050 °F. Above the critical point pressure, water expands rather than boils, and the liquid and gaseous phases of water are indistinguishable in the supercritical steam that results. More than 150 coal boilers currently operating in the U.S. produce supercritical steam with pressures between 3,300 and 3,500 psia and temperatures between 1,000 and 1,100 °F. Ultrasupercritical boilers produce steam at pressures above 3,600 psia and temperatures exceeding 1,100 °F. There are only a few of these boilers in operation worldwide, and none in the U.S.

It is reasonable to assume that a coal-fired alternative would use supercritical steam (see text box). Supercritical steam technologies are increasingly common in new coal-fired plants. Supercritical plants operate at higher temperatures and pressures than older subcritical coal-fired plants and, therefore, can attain higher thermal efficiencies. While supercritical facilities are more expensive to construct than subcritical facilities, they consume less fuel for a given output, reducing environmental impacts throughout the fuel life cycle. The NRC staff expects that a new, supercritical coal-fired plant beginning operation in 2017 would operate at a heat rate of 9,069 Btu/kWh, or approximately 38 to 39 percent thermal efficiency. However, heat inputs could be less, depending on the coal source and whether fuel blending is practiced in order to remain compliant with emission limitations.

In an SCPC coal-fired power plant, burning coal heats pressurized water. As the supercritical steam and 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, spinning them, and driving the generator to produce electricity. After passing through the turbine, any remaining steam is condensed back to water and recycled back to the boiler for additional steam production.

SCPC coal-fired power plants are currently commercially available and currently feasible alternatives to Davis-Besse license renewal. The overall environmental impacts of a coal-fired alternative, as well as the environmental impacts of the proposed Davis-Besse license renewal, are shown in Table 8–4. Additional details of the impacts on individual resources of the coal-fired alternative are provided in subsequent sections.

Table 8–4. Summary of Environmental Impacts of the Supercritical Coal-Fired Alternative Compared to Continued Operation of Davis-Besse

	Supercritical Coal-Fired Generation	Continued Davis-Besse Operation
Air quality	MODERATE	SMALL
Groundwater	SMALL	SMALL
Surface water	SMALL	SMALL
Aquatic resources	SMALL to LARGE	SMALL
Terrestrial resources	SMALL	SMALL
Human health	SMALL	SMALL
Land use	SMALL to MODERATE	SMALL
Socioeconomics	SMALL to MODERATE	SMALL
Transportation	SMALL to LARGE	SMALL
Aesthetics	SMALL	SMALL
Historic & archeological resources	SMALL to MODERATE	SMALL to MODERATE
Waste management	MODERATE	SMALL

8.3.1 Air Quality

8.3.1.1 Construction

Activities associated with the construction of the coal-fired power plant would cause air impacts as a result of emissions from construction equipment and fugitive dust from operation of the earth-moving and material handling equipment. Impacts result from the consumption of fossil fuels in the engines of construction vehicles and equipment, workforce vehicles used in commuting to and from the work site, and delivery vehicles. All such impacts would be temporary. Construction lead times for coal power plants are typically 4-5 years (OECD/IEA 2005). Workers' vehicles and motorized construction equipment would generate temporary criteria pollutant emissions. Dust-control practices would reduce fugitive dust, which would be temporary in nature. Given the expected workforces and a relatively short construction period for both the coal-fired power plant, the NRC concludes that the impact of vehicle exhaust emissions and fugitive dust from operation of earth-moving and material handling equipment would be SMALL.

The overall air quality impacts associated with construction of a new coal-fired power plant would be SMALL.

8.3.1.2 Operation

Section 8.1.1 discusses the various state and Federal regulations that would control the construction and operation of an NGCC facility. Although this alternative examines the impact of a coal-fired power plant, many of the same regulatory controls would apply to pollutant releases. Air quality impacts from coal-fired generation can be substantial, resulting from the emissions of significant quantities of SO_x, NO_x, PM, CO, and HAPs such as mercury. Coal combustion is also a major source of the greenhouse gas CO_2. However, many of these

pollutants can be effectively controlled by various technologies, albeit with performance penalties that result in reductions in net power-generating capacity.

There are many major regulatory controls applicable to large fossil fuel external combustion sources. Air pollution control regulations promulgated under authority of the CAA would apply throughout FENOC's service area. Emission limits for criteria pollutants would be reflective of existing ambient air quality at the selected location. Additionally, Ohio is subject to NO_x SIP call regulations designed to reduce transport of ground-level ozone across State lines (EPA 2011b). A new coal-fired alternative located in Ohio would also be required to comply with those regulations.

This coal-fired alternative would be subject to New Source Performance Standards (NSPS) and New Source Review (NSR)/PSD reviews, leading to an operating permit that would specify limits to emissions of all criteria pollutants. The coal-fired plant would need to comply with the standards of performance set forth in 40 CFR Part 60 Subpart D and limits for particulate matter and opacity (40 CFR 60.42(a)), sulfur dioxide (40 CFR 60.43(a)), and NO_x (40 CFR 60.44(a)). The Regional Haze Rule, promulgated by EPA in 1999 and last amended in October 2006 (71 FR 60631), requires states to demonstrate reasonable progress toward the national visibility goal established in 1977 to prevent future impairment of visibility due to anthropogenic pollution in Class I areas. The visibility protection regulatory requirements are contained in 40 CFR Part 51, Subpart P, including 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. If a gas-fired alternative were located close to a mandatory Class I area, additional air pollution control requirements would potentially apply; however, there are no Class I areas in Ohio (EPA 2013). Regulations promulgated under the Acid Rain Program would cap SO_2 and NO_x emissions from the coal-fired alternative and may require participation in an emissions trading program if sufficient reductions were not possible through the use of pollution control devices, fuel blending, or other strategies. In addition to being major sources of criteria pollutants, coal-fired plants can also be sources of HAPs as a result of hazardous constituents contained in the coal. Consequently, coal-fired plants would be subject to EPA's mercury and air toxic standards (MATS) for power plants. A new coal-fired plant would be subject to emission limits for sulfur dioxide and nitrogen oxide promulgated under the Clean Air Interstate Rule (CAIR)[4].

In response to the Consolidated Appropriations Action of 2008 (Public Law 110-161), EPA promulgated final mandatory GHG reporting regulations on October 30, 2009, that became effective in December 2009 (EPA 2010a). Section 8.1.1 provides additional discussion regarding reporting regulations. If the coal-fired alternative meets PSD or Title V permitting requirements for non-GHG pollutant emissions and the GHG emission thresholds established in the "Tailoring Rule" (see Section 8.1.1) rule, then GHG emissions from this alternative would be regulated under the PSD and Title V permit programs.

Estimated Quantities of Pollutants Emitted. Although the NRC staff has identified the primary features and operating parameters of the supercritical pulverized coal boiler represented in this coal-fired alternative, many more aspects of system design, boiler firing conditions, and operating procedures can influence the quantity of criteria pollutants ultimately released to the environment. Consequently, the quantifications of pollutant emissions appearing below should be considered only as estimates. Algorithms and emission coefficients developed by EPA (EPA 1998) or empirical data from other relevant sources were used to estimate the amounts of

[4] On July 6, 2010, EPA proposed replacing CAIR with the Cross-State Air Pollution Rule (CSAPR) for control of sulfur dioxide and nitrogen oxide emissions that cross state lines, the regulations of which would be implemented in 2011 and finalized in 2012. However, CSAPR was vacated by the D.C. Circuit Court on August 21, 2012. On April 29, 2014, the U.S. Supreme Court reversed the D.C. Circuit opinion vacating CSAPR. EPA is reviewing the opinion, and CAIR remains in effect (EPA 2014).

pollutants that would result from operation of the coal-fired alternative. With a collective gross generating capacity of 960 MWe, the coal-fired alternative, operating at a capacity factor of 85 percent, would produce 7,130,000 MWh of electricity per year to the grid. With an overall power plant thermal efficiency of 39 percent and an average caloric value of bituminous coal of 12,886 Btu/lb, the amount of coal consumed annually would be approximately 2.88 million tons per year or (2.61 million MT per year).

Sulfur Oxides. The coal-fired alternative at an alternate site would likely use wet, limestone-based scrubbers to remove SO_2. The NETL indicates that this technology can remove 95 to 98 percent of SO_2 from flue gases (gases that exit to the atmosphere via a pipe or channel) (NETL 2007). SO_2 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 NO_x, the two principal precursors of acid rain, by restricting emissions of these pollutants from power plants. Title IV caps aggregate annual power plant SO_2 emissions and imposes controls on SO_2 emissions through a system of marketable allowances.

Nitrogen Oxides. A coal-fired alternative at an alternate site would most likely employ various available NO_x control technologies, which can involve combustion modifications, post-combustion controls, or both. Combustion modifications include low-NO_x burners, over-fire air, and operational modifications. Post-combustion processes include selective catalytic reduction and selective non-catalytic reduction. An effective combination of the combustion modifications and post-combustion processes allow the reduction of NO_x emissions by up to 95 percent (EPA 1998). As discussed above, the most likely NO_x control would involve a combination of low-NO_x burners and selective catalytic reduction technologies to reduce NO_x emissions from this alternative by approximately 86 percent.

Particulates. The new coal-fired power plant would use fabric filters to remove particulates from flue gases with an expected 99.9 percent removal efficiency (NETL 2007). When present, wet SO_2 scrubbers further reduce particulate matter emissions (EPA 2008). Coal-handling equipment would introduce fugitive dust emissions when fuel is transferred to onsite storage and then reclaimed from storage for use in the plant. FENOC estimated the release of particulates contained in cooling tower drift during reactor operation is 1.4 tons per year (TRC 1995). The cooling tower drift from the coal-fired alternative would be less than that released by Davis-Besse, since the cooling tower for a nuclear reactor has higher heat rejection demands and is considered to be a bounding condition.

Carbon Monoxide. Based on firing conditions and the boiler's overall firing efficiency, supercritical pulverized coal boilers will emit carbon monoxide in limited quantities. Emission limits for CO will be based on heat input and typically expressed as pounds per million Btu input.

Carbon Dioxide. The amount of CO_2 released per unit of power produced would be dependent on the quality of the fuel, the firing conditions, and the overall firing efficiency of the boiler. As discussed above, NRC presumes a CO_2 emission factor of 210.2 lb/million Btu for the coal-fired alternative.

Hazardous Air Pollutants. The EPA has determined that coal- and oil-fired electric utility steam-generating units are significant emitters of the following HAPs: arsenic, beryllium, cadmium, chromium, dioxins, hydrogen chloride, hydrogen fluoride, lead, manganese, and mercury (EPA 2000b). The EPA concluded that mercury is the HAP of greatest concern and that the following is true (EPA 2000b):

- A link exists between coal combustion and mercury emissions.
- Electric utility steam-generating units are the largest domestic source of mercury emissions.

- 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.

Using data and algorithms published by EPA and EIA and performance guarantees provided by pollution-control equipment vendors, the estimated annual emissions of criteria pollutants and CO_2 from the operation of the coal-fired alternative are presented below.

- sulfur oxide—5,356 tons (4,860 MT) per year with 95 percent-efficient scrubbing,
- nitrogen oxide—1,490 tons (1,350 MT) per year with 86 percent-efficient control,
- particulate matter less than or equal to 10 μm—27.4 tons (24.9 MT) per year with 99.9 percent-efficient control,
- all particulate matter—135 tons (123 MT) per year with 99.9 percent-efficient control,
- carbon monoxide—719 tons (652 MT) per year,
- carbon dioxide—6,920,000 tons (6,280,000 MT) per year, and
- mercury—0.12 tons (0.11 MT) per year.

The above analysis shows that emissions of air pollutants—including SO_x, NO_x, CO, $PM_{2.5}$, and PM_{10}—far exceed those produced by the existing nuclear power plant during operation, as well as those of the other fossil fuel alternatives considered in this section. 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 8.4.5.

The NRC analysis of air quality impacts for a coal-fired alternative at an alternate site indicates that impacts would have clearly noticeable effects. However, given existing regulatory regimes, permit requirements, and emissions controls, the coal-fired alternative would not destabilize air quality. Therefore, NRC characterizes air impacts from a coal-fired plant located at an alternative site as MODERATE. Federal and state regulations would require the installation of pollution-control equipment to meet applicable local requirements and permit conditions and may eventually require participation in emissions trading schemes.

8.3.2 Groundwater Use and Quality

8.3.2.1 Construction

The use of groundwater is not expected in the construction of the coal-fired alternative at the alternative location. The alternative location may result in a greater area of impervious surface; thus, water that previously infiltrated the soil would instead become stormwater runoff. Groundwater recharge could be reduced, and resulting aquifer recharge rates may be reduced.

Dewatering of all open excavations would likely consume a small amount of groundwater. The NRC staff assumes that, during construction, liquid construction wastes would either be temporarily retained in lined evaporation ponds or stored in drums for shipment to offsite disposal facilities. With the application of best management practices and the controls established in a General Stormwater Permit, no impacts on groundwater quality due to the construction of the coal-fired alternative are expected. As a result, impacts to groundwater quality would be SMALL.

8.3.2.2 Operation

Impacts to the groundwater may result from the use of chemicals and fuels. The NRC presumes that a Groundwater Monitoring Program would be implemented, and any groundwater contamination from chemical spills would be detected and mitigated to restore the groundwater quality. As a result, no changes in the groundwater quality are likely to result from operation of the coal-fired alternative; thus, the impacts to the groundwater resource would be SMALL.

8.3.3 Surface Water Use and Quality

8.3.3.1 Construction

Minor impacts on surface water would occur during construction of the coal-fired alternative due to ground disturbances, alteration of natural drainage patterns, and from dewatering of excavations. A sitewide stormwater plan would be established for the construction period and would include controls and mitigations that would limit adverse impacts on surface water quality. The elements of that plan would be incorporated into a General Stormwater Permit, enforceable under the NPDES program authority, and would result in impacts on surface water during construction being SMALL.

8.3.3.2 Operation

During operation, surface water would be used for cooling and a water withdrawal, and NPDES permits would be required to regulate the thermal and chemical character of blowdown water from the cooling tower that would be discharged back to that surface water resource. Discharges of all other wastewaters associated with plant operation would also require an NPDES permit. Compliance with NPDES permits would assure that the operational impacts of the coal-fired alternative to surface water would remain SMALL.

8.3.4 Aquatic Ecology

8.3.4.1 Construction

Construction activities for the coal-fired alternative would cause minimal impacts on aquatic resources in Lake Erie because construction would occur far enough inland to remove the likelihood of the erosion and sedimentation. Additionally, stormwater control measures, which would be required to comply with Ohio’s NPDES permitting, would minimize the flow of disturbed soils into aquatic habitats. Depending on the available infrastructure at the selected site, the coal-fired alternative may require modification or expansion of the existing intake or discharge structures, or construction of new intake and discharge structures. Construction of new or modified intake and discharge structures may require dredging. Dredging activities would require BMPs for in-water work to minimize sedimentation and erosion. Due to the short-term nature of the dredging activities, the hydrological alterations to aquatic habitats would likely be localized and temporary. Therefore, the impacts to the aquatic ecology during construction would be SMALL.

8.3.4.2 Operation

During operations, the coal-fired alternative would require a similar amount of cooling water as Davis-Besse. Impingement and entertainment would be minimized because NRC assumes that the plant would use a closed-cycle cooling system. However, the effects to particular species would vary based on site selection and surface water source. A similar amount of water would be discharged as at Davis-Besse. However, thermal impacts would also vary based on site selection and surface water source. The cooling system for a new coal-fired plant would have similar chemical discharges as Davis-Besse. While air emissions from the coal-fired plant

would emit ash and particulates that could settle onto surface waters and introduce a new source of pollutants, lake or river tides would likely dissipate and dilute the concentration of pollutants resulting in minimal exposure to aquatic biota. Although the coal-fired alternative would have similar surface water usage, cooling system discharges, and chemical discharges as Davis-Besse, the impacts on aquatic ecology could range from SMALL to MODERATE because the impacts would vary substantially based on site selection for this alternative.

In addition, consultation under the ESA would be required to assess the occurrence and potential impacts to Federally protected aquatic species and habitats within affected surface waters. Coordination with State natural resource agencies would further ensure that the plant operator would take appropriate steps to avoid or mitigate impacts to state-listed species, habitats of conservation concern, and other protected species and habitats. The NRC assumes that these consultations would result in avoidance or mitigation measures that would minimize or eliminate potential impacts to protected aquatic species and habitats.

8.3.5 Terrestrial Ecology

8.3.5.1 Construction

Construction of a coal-fired plant would require land for both the plant site as well as land for coal mining and processing. Additionally, land would be required for disposal of ash and scrubber sludge. Because of the relatively large land requirement for the site, a portion of the site would likely be land that had not been previously disturbed, which would directly affect terrestrial habitat by removing existing vegetative communities and displacing wildlife. The level of direct impacts would vary substantially based on site selection. Offsite construction would occur mostly on land where coal extraction is ongoing. Erosion and sedimentation, fugitive dust, and construction debris impacts would be minor if appropriate BMPs are implemented. Impacts to terrestrial habitats and species from transmission line operation and corridor vegetation maintenance, and operation of the cooling system would be similar in magnitude and intensity as those resulting from operating nuclear reactors and would, therefore, be SMALL. Because of the potentially large area of undisturbed habitat that could be affected from construction of a coal-fired plant, the impacts of construction on terrestrial habitats and species could range from SMALL to MODERATE depending on the specific site location.

8.3.5.2 Operation

During operation, cooling towers could deposit chemically treated water on surrounding land areas as drift that could affect existing vegetation. Drift impacts would be confined to the immediate vicinity of the cooling tower. Coal-mining operation would also affect terrestrial ecology in offsite coal mining areas, although the coal is likely to be provided from existing mines where land disturbances have already occurred. The operation of a coal-fired alternative would result in the generation of substantial amounts of solid and liquid wastes. It is not reasonable to conclude that disposal of those operational wastes would take place on the alternative site. Any offsite waste disposal by landfilling of coal combustion residues (CCR) would affect terrestrial ecology, at least throughout the active life of the disposal facility and until the land was reclaimed through a closure action. Deposition of acid rain resulting from NO_x or SO_x emissions, as well as the deposition of other pollutants, could also affect terrestrial ecology. Because of the expected controls on emissions in necessary operating permits, air deposition impacts might be noticeable but would not likely be destabilizing. Primarily because of the potential habitat disturbances, impacts on terrestrial resources from a coal-fired alternative would be SMALL and would occur mostly during construction. Section 8.3.8 provides an additional analysis of waste management.

As discussed under aquatic ecology impacts, consultation with FWS under the ESA would avoid potentially adverse impacts to Federally listed species or adverse modification or destruction of designated critical habitat. Coordination with State natural resource agencies would further ensure that the plant operator would take appropriate steps to avoid or mitigate impacts to state-listed species, habitats of conservation concern, and other protected species and habitats. The NRC assumes that these consultations would result in avoidance or mitigation measures that would minimize or eliminate potential impacts to protected aquatic species and habitats. Consequently, the impacts operation of a coal-fired alternative on protected species and habitats would be SMALL.

8.3.6 Human Health

8.3.6.1 Construction

Construction of a coal-fired alternative would carry the same risks as construction of any major industrial facility. Federal and state regulations for worker protection would adequately control impacts on construction workers, and it is reasonable to assume that access to the active construction site would be limited to authorized, adequately trained personnel equipped with appropriate personal protection equipment. Impacts on the public would depend on existing land uses in parcels adjacent to the active construction zone but are expected to be SMALL.

8.3.6.2 Operation

Coal-fired power plants introduce worker risks from coal and limestone mining, from coal and limestone transportation, and from disposal of coal combustion residues 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.

Human health risks of coal-fired power plants are described, in general, in Table 8-2 of the GEIS (NRC 1996). Cancer and emphysema, as a result of the inhalation of toxins and particulates, are identified as potential health risks to occupational workers and members of the public (NRC 1996). The human health risks associated with coal-fired power plants, both for occupational workers and members of the public, are greater than those of the current Davis-Besse reactor, due to exposures to chemicals such as mercury; SO_x; NO_x; radioactive elements such as uranium and thorium contained in coal and coal ash; and polycyclic aromatic hydrocarbon (PAH) compounds.

Regulations restricting emissions, enforced by either EPA or delegated state agencies, have reduced potential health effects but have not entirely 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 non-attainment area, emission controls and trading or offset mechanisms could prevent further regional degradation; however, local effects could be visible. Many of the byproducts of coal combustion responsible for health effects are largely controlled, captured, or converted in modern power plants, although some level of health effects may remain.

Aside from emissions impacts, the coal-fired alternative introduces the risk of coal pile fires and, for those plants that manage coal combustion residue liquids and sludge in waste impoundments, the release of the waste may result due to a failure of the impoundment. Good housekeeping practices to control coal dust greatly reduce the potential for coal dust explosions or coal pile fires. Although there have been several instances in recent years, sludge impoundment failures are still rare. Free water could also be recovered from such waste streams and recycled, and the solid or semi-solid portions could be removed to permitted offsite disposal facilities.

Overall, given extensive health-based regulation and controls likely to be imposed as permit conditions applicable to waste handling and disposal, the NRC staff expects human health impacts from operation of the coal-fired alternative at an alternate site to be SMALL.

8.3.7 Land Use

The GEIS generically evaluates the impact of constructing and operating various replacement power plant alternatives on land use, both on and off each power plant site. The analysis of land-use impacts focuses on the amount of land area that would be affected by the construction and operation of an SCPC power plant at an alternate brownfield site.

8.3.7.1 Construction

Based on FENOC estimates, 1,547 ac (626 ha) of land could be needed to support a coal-fired alternative to replace Davis-Besse, along with 10 miles of transmission lines. It is expected that the SCPC alternative would be located at an existing power plant site or an industrial brownfield site with existing infrastructure, thus minimizing land requirements and construction impacts. Depending on existing power plant infrastructure, additional land may be needed for frequent coal and limestone deliveries by rail or barge. Therefore, land use impacts from land acquisition and construction would be SMALL to MODERATE.

8.3.7.2 Operation

Offsite land use would be affected by coal mining during power plant operations. Using the GEIS estimate, the SCPC alternative might require up to 20,020 ac (8,101 ha) of land for coal mining and ash and scrubber sludge disposal during power plant operations, based on an assumption of 22,000 ac (8,903 ha) of land required per 1,000 MWe and 910 MWe of generating capacity (NRC 1996). However, much of the land in existing coal mining areas has already experienced some level of disturbance.

The elimination of uranium fuel for Davis-Besse would partially offset some of the land requirements for the SCPC alternative. Scaling from GEIS estimates, approximately 635 ac (256 ha) (based on 35 ac/yr disturbed per 1,000 MWe for 20 years) would no longer be needed for mining and processing uranium during the operating life of the plant (NRC 1996).

Based on this preference to site the SCPC alternative on a previously disturbed industrial site, land use impacts from an NGCC power plant would range from SMALL to MODERATE depending on the amount on land needed to support coal mining and processing uranium during the operating life of the SCPC plant.

8.3.8 Socioeconomics

As previously discussed in Section 8.1.8, two types of jobs would be created by this alternative: (1) construction jobs, which are transient, short in duration, and less likely to have long-term socioeconomic impacts; and (2) power plant operation jobs, which have a greater potential for permanent, long-term socioeconomic impacts. Workforce requirements for the construction and operation of the coal-fired alternative were evaluated to measure their possible effects on current socioeconomic conditions.

8.3.8.1 Construction

FENOC projected a construction workforce ranging from 1,092 to 2,275 workers would be required to construct the SCPC alternative at an alternative site. The relative economic impact of this many workers on the local economy and tax base would vary, with the greatest impacts occurring in the communities where the majority of construction workers would reside and

spend their income. As a result, local communities could experience a short-term "boom" from increased tax revenue and income generated by construction expenditures and the increased demand for temporary (rental) housing and business services. After construction, local communities could experience a return to pre-construction economic conditions. Based on this information, and given the number of construction workers, socioeconomic impacts during construction in local communities could range from SMALL to MODERATE.

8.3.8.2 Operation

FENOC estimated an operational workforce of 228 workers. This alternative would result in a loss of approximately 825 relatively high-paying jobs at Davis-Besse, with a corresponding reduction in purchasing activity and tax contributions to the regional economy. In addition, the permanent housing market could also experience increased vacancies and decreased prices if operations workers and their families move out of the region. However, the amount of property taxes paid to local jurisdictions under the SCPC alternative may increase if additional land is required to support this alternative. Based on the above discussion, socioeconomic impacts during operations could range from SMALL to MODERATE.

8.3.9 Transportation

Commuting workers and truck deliveries of materials and equipment would cause transportation impacts during the construction and operation of the SCPC power plant.

8.3.9.1 Construction

Transportation impacts associated with construction of the SCPC alternative would consist of commuting workers and truck deliveries of construction materials. During periods of peak construction activity, up to 2,275 workers could be commuting daily to the site significantly adding to the normal flow of traffic (NRC 1996). Vehicular traffic would peak during shift changes, resulting in temporary levels of service impacts and delays at intersections. Materials also could be delivered by rail or barge, depending on site location. Traffic-related transportation impacts during construction likely would range from MODERATE to LARGE.

8.3.9.2 Operation

Once construction of the SCPC alternative is complete, traffic-related transportation impacts on local roads would be greatly reduced. The estimated number of operations workers would be 228 (NRC 1996). Traffic on roadways would peak during shift changes, resulting in temporary levels of service impacts and delays at intersections. Frequent deliveries of coal and limestone by rail would cause levels of service impacts on certain roads because of delays at railroad crossings. Onsite coal storage would make it possible to receive several trains per day at a site with rail access. Limestone delivered by rail could also add additional traffic (though considerably less traffic than that generated by coal deliveries). If a site on navigable waters were used, barge delivery of coal and other materials would be feasible. Overall, the SCPC alternative transportation impacts would be SMALL to MODERATE during plant operations.

8.3.10 Aesthetics

The analysis of aesthetic impacts focuses on the degree of contrast between the SCPC alternative and the surrounding landscape and the visibility of the new SCPC plant at an existing power plant site.

During construction, all of the clearing and excavation would occur on the existing power plant site. These activities could be visible from offsite roads. The coal-fired power plant could be

approximately 100 ft (30 m) tall, with two to four exhaust stacks several hundred feet tall with natural draft cooling towers approximately 400 to 500 ft (122 to 152 m) in height.

The power block of the SCPC alternative could look very similar to the existing power plant, and construction would appear similar to other ongoing onsite activities. Aesthetic changes during construction would be limited to the immediate vicinity of the existing power plant site, and overall impacts would be SMALL.

8.3.11 Noise

Ambient noise conditions in the vicinity of the existing power plant site would be affected by the construction and operation of a new SCPC power plant.

8.3.11.1 Construction

Overall noise levels at the existing power plant site would increase during the construction of the new SCPC power plant. Construction noises during construction, however, would be intermittent and relatively brief, and noise levels would decrease as the distance from the noise source increases. Impacts due to noise as a result of the construction of the SCPC alternative could range from SMALL to MODERATE.

8.3.11.2 Operation

Noise generated during power plant operations would be limited to routine industrial processes and communications. Therefore, noise impacts due to the operation of the SCPC power plant would be SMALL.

8.3.12 Historic and Archeological Resources

Lands needed to support construction of a coal-fired plant and associated corridors would need to be surveyed for historic and archaeological resources. Resources found in these surveys would need to be evaluated for eligibility on the NRHP, and mitigation of adverse effects would need to be addressed if eligible resources were encountered. When constructing a coal-fired plant on a previously disturbed former plant (brownfield) site, an inventory may still be necessary if the site has not been previously surveyed or to verify the level of disturbance and evaluate the potential for intact subsurface resources. The potential for impacts on historic and archaeological resources from this alternative would vary greatly depending on the resource richness and location of the proposed site. However, given that the preference is to use a previously disturbed former plant site, avoidance of significant historic and archaeological resources should be possible and effectively managed under current laws and regulations. Therefore, the impacts on historic and archaeological resources from the coal-fired alternative would be SMALL to MODERATE.

8.3.13 Environmental Justice

The environmental justice impact analysis evaluates the potential for disproportionately high and adverse human health, environmental, and socioeconomic effects on minority and low-income populations that could result from the construction and operation of a new power plant. As previously discussed in Section 8.1.12, such effects may include human health, biological, cultural, economic, or social impacts.

8.3.13.1 Construction

Potential impacts to minority and low-income populations from the construction of an SCPC alternative would mostly consist of environmental and socioeconomic effects (e.g., noise, dust,

traffic, employment, and housing impacts). Noise and dust impacts from construction would be short-term and primarily limited to onsite activities. Minority and low-income populations residing along site access roads would be directly affected by increased commuter vehicle traffic during shift changes and truck traffic. However, because of the temporary nature of construction, these effects are unlikely to be high and adverse and would be contained to a limited time period during certain hours of the day. Increased demand for rental housing during construction could cause rental costs to rise disproportionately affecting low-income populations who rely on inexpensive housing. However, given the likelihood of locating the SCPC alternative at the site of an existing or former power plant and the proximity of most power plant sites to metropolitan areas, workers could commute to the construction site, thereby reducing the need for rental housing.

Based on this information and the analysis of human health and environmental impacts presented in Section 8.3 of this chapter, the construction of the SCPC power plant would not have disproportionately high and adverse human health and environmental effects on minority and low-income populations.

8.3.13.2 Operation

Emissions from the operation of an SCPC plant could affect minority and low-income populations as well as the general population living in the vicinity of the new power plant. However, all would be exposed to the same potential effects from SCPC power plant operations, and any impacts would depend on the magnitude of the change in ambient air quality conditions. Permitted air emissions are expected to remain within regulatory standards.

Based on this information and the analysis of human health and environmental impacts presented in Section 8.3 of this chapter, the operation of the SCPC power plant would not have disproportionately high and adverse human health and environmental effects on minority and low-income populations.

8.3.14 Waste Management

8.3.14.1 Construction

The coal-fired alternative would result in wastes during construction as a result of activities such as vegetation removal, excavation, and preparing the site surface before other crews begin actual construction of the plant. Wastes typical of the construction of large industrial facilities would also be generated. Because this alternative would be located an alternative site, additional construction of new transmission lines and a new rail spur would be necessary.

The impacts from waste generated during construction stage would be short-lived. The amount of construction waste would be small compared to the amount of waste generated during operational stage, and most could be recycled. Overall, the impacts from waste generated during construction stage would be SMALL.

8.3.14.2 Operation

Coal combustion generates several waste streams, including ash (a dry solid recovered from both pollution control devices (fly ash) and from the bottom of the boiler (bottom ash)) and sludge (a semi-solid by-product of emission control system operation, in this case, primarily calcium sulfate from the operation of the wet calcium carbonate SO_2 scrubber). Although EPA has not classified coal residue as hazardous waste, it does contain hazardous constituents that might leach from improperly designed or operated disposal cells and threaten surface or groundwater resources.

Particulates. Combustion of 2.88 million tons per year (2.61 million MT per year) of coal would result in substantial amounts of CCR, which includes both fly and bottom ash recovered from the fabric filter and from the bottom of the boiler. The NRC staff estimates that 271,960 tons of ash would be generated each year; of that, approximately 271,830 tons per year would be collected as bottom ash and fly ash in the fabric filter. Some additional fly ash might also be captured in the SO_2 scrubber downstream of the fabric filter. That amount has not been quantified; however, some CCR and scrubber sludge could be put to beneficial use, such as an admixture for lightweight concrete, road base, and road embankment stabilization. The remainder of the CCR and scrubber sludge would require disposal. Because the recycle potential for CCR relies on both the physical properties of the ash and the leachability of any toxic constituents present, a more conservative estimate of 50 percent being recycled is appropriate, with the remaining amount—135,400 tons per year—requiring disposal. Disposal of this amount of ash annually by landfilling over the expected 40-year lifetime of the coal-fired plants could noticeably affect land use, groundwater, and surface water quality. Landfill locations would require proper siting in accordance with state solid waste regulations and leachate from the disposal cells would need to be monitored and possibly captured for treatment because of leaching of toxic components (including heavy metals) in the ash. After closure of the waste site and revegetation, the land could be available for other uses.

Sulfur Oxides. Combustion of 2.88 million tons per year (2.61 million MT per year) of coal with 1.96 percent sulfur would result in the generation of 102,260 tons per year (92,770 MT per year) of SO_2, 95 percent of which would be captured in the wet scrubber and converted to an equimolar amount of calcium sulfate or 217,288 tons per year (197,120 MT per year) (dry basis). The NRC staff presumes that as much as 90 percent of the scrubber sludge could be recycled for such applications as gypsum wallboards. The remaining 21,730 tons per year (19,710 MT per year) could be co-disposed with the previously mentioned remaining CCR.

Spent Catalysts. The NRC staff has not estimated the amount of spent catalysts that would be produced, but it presumes that the entire amount would have no recycling opportunities and would require disposal. Depending on the catalysts used, special handling might also be required to address the potential hazardous character of these spent catalysts.

The impacts from waste generated during operation of this coal-fired alternative would be MODERATE; the affects would be clearly visible but would not destabilize any important resource, provided appropriate controls were applied. Failure to implement proper controls could result in a LARGE impact on surface water and land. The extent of disposal would be dependent on the percentage of the CCR and scrubber sludge that could be recycled.

Therefore, the NRC staff concludes that the overall impacts on wastes from construction and operation of this alternative would be MODERATE.

8.3.15 Climate Change-Related Impacts of a Coal-Fired Alternative

Combustion of fossil fuels, including coal, is the greatest anthropogenic source of GHG emissions in the U.S. After a thorough examination of the scientific evidence and careful consideration of public comments, the EPA announced on December 7, 2009, that GHGs threaten the public health and welfare of the American people and meet the CAA definition of air pollutants. Carbon dioxide (CO_2) is by far the largest GHG emitted during fossil fuel combustion. This section presents an assessment of the potential impacts the construction and operation of a coal-fired plant will have on climate change.

8.3.15.1 Construction

Impacts on climate change from the construction of a coal-fired alternative would result primarily from the consumption of fossil fuels in the engines of construction vehicles and equipment, workforce vehicles used in commuting to and from the work site, and delivery vehicles. All such impacts would be temporary. However, given the expected relatively short construction period, the overall impact on climate change from the releases of GHGs during construction of a coal-fired alternative would be SMALL.

8.3.15.2 Operation

EPA reported that, in 2010, the total amount of carbon dioxide equivalent (CO_2e) emissions related to electricity generation was 2,277.3 MMT (EPA 2012). The EIA reported that, in 2010, electricity production in Ohio was responsible for 121 MMT of CO_2 emissions (123 MMT of CO_2e) (EIA 2012). The NRC staff estimates that operation of the coal-fired alternative would amount to 6.98 million tons of CO_2e per year (6.33 MMT of CO_2e per year). This amount would represent 5 percent of the GHGs emitted in Ohio in 2010. This amount represents a 5 percent increase over the 2010 Ohio CO_2e emissions. Although coal combustion in the boilers would be the primary source, other miscellaneous ancillary sources such as truck and rail deliveries of materials to the site, commuting of the workforce, and deliveries of wastes to offsite disposal or recycling facilities would make contributions to the CO_2e emissions from continued operations.

NETL estimates that further development could yield technologies that could capture and remove as much as 90 percent of the CO_2 from the exhausts of supercritical pulverized coal-fired boilers (NETL 2010). With CCS in place, the coal-fired alternative would release 625,000 tons per year (567,000 metric tons per year), and impacts to climate change would be further reduced.

A coal-fired alternative would be expected to have a MODERATE impact on climate change. GHG emissions resulting from operation would be noticeable. Estimated GHG emissions would be nine times larger than the threshold in EPA's tailoring rule for GHG (75,000 tons (68,000 MT) per year of CO_2e).

8.4 Alternatives Considered but Dismissed

Alternatives to Davis-Besse license renewal that were considered and eliminated from detailed study are presented in this section. The order of presentation does not imply a priority. These alternatives were eliminated because of technical, resource availability, or current commercial limitations associated with these alternatives. As such, these alternatives would not be able to supply the replacement power needed if Davis-Besse were to shutdown in 2017.

8.4.1 New Nuclear

Given the current combined license (COL) application schedule, the time needed to review an application, and the anticipated length of construction, the NRC staff considers it unlikely that a new nuclear reactor could be sited, constructed, and become operational by the time the Davis-Besse license expires on April 22, 2017, and so it will not be considered by NRC staff as an alternative to license renewal.

8.4.2 Wind

Ohio has approximately 55,000 MW of wind power potential (NREL 2011), though only 67 MW of wind power capacity was in service as of mid-2011 (Wind Powering America 2011). Ohio has

lagged the neighboring states of Pennsylvania, West Virginia, and Indiana in wind power implementation.

The largest wind project in Ohio history, the Blue Creek Wind Farm, was completed in March 2012 and has a capacity of 304 MW. Preliminary work for Blue Creek began in 2006. The State of Ohio currently has 1,401 MW of OPSB-approved projects that have not yet started operations and 452 MW of wind projects in review for a Certificate of Environmental Compatibility and Public Need (OPSB 2014). All of the approved projects are located onshore.

Offshore wind resources in Lake Erie are of high quality, though no wind installations currently operate there. The Lake Erie Energy Development Corporation (LEEDCo), a private non-profit group, has plans to install 20 to 30 MW of wind capacity 7 miles offshore of Cleveland. This would be the first freshwater, offshore wind facility in the U.S. LEEDCo aims to develop 1,000 MW of offshore windpower in Lake Erie by 2020 (LEEDCo 2013), though no turbines have yet been sited in Lake Erie.

Efforts to build offshore wind installations elsewhere in the Great Lakes have yet to succeed. For example, the New York Power Authority (NYPA) proposal to site and develop wind power resources in New York's portions of Lake Erie or Lake Ontario were shelved in September 2011, when NYPA found that offshore wind installations would cost two to four times more than land-based wind (Reuters 2011).

In the Atlantic Ocean, several wind-power projects have been proposed, but none have yet to begin construction. The most prominent of these projects, Cape Wind, was first proposed in 2001 and, after a lengthy and controversial permitting process, construction is expected to begin once project financing is completed in late 2014 (Cape 2014). Other projects offshore of Rhode Island and New Jersey are smaller than Cape Wind (Wald 2011), and another organization has proposed—though not yet constructed—a high-voltage direct-current powerline on the seafloor to connect offshore projects (Atlantic Wind Connection undated; Wald 2011). Finally, a group working near Long Island proposes an installation of 700 MW of wind capacity (Con Edison 2009). Backers are optimistic and the potential is great, but despite strong interest in offshore wind on the Great Lakes and the Atlantic Coast, no offshore wind power installations have yet materialized in the U.S. As no offshore wind capacity yet exists in either the Great Lakes or on the Atlantic Coast and as none appear likely to exist on a large commercial scale by 2017 (given the current state of development), the NRC staff finds that offshore wind will not be a reasonable alternative to Davis-Besse by 2017.

Comments received during scoping suggest that wind power could replace Davis-Besse. The NRC staff notes that, although wind power is intermittent and individual installations are unable to support baseload power supply, some individuals or groups have proposed that multiple, interconnected wind installations separated by long distances (and thus exposed to different weather and wind conditions) could function as a virtual power plant and provide wind power that could replace baseload generators like Davis-Besse. To date, however, no states or utilities operate arrays of wind installations as virtual power plants.

While Ohio is not large enough to site wind turbines as far apart as in the Archer and Jacobsen (2007) study discussed in Section 8.2, assuming that wind turbines could be constructed in neighboring states, approximately 4,300 MW of new wind capacity would be necessary to replace Davis-Besse. Provided that Blue Creek Wind Farm and all other approved wind projects in Ohio are completed as planned, this amount of wind power would exceed by approximately 2,300 MW the planned capacity in the State. To date, only Texas has more than 4,300 MW of installed wind capacity, and it is also the only state that has seen construction of 4,300 MW of wind capacity in 5 years' time.

Unlike Ohio, Texas has outstanding onshore wind resources, with potential for over 1,900,000 MW of wind power, or more than 34 times the amount of wind potential that NREL found could exist in Ohio (Texas' potential is also more than 31 times greater than Ohio's, Pennsylvania's, West Virginia's, and New Jersey's potentials combined) (NREL 2011). To date, Texas has approximately 10,135 MW of installed capacity (Wind Powering America 2011). Iowa, which has the largest installed capacity after Texas at 3,675 MW (Ibid.), has more than 10 times Ohio's wind potential (and more than 9 times the wind potential in Ohio, West Virginia, Pennsylvania, and New Jersey, combined) (NREL 2011). In short, to replace Davis-Besse with a wholly wind-powered alternative would require the second-fastest build-out of wind capacity in U.S. history in a State with relatively modest (19th of 50 states, and lower than the mean of all states) wind potential (NREL 2011).

Given the amount of wind capacity necessary to replace Davis-Besse, Ohio's wind resource potential (as well as the wind resources of surrounding states), Ohio's pace of wind development to date, and the 5 years available prior to license expiration, the NRC staff finds a completely wind-based alternative to be unreasonable.

Wind With Power Storage. Two storage options exist on a large enough scale to prove useful in supporting large wind installations. The largest energy storage installations in use in the U.S. are pumped storage hydroelectric facilities. These facilities use two reservoirs, one above the other in elevation. One or more electric pumps, driven by excess electricity, push water into the upper reservoir during periods of low demand or high electrical availability. During periods of high demand or low availability, operators release water from the upper reservoir to the lower reservoir through turbines that generate electricity. As the NRC staff notes in Section 8.4.5, Ohio has approximately 183 MW of undeveloped hydropower potential, an amount that is insufficient to back up wind power to function as an alternative to license renewal. Further, EIA is projecting a 2.2 percent growth in pumped storage capacity through 2040 (DOE/EIA 2013).

In compressed air energy storage (CAES), an electric motor uses excess electricity to pump air into an underground, pressurized cavity, and when electricity is needed, the compressed air is released through a gas turbine generator. The compressed air provides some power to the generator (essentially, reducing the need for compression by the turbine), and burning natural gas provides heat to increase the pressure and power the turbine. Thus, CAES is not solely an energy storage technology but also relies on additional fossil fuel (future, as-yet-undeveloped compressed air energy storage technologies promise no reliance on natural gas).

The other option, CAES, is a commercially viable technology for energy storage, though it is seldom used on a utility scale. CAES is discussed as part of the combination alternative in Section 8.2.

Currently, no CAES facilities exist in Ohio, though—as discussed in Section 8.2—First Energy has acquired the Norton Energy Storage project, a proposed CAES facility that could be constructed in a retired limestone mine.

Without detailed wind-speed data, specific site information, and detailed information on the full energy-storage capacity of the Norton Energy Storage project (measured in MWh, as opposed to its maximum instantaneous power output, measured in MW), it is difficult to estimate how much less wind capacity would be necessary if 536 MW of CAES are available. CAES is less effective at offsetting seasonal wind variation than it is at offsetting intra-day or day-to-day variation, as very large air reservoirs would be necessary to offset month-to-month or season-to-season variation. The McIntosh facility in Alabama provides up to 26 hours of compressed-air storage, while the Huntorf facility in Germany provides up to 2 hours of storage. Based on current experience, the NRC staff finds that CAES is unlikely to offset seasonal wind variability.

Currently, no state or utility in the U.S. is operating wind power in combination with CAES to offset baseload power supplies. A group of utilities had proposed a 270-MW project of that type in Iowa but has since terminated the project due to geologic unsuitability of the proposed site (ISEPA 2011). The McIntosh facility is the only existing U.S. CAES installation, and it is approximately one-fifth the size of the maximum capability FENOC indicates could exist at the Norton Energy Storage site by 2017. Further, the geology of the Norton Energy Project site (limestone) differs from both the Huntorf facility in Germany and the McIntosh facility in Alabama, which are in salt domes. Given the relatively rarity of these facilities, despite a 33-year span since the Huntorf facility went into operation, the challenges encountered to date at other sites where CAES has been considered, and the unique geology necessary for compressed air energy storage to work on a utility scale, the NRC staff assumes that the Norton Energy Storage project is the only viable nearby option for CAES at this time.

Archer and Jacobsen found that a widely dispersed array of interconnected wind installations could provide a portion of its nameplate capacity at a high availability. Under most conditions, a 19-site array (the largest array Archer and Jacobsen considered) produced more than 21 percent of its nameplate capacity, ultimately yielding 45 percent of the nameplate capacity when averaged over a year's time. Conceivably, the extra 24 percent of the array's nameplate output could be stored and dispatched during periods of low wind availability to allow a smaller wind array to serve the same load with the same availability, the same wind installation to serve a larger load with the same availability, or the same array to serve the same load with a higher availability (or some combination of the three possible outcomes). Assuming that CAES could allow a multiple site wind power array to capture all of the wind power up to its 45 percent capacity factor, approximately 2,018 MW of installed wind capacity would be necessary to replace Davis-Besse. This assumption oversimplifies the challenges associated with using the Norton project to store and release power. The maximum theoretical output of Norton by 2017 is 536 MW; therefore, it would be unable to provide enough power on days with little or no wind to offset the capacity provided by Davis-Besse. A utility would have to construct more than 2,018 MW, but less than 4,300 MW, in order to rely on a project like Norton to provide baseload wind when paired with a wind power array. Properly sizing a wind array to match the available energy storage would depend on detailed wind power information, operational characteristics for each installation, and performance characteristics of the storage site.

The amount of new wind power (2,018 MW) would exceed the amount of windpower installed in Ohio, West Virginia, Pennsylvania, Michigan, and New Jersey, combined, over the past 12 years. When combined with the fact that no utility is currently using CAES in combination with wind power to provide baseload power, the NRC staff does not consider this combination to be a reasonable alternative to Davis-Besse license renewal.

<u>Environmental Impacts of a Wind Array and a Wind Array with the Norton Project</u>. Although wind power or wind power with CAES are not considered reasonable alternatives, FENOC provided an analysis of potential impacts from both of these alternatives in its September 19, 2011, supplement to the Davis-Besse ER (FENOC 2011). The potential impacts of these dismissed alternatives to provide a comparison to the impacts of the proposed action.

Land Use. FENOC indicated that an array of interconnected wind installations would have a MODERATE to LARGE impact on land use, depending on the locations of the wind installations (FENOC 2011). FENOC assumed that an individual wind farm would require 50 ac (20 ha) per MW of capacity and that approximately 5 percent of the total land area would actually be occupied by turbines and support equipment. FENOC noted that Ohio's predominant land uses are rural agricultural croplands with scattered residences and woodlots and that turbines could be placed with adequate buffers around incompatible land uses. Assuming that 50 ac (20 ha) is required for each MW, a total of 10,800 ac (4,370 ha) will be occupied by the wind farm

throughout its operation, while turbine installations will be spread across 216,000 ac (87,400 ha).[5] As this amount of land use is widely spread across Ohio, and perhaps into neighboring states or, in small amounts, to offshore Lake Erie, and is unlikely to prevent complimentary land uses from continuing in adjoining lands. Overall land use impacts from an interconnected wind array would be MODERATE.

Two elements change if CAES is paired with wind farm power generation. First, less land is required if the number of turbines is reduced due to energy storage. The amount of land required would vary from 5,040 ac (2,040 ha) to 10,800 ac (4,370 ha), depending on the characteristics of the CAES technology and specific wind characteristics at each site. Second, the North Energy Storage project site, with 92 ac (37 ha) at the surface, would be added to the total land use for the project, though that site is already a former mining site and committed to First Energy's uses. The amount of total land would range from 5,132 ac (2,080 ha) to 10,892 ac (4,410 ha). Again, overall land use impacts from a combination of wind power generation and CAES would be MODERATE.

Water Use and Quality—Surface Water. As FENOC noted in its supplement to the ER, wind turbines require no cooling water or water intakes, and the only potential impacts to surface water are a result of erosion or sedimentation during construction. As any projects within Ohio would have to minimize erosion and sedimentation through the use of onsite best management practices, and as construction-related issues would be short-lived with only temporary effects, the NRC staff finds that these impacts would only be temporarily noticeable and would be unlikely to affect any important attributes of surface water resources. Further, as any offshore portion of an interconnected array of wind installations will be limited in size, the NRC staff does not expect these impacts to be significant. Overall, the NRC staff estimates that impacts to surface water use and quality will be SMALL.

Surface water use will increase if CAES is paired with an interconnected array of wind installations. FENOC indicates that the Norton Energy Storage project would rely on cooling towers to dissipate the heat that the gas turbines and compressors create, though the cooling towers would be much smaller than those typically used for coal and gas generation plants. FENOC indicates that cooling water makeup losses would be considerably less than those from Davis-Besse, as would discharge flows. FENOC indicates that this is primarily because less power would be derived from a steam cycle, though FENOC's ER supplement provides no indication that a CAES would rely on a steam cycle for any of its power generation. FENOC cites its 2007 ER from Beaver Valley Generating Station to support this proposition, though FENOC did not consider CAES in that ER. Based on a review of CAES technologies and FENOC's assertions regarding the Norton Energy Storage project, the NRC staff concludes that FENOC's overall assertion regarding water consumption is correct and is likely conservative, as it appears that no water is necessary to condense steam at the Norton Energy Storage project site. As a result, the NRC staff concludes that water consumption will not have a noticeable effect on surface water use or quality from an interconnected array of wind installations combined with compressed air energy storage. The overall impact on surface water use and quality is SMALL.

Water Use and Quality—Groundwater. FENOC indicated that groundwater would be used during construction only if other potable water supplies are limited and that "minor" amounts

[5] While FENOC calculated that 3,030 turbines would occupy 4,550 ac, the NRC staff here estimates that 2,150 turbines would occupy 10,750 ac. In reviewing FENOC's supplement, the NRC staff identified an error that caused FENOC to underestimate the potential land use of the wind installation rather than calculating land use on the size of the total installation (6,060 MW), FENOC appears to have calculated land use based only on the credited capacity factor (1,820 MW). Thus, although NRC staff assumed fewer turbines would be necessary to replace Davis-Besse than FENOC did, the NRC staff found the wind alternative requires more land area used than FENOC did.

may be necessary during operation if other supplies are unavailable. As indicated in the preceding section, wind turbines do not rely on water for cooling, and the lack of onsite crews at wind installations means that installations do not generally require water for operations or to provide for the potable and sanitary needs of personnel. As a result, impacts to groundwater from an interconnected array of wind installations would be SMALL.

CAES, as noted in the previous section, increases the amount of water the interconnected array of wind installations would require, but FENOC indicates that a CAES plant would not rely on groundwater for cooling and that regulations for groundwater extraction for potable water would limit impacts to SMALL. Groundwater would not be used for cooling, and consumption of groundwater for potable water supply would have a SMALL impact.

Air Quality. FENOC indicates that there are no air quality impacts associated with the operation of interconnected wind farms, and construction of the installations could result in short-term impacts from fugitive dust and equipment emissions. FENOC indicates that the emissions are SMALL. The NRC staff's review of potential air emissions from wind power installation shows that some maintenance equipment may produce emissions during operations, but, generally, the turbines themselves do not create air emissions. During construction, crews will employ dust-control practices, and emissions from installation equipment will be temporary and will not noticeably affect air quality. The air quality impacts from an interconnected array of wind installations is SMALL.

CAES creates operational air-quality impacts because the Norton Energy Storage project relies on gas-fired turbines to heat the air released from underground storage and provide some of the energy produced by the compressed air storage system. FENOC estimated emissions for the Norton Energy Storage project based on six combustion trains and one cooling tower, to match the amounts permitted by the Norton Energy Storage project's air emissions permit. The NRC staff notes that this overestimates the air quality impacts from the four trains that FENOC indicates could be operational at the Norton Energy Storage project by 2017. The NRC staff has scaled the air emissions from the Norton Energy Storage project to provide an estimate for four trains rather than six, while acknowledging that this estimate may slightly over or underestimate impacts of four trains, depending on their operational characteristics and whether additional trains benefit from efficiencies of scale or require additional support services.

The NRC staff estimates that the Norton Energy Storage project would have the following emissions:

- sulfur dioxide—28 tons (26 MT),
- nitrogen oxide—62 tons (57 MT),
- particulate matter less than or equal to 10 μm—31 tons (28 MT),
- VOCs—18 tons (16 MT), and
- carbon dioxide—450,000 tons (410,000 MT).

FENOC indicated that both sulfur dioxide and nitrogen oxide emissions would be subject to cap and trade programs; they would not add to regional emissions of either pollutant (in all seasons for sulfur dioxide and in ozone season for nitrogen oxides) as well as permit-based emissions controls for all listed pollutants. FENOC indicated that air quality impacts would be MODERATE. Earlier in this chapter, however, the NRC staff found these air emissions to be SMALL. The NRC staff notes that impacts are substantially lower than those of the NGCC alternative considered in Section 8.1. As a result, the NRC staff finds that the impacts of the Norton Energy Storage facility portion of this combination alternative on air quality would be SMALL.

Ecological Resources. FENOC indicates that interconnected wind installations could have a LARGE impact on ecological resources, especially during construction. Further, FENOC notes that wind installations could have noticeable impacts on migratory birds, eagles and raptors, and bats. FENOC indicates that wind installations in some parts of the U.S. have minor impacts, although FENOC also asserts that one cannot assume that similar impacts would occur in Ohio, particularly if any wind turbines are sited in or near Lake Erie. FENOC indicates that best management practices and awareness of habitats would minimize impacts to ecological resources. FENOC concludes that impacts to migratory species would depend on the location of wind installations and could be SMALL to MODERATE.

Most of the land on which wind farms would be located is already in agricultural use. As a result, terrestrial impacts would be SMALL, though impacts to birds and bats could increase in some locations. Generally, however, impacts would not destabilize any resources. The impacts to ecological resources from an interconnected array of wind installations would, therefore, range from SMALL to MODERATE.

Combining wind farms paired with CAES would likely affect fewer sites or have a smaller impact on the same number of sites. The types of impact from the wind portion, however, would remain the same. FENOC indicates that the impacts from the Norton Energy Storage project would be SMALL, given that it would only affect 92 ac (37 ha) of land surface and that water consumption and discharges would be regulated by NPDES limitations and provisions under Sections 316(a) and (b) of the Clean Water Act. Water consumption, water discharges, and air emissions are unlikely to noticeably affect important attributes of ecological resources except at the immediate Norton Energy Storage project site, which has already been degraded by previous mining operations. The overall impact of wind plus CAES is thus SMALL to MODERATE and dependent largely on the locations and characteristics of the wind installations.

Human Health. FENOC indicated that the only major human health risk from construction and operation of an interconnected array of wind installations is accidents. FENOC indicated that compliance with applicable occupational safety and health regulations (those implemented by OSHA) would ensure that impacts will be SMALL. The NRC staff agrees that impacts from construction and operation of an array of wind installations would be SMALL.

Construction of the Norton Energy Storage project would likely reduce the number of wind turbines necessary, but it would not eliminate the potential for accidents. In addition, it would add the same types of risks to human health as the NRC power plant alternative. Human health risks for the NGCC alternative would be SMALL. The Norton Energy Storage project poses some unique challenges, such as construction activities within a cavern, but the potential for health effects from its markedly lower emissions is much smaller. As a result, the overall impact level for the array of interconnected wind farms with CAES would be SMALL as well.

Socioeconomics. Constructing an interconnected array of wind installations would create temporary construction jobs, economic activity, and increased demand for short-term rental housing and public services in communities nearest to the construction sites. FENOC further indicates that the impacts would be spread throughout the region and that losses of jobs, tax revenues, and economic activity from Davis-Besse would have a significant impact on communities near Davis-Besse. FENOC also indicates that renewable resources are taxed at a lower rate than “conventional” energy generating facilities. The NRC staff notes that an interconnected array of wind farms would affect many rural communities during installation. However, given the relatively small number of construction workers scattered over a large area at various construction sites, the relative socioeconomic impact of this many construction workers would be SMALL. CAES construction workers are most likely to commute from nearby

Akron and Cleveland during the short duration of construction activities. Commuting workers and transportation of wind-turbine components would noticeably increase traffic volumes on local roads and could create SMALL to MODERATE transportation impacts.

During operations, FENOC estimates that 50 to 100 CAES workers would be employed at the Norton Energy Storage project site. Fewer wind turbines would be installed under this wind combined with CAES alternative than the interconnected wind installation alternative. Since less land may be required for wind turbines due to energy storage, property tax payments to local communities would be smaller.

Wind turbines would have the greatest potential visual impact; wind turbines often dominate the view and become the major focus of attention. On flat terrain, wind turbines would be visible from miles away and would be the tallest man-made structures in rural settings. Placing turbines along ridgelines would maximize their visibility. Because wind farms are generally located in rural or remote areas, the introduction of wind turbines would be in sharp contrast to the visual appearance of the surrounding environment. Assuming the interconnected array of wind installations consisted of 2-MW turbines, 2,150 turbines would be required. These turbines would be spread widely over the region and would affect many viewsheds. Overall, the aesthetic impacts would range from MODERATE to LARGE.

Combining the Norton Energy Storage project with a somewhat smaller array of interconnected wind turbines would not reduce the overall aesthetic impact. The Norton project would be similar in appearance to the NGCC power plant alternative, but smaller. It does not have heat recovery steam generators and uses smaller cooling towers than the NGCC power plant. Overall, the aesthetic impacts would likely remain MODERATE to LARGE.

A widely scattered array of wind installations has the potential to affect historical and archaeological resources as well. Each turbine will require construction of a base structure that may extend up to 40 ft (12 m) below ground, depending on soils and topography (BLM 2005), and each would be 15 to 20 ft (5 to 6 m) wide depending on the turbine model. Construction crews may encounter some archaeological resources, even in areas that have been extensively farmed. FENOC indicates that impacts could be LARGE, but construction activity was likely to take place under OPSB or other comparable program rules; thus, actions would be taken to avoid, recover, or otherwise mitigate resource loss or disturbance during construction. Turbines would be widely spaced but could affect thousands of acres of land spread across the state. Given the potential for discovery, impacts to historical and archaeological resources from the wind and CAES alternative could range from SMALL to MODERATE.

Combining wind farms with the Norton Energy Storage CAES project would reduce the number of wind turbines and ground disturbance, thus reducing the overall impact to historic and archeological resources from wind turbines installation. The only potential new effects would come from the Norton project site, which was previously used for limestone mining. Mining and industrial use of the 92-ac (37-ha) site has removed or otherwise affected the historic and archaeological resources at the former mine site. As a result, the Norton Energy Storage project is unlikely to contribute any additional impacts to existing historical and archaeological resources. Given the potential for discovery, impacts to historical and archaeological resources from the wind and CAES alternative could range from SMALL to MODERATE.

Overall, the interconnected array of wind installations would be noticeable and could affect important socioeconomic attributes. Therefore, overall socioeconomic impacts could range from MODERATE to LARGE. In addition, overall socioeconomic effects of the Norton Energy CAES project, in conjunction with a somewhat smaller interconnected array of wind farm installations, would be similar to the impacts from the standalone interconnected array of wind farm

installations. Socioeconomic impacts under this alternative could also range from MODERATE to LARGE.

Waste Management. FENOC indicated that construction of an interconnected array of wind farm installations could generate large amounts of vegetation debris from land-clearing activities, and appropriate waste disposal activities would minimize these impacts. Most of the land used for wind farm installations is likely to be in agricultural use and fairly clear of vegetation, and wind turbines generate no waste during operations. As such, impacts from waste management would be SMALL.

FENOC indicated that operation of the Norton Energy Storage project would generate a small volume of waste during operations, like other gas-fired facilities, and that impacts would be SMALL. The primary types of waste generated by gas-fired power plants are SCR catalysts and other operational wastes. Overall, a combination of the Norton Energy Storage project with an interconnected array of wind installations would have SMALL waste management impacts.

Environmental Justice. Minority and low-income populations could be disproportionately affected by the visual impact and noise from the wind turbines. However, the turbines could be positioned away from these communities, thus reducing or avoiding disproportionately affecting minority and low-income populations.

Noise from CAES storage operations could have a localized impact on minority and low-income populations living near the Norton Energy Storage project site. Impacts from both components of this alternative could disproportionately affect minority or low-income populations.

8.4.3 Solar Power

Solar technologies, including PV and solar thermal (also known as concentrated solar power (CSP)), use the sun's energy to produce electricity at a utility scale. In PV systems, the energy contained in photons of sunlight incident on special PV materials results in the production of direct current (DC) electricity that is aggregated, converted to alternating current (AC), and connected to the high-voltage transmission grid. CSP technologies produce electricity by capturing the sun's heat energy. Two types of CSP technology that have enjoyed the greatest utility-scale applications are the parabolic trough and the power tower; both involve capturing the sun's heat and converting it to steam, which powers a conventional Rankine cycle steam turbine generator. Although some aspects of solar generation result in few environmental impacts, solar technology requires substantial land areas, and CSP technologies require roughly the same amount of water for cooling of the steam cycle as most other thermoelectric technologies.

The potential for solar technologies to serve as reliable baseload power alternative to Davis-Besse depends on the value, constancy, and accessibility of the solar resource. Both PV and CSP are enjoying growth worldwide, especially for various off-grid applications or to augment grid-provided power at the point of consumption; however, discrete baseload applications still have technological limitations. Although thermal storage can markedly increase the value of CSP-derived power for baseload applications by providing energy storage capabilities, low energy conversion efficiencies and the inherent weather-dependent intermittency of solar power limit its application as baseload power in all but those geographic locations with the highest and most constant solar energy values.

Ohio's RPS requires utilities to obtain 12.5 percent of their electricity through renewables by 2054. At least 0.5 percent of the renewable requirement must be met through solar energy resources (DSIRE 2013). EIA reports the total solar generating capacity (solar thermal and solar PV) in the U.S. in 2009 was 619 MW, 0.005 percent of the total nationwide generating

capacity of 1,025,400 MW. Solar power produced 891,000 MWh of power in 2009, 0.02 percent of the nationwide production of 3,950,331 thousand MWh (EIA 2011a). In Ohio in 2010, all renewables (excluding hydroelectric) were responsible for 1,129,000 MWh, or 0.79 percent of the State's total generation of 143,598,000 MWh (EIA 2012a).

The DOE's NREL reports that the State of Ohio has average solar insolation useful for PV applications on the order of 4.0 kWh/m^2/day and direct normal irradiance (DNI) suitable for use in CSP applications averaging 3.5 kWh/m^2/day (NREL 2010b). Both of these solar insolation values are below the ideal for efficient and cost-effective application of PV and CSP technologies. For utility-scale development, insolation levels below 6.5 kWh/m^2/day are considered "not economically viable" given current technologies (BLM/DOE 2010).

PV installations have no ability to provide power at night, and they provide reduced levels of power on overcast days, during fog events, and when snow accumulates. While their generation during summer months is high when electricity consumption is high, their capacity to generate electricity in winter declines before the evening electricity demand peaks.

To date, PV installations have been the dominant technology installed in Ohio, and they are also the largest installations in the State are PV installations (the 10 MW Wyandot facility and the under-construction 49.9 MW Turning Point project, to be completed in 2015). As a result, the solar capacity considered as part of a combination alternative is from PV installations. Because PV does not produce electricity at night and produces diminished amounts of power during particular weather conditions, PV is not considered a viable, standalone alternative to license renewal. Further, because no CSP installations exist in Ohio, and because CSP has lower insulation values than PV, the NRC staff does not consider CSP to be a viable alternative to Davis-Besse license renewal.

As discussed in the wind power section, CAES could conceivably offset the variable power output of solar PV facilities and allow them to store some energy to be released when the sun is not shining or when output is low due to weather conditions. Because Ohio has very limited potential for new hydro development, the NRC staff will not consider pumped storage as a means of offset solar PV variability.

As noted in the combination alternative section, First Energy recently purchased the Norton Energy Storage project and could conceivably have 536 MW of capacity available by 2017. However, the Norton Energy Storage project is too small to provide for production of sufficient power to replace Davis-Besse while the sun is not shining, so the NRC staff does not consider solar plus the Norton Energy Storage project to be a reasonable alternative.

FENOC (2011) evaluated the potential environmental impacts of a combined solar and CAES alternative, and the NRC staff provides a brief discussion of its results here.

<u>Environmental Impacts of Solar PV with the Norton Project</u>

Land Use. FENOC indicated that a solar facility with sufficient capacity to replace Davis-Besse and provide electricity to a CAES facility (a total of 1,820 MW of solar capacity) would require approximately 37,900 ac (15,300 ha). The Norton Energy Storage project would require an additional 92 ac (37 ha) of a former mining site. This alternative would require more land than any other alternative. The land use impacts of this alternative would range from MODERATE to LARGE.

Water Use and Quality—Surface Water. FENOC indicated that a solar PV facility requires no water for cooling or operations. FENOC further notes that the only effects on surface water would occur during construction, when sedimentation or runoff could affect surface water, but best management practices would minimize this impact. The solar facility would have to comply

with storm water discharge limits, and the from the Norton Energy Storage project would be SMALL. The NRC staff, therefore, finds that surface water impacts would be SMALL.

Water Use and Quality—Groundwater. FENOC assumed that neither solar PV installations nor the Norton Energy Storage project would use groundwater for any purpose. The NRC staff finds this to be a reasonable assumption. If the project does not use any groundwater, then the impacts to groundwater would be SMALL.

Air Quality. FENOC indicated that solar PV installations would have no effect on air quality. However, PV construction, installation, and maintenance (serving equipment or repairs) would cause some temporary air pollutant emissions.

The Norton Energy Storage project would have the following emissions, assuming that the maximum 536 MW would be installed by 2017:

- sulfur dioxide—28 tons (26 MT),
- nitrogen oxide—62 tons (57 MT),
- particulate matter less than or equal to 10 µm—31 tons (28 MT),
- VOCs—18 tons (16 MT), and
- carbon dioxide—450,000 tons (410,000 MT).

FENOC indicated that both sulfur dioxide and nitrogen oxide emissions would be subject to cap and trade programs; thus, they would not add to regional emissions of either pollutant (in all seasons for sulfur dioxide, and ozone season for nitrogen oxides) or permit-based emissions controls for all listed pollutants. FENOC indicated that air quality impacts would be MODERATE. However, the NRC staff found these air emissions to be SMALL. The impacts would be substantially lower than those of the NGCC alternative considered in Section 8.1. As a result, the impacts of the Norton Energy Storage facility portion of this combination alternative on air quality would be SMALL.

Ecological Impacts. FENOC indicated that development of solar PV installations could have major impacts on land resources as well as significant impacts on terrestrial ecological resources.

Most land would already be in agricultural use, given the predominant land use patterns in Ohio. As a result, terrestrial impacts are likely to affect those ecological resources that exist on agricultural lands. These impacts are likely to be noticeable; however, they are unlikely to be destabilizing, so impacts are MODERATE. Effects from the Norton Energy Storage project would be SMALL. Overall impacts to terrestrial ecological resources would be MODERATE.

As the solar PV portion of this alternative does not rely on any water during operation, and as permitting and practices during construction will limit impacts to surface water, the solar PV portion is unlikely to noticeably affect aquatic ecological resources. The Norton Energy Storage project is also unlikely to noticeably affect aquatic ecological resources. As a result, impacts to aquatic ecological resources will be SMALL.

Human Health. FENOC indicated that human health impacts from construction and operation of both solar PV and CAES would be regulated by OSHA and would, therefore, be SMALL. Impacts on human health from the CAES facility's air emissions would also not be noticeable. As a result, the NRC staff finds that human health impacts from this alternative would be SMALL.

Socioeconomics. Constructing solar PV installations would create temporary construction jobs, economic activity, and increased demand for short-term rental housing and public services in

communities nearest to the construction sites. FENOC further indicates that the impacts would be spread throughout the region and that losses of jobs, tax revenues, and economic activity from Davis-Besse would have a significant impact on communities near Davis-Besse. FENOC also indicates that renewable resources are taxed at a lower rate than "conventional" energy generating facilities. Solar PV facilities would affect many rural communities during installation. However, given the relatively small number of construction workers scattered over a large area, the relative socioeconomic impact of this many construction workers would be SMALL. CAES construction workers are most likely to commute from nearby Akron and Cleveland given the short duration of construction activities. Commuting workers and transportation of solar PV components could noticeably increase traffic volumes on local roads and could create SMALL to MODERATE transportation impacts.

During operations, FENOC estimates that 150 to 200 workers would be employed at both the solar PV installations and the Norton Energy Storage project. FENOC indicated that the Norton project would generate additional revenues for the communities near the project. Socioeconomic impacts would be SMALL to MODERATE.

FENOC indicates that solar PV facilities would be located in remote areas, would likely not generate large aesthetic concerns, and would likely meet minor resistance. The footprint of a utility scale, standalone solar PV installation would be quite large (approximately 37,900 ac (15,300 ha)) and would create a noticeable visual impact. Spread across a large site, the utility scale, standalone solar PV installation would dominate the view and would likely become the major focus of attention. The introduction of a utility scale, standalone solar PV installation would be in sharp contrast to the visual appearance of the surrounding environment. Installing solar PV technologies on building rooftops, although noticeable to a lesser degree in urban settings, would reduce the amount of land required for standalone solar sites. Any noise at a utility scale, standalone solar PV installation would be limited to industrial processes and communications. Based on this information, aesthetic impacts from the construction and operation of a solar PV alternative could range from MODERATE to LARGE depending on the type of solar technology installed and its location and surroundings.

FENOC indicated that the large amount of land needed for this alternative could have a large impact on cultural resources, but OPSB or other comparable program rules could reduce or minimize these impacts. Solar PV installations will require smaller and shallower excavations than wind turbines; so, they are less likely to disturb historical and archaeological resources beyond those already disturbed by farming or other activities.

Mining and industrial use of the 92-ac (37-ha) Norton Energy Storage project site has removed or otherwise affected the historic and archaeological resources at the former mine site. As a result, the Norton Energy Storage project is unlikely to contribute to impacts to existing historical and archaeological resources. Given the potential for discovery, impacts to historical and archaeological resources could range from SMALL to MODERATE.

Overall, solar PV installations paired with the Norton Energy Storage project would be noticeable and could affect socioeconomic attributes. Therefore, overall socioeconomic impacts could range from SMALL to MODERATE.

Waste Management. FENOC indicated that hazardous materials, such as cadmium and lead, are used in the manufacture of solar PV panels; thus, solar PV could create environmental impacts during manufacture and disposal. Solar PV technology manufacturers would employ best practices to minimize release and disposal of hazardous wastes and recycle any commercially valuable quantities of waste items. Some debris may be generated during installation. FENOC indicated that CAES would generate minimal amounts of wastes, similar to the NGCC alternative. Overall, waste management impacts would be SMALL.

Environmental Justice. Predominately minority and low-income communities could be disproportionately affected by the visual impact from the vast size of the solar PV installations if located near the installation. However, because of the large amount of land necessary for solar PV installations, solar PV installations could be positioned away from communities, thus reducing or avoiding disproportionately affecting minority and low-income populations.

Solar PV installations and CAES storage operations are unlikely to have any high and adverse effects on minority and low-income populations given their lack of emissions, lack of water consumption or discharge, and minimal aesthetic impacts. However, noise from the existing CAES storage operations component of this alternative would continue to have a localized impact on people living near the Norton Energy Storage project site. Impacts from both components of this alternative could disproportionately affect nearby minority or low-income populations but the overall effects would not be high and adverse.

8.4.4 Wood Waste

As noted in the GEIS (NRC 1996), the use of wood waste to generate utility-scale baseload power is limited to those locations where wood waste is plentiful. Wastes from pulp, paper, and paperboard industries and from forest management activities can be expected to provide sufficient, reliable supplies of wood waste as feedstocks to external combustion sources for energy generation. Beside the fuel source, the technological aspects of a wood-fired generation facility are virtually identical to those of a coal-fired alternative—combustion in an external combustion unit such as a boiler to produce steam to drive a conventional STG. Given constancy of the fuel source, wood waste facilities can be expected to operate at equivalent efficiencies and reliabilities. Costs of operation would depend significantly on processing and delivery costs. Wood waste combustors would be sources of criteria pollutants and GHGs, and pollution control requirements would be similar to those for coal plants. Unlike coal plants, there is no potential for the release of HAPs such as mercury. Co-firing of wood waste with coal is also technically feasible. Processing the wood waste into pellets can improve the overall efficiency of such co-fired units. Although co-fired units can have capacity factors similar to baseload coal-fired units, such levels of performance are dependent on the continuous availability of the wood waste fuel. In the State of Ohio, 2008 electricity generating capacity from wood waste was 65 MW and produced 418,000 MWh (EIA 2011c). Given the limited capacity and modest actual electricity production, the NRC staff has determined that production of electricity from wood waste at levels equivalent to Davis-Besse would not be a feasible alternative to Davis-Besse license renewal.

8.4.5 Conventional Hydroelectric Power

Three technology variants of hydroelectric power exist—dam and release (also known as impoundment), run-of-the-river (also known as diversion), and pumped storage. In each variant, flowing water spins turbines of different designs to drive a generator to produce electricity. Dam and release facilities affect large amounts of land behind the dam to create reservoirs but can provide substantial amounts of power at capacity factors greater than 90 percent. Power generating capacities of run-of-the-river dams fluctuate with the flow of water in the river, and the operation of such dams is typically constrained (and stopped entirely during certain periods) so as not to create undue stress on the aquatic ecosystems present. Pumped storage facilities use grid power to pump water from lower impoundments or flowing watercourses to higher elevations during off-peak load periods. Water is then released during peak load periods through turbines to generate electricity. Capacities of pumped storage facilities are dependent on the configuration and capacity of the elevated storage facility.

A comprehensive survey of hydropower resources in Ohio was completed in 1997 by DOE's Idaho National Environmental Engineering Laboratory (now known as the Idaho National Laboratory). In the study, generating potential was defined by a model that considered the existing hydroelectric technology at developed sites or applied the most appropriate technology to undeveloped sites and introduced site-specific environmental considerations and limitations. Ohio had little hydroelectric potential, with a total generating potential of 183 MW (INEEL 1998). More recently, EIA reported that, in 2008, conventional hydroelectric power (excluding pumped storage) was the principal electricity generation source among renewable sources in Ohio (EIA 2011c). Nevertheless, only 527 gigawatt-hours (GWh) of hydroelectric power was generated in 2009, 0.19 percent of the nationwide total of 273,445 GWh (EIA 2011a). Although hydroelectric facilities can demonstrate relatively high capacity factors, the small potential capacities and actual recent power generation of hydroelectric facilities in Ohio, combined with the diminishing public support for large hydroelectric facilities because of their potential for adverse environmental impacts, supports NRC's conclusion that hydroelectric is not a feasible alternative to Davis-Besse.

8.4.6 Ocean Wave and Current Energy

Ocean waves, currents, and tides represent kinetic and potential energies. The total annual average wave energy off the U.S. coastlines at a water depth of 60 m (197 ft) is estimated at 2,100 terawatt-hours (TWh) (MMS 2006). Waves, currents, and tides are often predictable and reliable; ocean currents flow consistently, while tides can be predicted months and years in advance with well-known behavior in most coastal areas. Four principal wave energy conversion (WEC) technologies have been developed to date to capture the potential or kinetic energy of waves—point absorbers, attenuators, overtopping devices, and terminators. All have similar approaches to electricity generation but differ in size, anchoring method, spacing, interconnection, array patterns, and water depth limitations. Point absorbers and attenuators both allow waves to interact with a floating buoy, subsequently converting its motion into mechanical energy to drive a generator. Overtopping devices and terminators are also similar in their function. Overtopping devices trap some portion of the incident wave at a higher elevation than the average height of the surrounding sea surface, thus giving it higher potential energy, which is then transferred to power generators. Terminators allow waves to enter a tube, compressing air trapped at the top of the tube, which is then used to drive a generator.

Capacities of point absorbers range from 80 to 250 kW, with capacity factors as high as 40 percent; attenuator facilities have capacities of as high as 750 kW. Overtopping devices have design capacities as high as 4 MW, while terminators have design capacities ranging from 500 kW to 2 MW and capacity factors as high as 50 percent (MMS 2007).

The most advanced technology for capturing tidal and ocean current energy is the submerged turbine. Underwater turbines share many design features and functions with wind turbines, but because of the greater density of water compared to air, they have substantially greater power-generating potential than wind turbines with comparably sized blades. Only a small number of prototypes and demonstration units have been deployed to date, however. Underwater turbine "farms" are projected to have capacities of 2 to 3 MW, with capacity factors directly related to the constancy of the current with which they interact.

The Great Lakes do not experience large tides, and the limited energy output for wave technologies in the Great Lakes would outweigh the high cost. Consequently, the relatively modest power capacities, relatively high costs, and limited resource availability in Lake Erie support the NRC staff's conclusion that water energy current technologies are not feasible substitutes for Davis-Besse.

8.4.7 Geothermal Power

Geothermal technologies extract the heat contained in geologic formations to produce steam to drive a conventional steam-turbine generator. The following variants of the heat exchanging mechanism have been developed:

- Hot geothermal fluids contained under pressure in a geological formation are brought to the surface where the release of pressure allows them to flash into steam (the most common of geothermal technologies applied to electricity production).
- Hot geothermal fluids are brought to the surface in a closed loop system and directed to a heat exchanger where they convert water in a secondary loop into steam.
- Hot dry rock technologies involve fracturing a rock formation and extracting heat through injection of a heat transfer fluid.

Facilities producing electricity from geothermal energy can routinely demonstrate capacity factors of 95 percent or greater, making geothermal energy clearly eligible as a source of baseload electric power. However, as with other renewable energy technologies, the ultimate feasibility of geothermal energy serving as a baseload power replacement for Davis-Besse is dependent on the quality and accessibility of geothermal resources within or proximate to the region of interest—in this case, FirstEnergy's Ohio service territory. As of April 2010, the U.S. had a total installed geothermal electricity production capacity of 3,087 MW originating from geothermal facilities in nine states—Alaska, California, Hawaii, Idaho, Nevada, New Mexico, Utah, and Wyoming. Additional geothermal facilities are being considered for Colorado, Florida, Louisiana, Mississippi, and Oregon. Ohio does not have adequate geothermal resources to support utility-scale electricity production (GEA 2010). NRC concludes, therefore, that geothermal energy does not represent a feasible alternative to Davis-Besse.

8.4.8 Municipal Solid Waste

Municipal solid waste (MSW) combustors use three types of technologies—mass burn, modular, and refuse-derived fuel. Mass burning is currently the method used most frequently in the U.S. and involves no (or little) 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 86 waste-to-energy plants operate in 24 states, processing 97,000 tons (88,000 MT) of municipal solid waste per day. Latest estimates are that 26 million tons (24 million MT) of trash were processed in 2008 by waste-to-energy facilities. With a reliable supply of waste fuel, waste-to-energy plants have an aggregate capacity of 2,572 MW and can operate at capacity factors greater than 90 percent (ERC 2010). Currently, there are no waste-to-energy facilities operating in Ohio.

The EPA estimates that, on average, air impacts from MSW-to-energy plants are as follows:

- 3,685 lb (1,672 kg)/MWh of carbon dioxide,
- 1.2 lb (0.54 kg)/MWh of sulfur dioxide, and
- 6.7 lb (3.0 kg)/MWh of nitrogen oxide.

Depending on the composition of the municipal waste stream, air emissions can vary greatly, and the ash produced may exhibit hazardous characteristics that require special treatment and handling (EPA 2010b).

Estimates in the GEIS suggest that the overall level of construction impact from a waste-fired plant would be approximately the same as that for a coal-fired power plant. Additionally, waste-fired plants have the same or greater operational impacts as 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 those for comparable steam-turbine technology at coal-fired facilities or at wood-waste facilities because of the need for specialized waste separation and handling equipment (NRC 1996).

The decision to burn municipal waste to generate energy is usually driven by the need for an alternative to landfills, rather than energy considerations. The use of landfills as a waste disposal option is likely to increase in the near term as energy prices increase (and especially since such landfills, of sufficient size and maturity, can be sources of easily recoverable methane fuel); however, it is possible that municipal waste combustion facilities may become attractive again.

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. Additionally, 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. In addition, 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, the likelihood that additional stable streams of MSW are unlikely to be available to support numerous new facilities, the increasingly unfavorable regulatory environment, especially with respect to expanding pollution control regulations, and the fact that Ohio does not have any operating MSW plants, the NRC staff does not consider municipal solid waste combustion to be a reasonable alternative to Davis-Besse license renewal.

8.4.9 Biomass Fuels

When used here, “biomass fuels” includes crop residues, switchgrass grown specifically for electricity production, forest residues, methane from landfills, methane from animal manure management, primary wood mill residues, secondary wood mill residues, urban wood wastes, and methane from domestic wastewater treatment. The feasibility of using biomass fuels for baseload power depends on its geographic distribution, available quantities, constancy of supply, and energy content. A variety of technical approaches has been developed for biomass-fired electric generators, including direct burning, conversion to liquid biofuels, and biomass gasification. In a study completed in December 2005, Milbrandt of NREL documented the geographic distribution of biomass fuels within the U.S., reporting the results in metric tons available (dry basis) per year (NREL 2005). Limited amounts of potential biomass fuels are available in Ohio, with the highest potential located in the western half of the State. Power-generating capacity from biomass fuels is only 41 MW in Ohio and, in 2008, generated only 191,000 MWh (EIA 2011c).

In the GEIS, the NRC indicated that technologies relying on a variety of biomass fuels had not progressed to the point of being competitive on a large scale or of being reliable enough to replace a baseload plant such as Davis-Besse. After reevaluating current technologies, and after reviewing existing State-wide capacities and the extent to which biomass is currently being used to produce electricity in Ohio, the NRC staff finds biomass-fired alternatives are still unable

to reliably replace the Davis-Besse capacity and are not considered feasible alternatives to Davis-Besse license renewal.

8.4.10 Oil-Fired Power

Although oil has historically been used extensively in the Northeast for comfort heating, EIA projects that oil-fired plants will account for very little of the new generation capacity constructed in the U.S. during the 2008 to 2030 time period. In 2008, Ohio generated approximately 1,311,743 MWh of electricity from oil-fired generation, just 1 percent of its total electricity profile. Further, EIA does not project that oil-fired power will account for any significant additions to capacity (EIA 2013).

The variable costs of oil-fired generation tend to be greater than those of nuclear or coal-fired operations, and oil-fired generation tends to have greater environmental impacts than natural gas-fired generation. In addition, future increases in oil prices are expected to make oil-fired generation increasingly more expensive (EIA 2013). The high cost of oil has prompted a steady decline in its use for electricity generation. Thus, the NRC staff does not consider oil-fired generation as a reasonable alternative to Davis-Besse license renewal.

8.4.11 Fuel Cells

Fuel cells oxidize fuels without combustion and its 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 reforming under pressure. Natural gas is typically used as the source of hydrogen.

Currently, fuel cells are not economically or technologically competitive with other alternatives for electricity generation. EIA projects that fuel cells may cost $5,478 per installed kW (total overnight costs, 2008 dollars) (EIA 2010c). This amount is substantially greater than coal ($2,223), advanced (natural gas) combustion turbines ($648), onshore wind ($1,966), or offshore wind ($3,937), but it is cost-competitive with solar PV ($6,171) or CSP solar ($5,132). Installed costs provided for PV and CSP solar are before application of Investment Tax Credits provided in Federal statutes. More importantly, 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 Davis-Besse, it would be extremely costly to do so and would require many units and wholesale modifications to the existing transmission system. Accordingly, the NRC staff does not consider fuel cell technology to be a reasonable alternative to Davis-Besse license renewal.

8.4.12 Coal-Fired Integrated Gasification Combined Cycle

Integrated gasification combined cycle (IGCC) is an emerging technology for generating electricity with coal that combines modern coal gasification technology with both gas turbine and steam turbine power generation. Gasifiers similar to those used in oil refineries use heat pressure and steam to pyrolyze (thermally reform complex organic molecules without oxidation) coal to produce synthesis gases (generically referred to as syngas) typically composed of carbon monoxide, hydrogen, and other flammable constituents. After processing to remove contaminants and produce various liquid chemicals, the syngas is combusted in a combustion turbine to produce electric power. Separating the CO_2 from the syngas prior to combustion is also possible. Latent heat is recovered both from the syngas as it exits the gasifier and from the combustion gases exiting the combustion turbine and directed to a heat recovery steam

generator feeding a conventional Rankine cycle STG to produce additional amounts of electricity. Emissions of criteria pollutants would likely be slightly higher than those from an NGCC alternative but significantly lower than those from the supercritical coal-fired alternative. Depending on the gasification technology employed, IGCC would use less water than SCPC units but slightly more than NGCC (NETL 2007). Long-term maintenance costs of this relatively complex technology would likely be greater than those for a similarly sized SCPC or NGCC plant.

Only a few IGCC plants are operating at utility scale. Operating at higher thermal efficiencies than supercritical coal-fired boilers, IGCC plants can produce electrical power with fewer air pollutants and solid wastes than coal-fired boilers. To date, however, IGCC technologies have had limited application and have been plagued with operational problems such that its effective, long-term capacity factors are often not high enough for them to reliably serve as baseload units. Although IGCC technology is likely to become more commonplace in the future, current operational problems that compromise reliability result in the dismissal of this technology as a viable alternative to Davis-Besse.

8.4.13 Energy Conservation/Energy Efficiency

Though often used interchangeably, energy conservation and energy efficiency are different concepts. Energy efficiency typically means deriving a similar level of service by using less energy, while energy conservation simply indicates a reduction in energy consumption. Both fall into a larger category known as demand-side management (DSM). DSM measures—unlike the energy supply alternatives discussed in previous sections—address energy end uses. DSM can include measures that do the following:

- shift energy consumption to different times of the day to reduce peak loads;
- interrupt certain large customers during periods of high demand;
- interrupt certain appliances during high demand periods;
- replace older, less efficient appliances, lighting, or control systems; and
- encourage customers to switch from gas to electricity for water heating and other similar measures that utilities use to boost sales.

Unlike other alternatives to license renewal, the GEIS notes that conservation is not a discrete power-generating source; it represents an option that states and utilities may use to reduce their need for power generation capability (NRC 1996).

In a 2008 staff report, the FERC outlined the results of the 2008 FERC Demand Response and Advanced Metering Survey (FERC 2008). Nationwide, approximately 8 percent of retail electricity customers are enrolled in some type of demand response program. The potential demand response resource contribution from all U.S. demand response programs is estimated to be close to 41,000 MW, or about 5.8 percent of U.S. peak demand. A national assessment of demand response (DR) potential, required of FERC by Section 529 of the Energy Independence and Security Act of 2007, evaluated potential energy savings in 5- and 10-year horizons for four development scenarios—Business As Usual, Expanded Business As Usual, Achievable Participation, and Full Participation. Each of these scenarios represents successively greater demand response program opportunities and proportionally increasing levels of customer participation (FERC 2009). The greatest savings would be realized under the Full Participation scenario, with peak demand reductions of 188 GW by the year 2019, a 20 percent reduction of the anticipated peak load that would result without any DR programs in place. Under the Achievable Participation scenario, reflecting a more realizable voluntary participation level of

60 percent of eligible customers, peak demand would be reduced by 138 GW by 2019, a 14 percent reduction. The Business-as-Usual scenario considers the amount of demand response that would take place if existing and currently planned demand response programs continued unchanged over the next 10 years.

FERC's State-specific analysis indicates that by the year 2019, the Full Participation scenario would yield a 6,753 MW peak demand reduction in Ohio (17.5 percent of the State's projected peak demand). The Business as Usual scenario suggests that DR programs would yield a reduction of 483 MW (1.2 percent of the State's projected peak demand) (FERC 2009).

In July 2008, the Ohio legislature passed SB 221, which established an energy-efficiency resource standard that requires electric utilities to implement an energy-efficiency and peak demand reduction program that will yield a cumulative electricity savings of 22 percent by the end of 2025, with specific annual benchmarks. The bill also requires utilities to implement programs to reduce peak energy demand by 1 percent in 2009, and an additional 0.75 percent each year through 2018 (DSIRE 2013). In its ER, FENOC discussed that DSM load reductions are already considered in load forecasts; therefore, the reductions do not offset the projected power demands that Davis-Besse is expected to supply (FENOC 2010). Because the energy efficiency resource standard would require utilities to achieve savings of anywhere between 0.3 and 2 percent each year, and Davis-Besse contributes 5 percent of Ohio's total electrical generation annually, it is unlikely that the energy savings would completely replace the power generated by Davis-Besse by 2017, which is when the Davis-Besse operating license would have expired if FENOC had not applied for license renewal. Thus, the NRC staff concludes that passive DR programs are not a feasible baseload power alternative to Davis-Besse.

8.4.14 Purchased Power

Under the Purchased Power alternative, no new generating capacity would necessarily be built and operated by FirstEnergy; instead, the company would purchase electricity from other generators, in amounts equivalent to what Davis-Besse currently supplies. Those generators could be located anywhere within or outside the FirstEnergy service territory, although far-distant sources may not be immediately available to serve nearby load centers without substantial transmission system build-outs or without significant line loss when power delivered to Davis-Besse load centers originates at distant generation sources.

In theory, purchased power is a feasible alternative; however, because there are no assurances that sufficient capacity would exist during the entire license renewal timeframe to replace Davis-Besse, FENOC has determined that purchased power would not be a reasonable alternative (FENOC 2010). Davis-Besse is located in the region administered by the Midwest Independent System Operator (MISO), and ReliabilityFirst Corporation (RFC) enforces reliability standards in the areas in which Davis-Besse operates. The North American Electric Reliability Corporation's (NERC's) 2008 Regional Reliability Assessment estimates that the total internal demand of MISO will increase by 14,500 MW from 2008 through 2017, while the increase in planned generation additions through 2017 is only 4,400 MW. The reserve margins are expected to be 14.1 percent through 2014; however, additional generating capacity would be needed in the region in order to maintain sufficient capacity reserves beyond 2017 (NERC 2008). If Davis-Besse were not to operate beyond its current license period, existing resources may not be sufficient to support a purchased power alternative beyond 2017. NRC, therefore, concludes that a purchased power option is not a viable discrete alternative to extending the Davis-Besse reactor license.

8.5 No-Action Alternative

This section examines the environmental effects that occur if NRC takes no action. No action, in this case, means that NRC denies the renewed the operating license for Davis-Besse and the license, NPF-3, expires at the end of the current license term, on April 22, 2017. If NRC denies the renewed operating license, the plant will shut down at or before the end of the current license. After shutdown, plant operators will initiate decommissioning in accordance with 10 CFR 50.82.

No action is the only alternative that we consider in depth that does not satisfy the purpose and need for this SEIS, as it neither provides power-generation capacity nor meets the needs currently met by Davis-Besse 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 Davis-Besse, the no-action alternative would require the appropriate energy-planning decisionmakers (not NRC) to rely on an alternative to replace the capacity of Davis-Besse or rely on energy conservation or power purchases to offset parts of the Davis-Besse capacity.

This section addresses only those impacts that arise directly as a result of plant shutdown. The environmental impacts from decommissioning and related activities have already been addressed in several other documents, including 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 SEIS. These analyses either directly address or bound the environmental impacts of decommissioning whenever FENOC ceases to operate Davis-Besse.

Even with a renewed operating license, Davis-Besse will eventually shut down, and the environmental effects we address in this section will occur at that time. Because these effects have not otherwise been addressed in this SEIS, the impacts are addressed in this section. As with decommissioning effects, shutdown effects are expected to be similar whether they occur at the end of the current license or at the end of a renewed license. Table 8–5 provides a summary of the environmental impacts of the no-action alternative.

Table 8–5. Environmental Impacts of No-Action Alternative

	No-Action Alternative	Continued Operation of the Davis-Besse Reactor
Air quality	SMALL	SMALL
Groundwater	SMALL	SMALL
Surface water	SMALL	SMALL
Aquatic resources	SMALL	SMALL
Terrestrial resources	SMALL	SMALL
Human health	SMALL	SMALL
Land use	SMALL	SMALL
Socioeconomics	SMALL to MODERATE	SMALL
Transportation	SMALL	SMALL
Aesthetics	SMALL	SMALL
Historical & archeological resources	SMALL	SMALL to MODERATE
Waste management	SMALL	SMALL

8.5.1 Air Quality

When the plant stops operating, there will be a reduction in emissions from activities related to plant operation, such as use of diesel generators and employee vehicles. In Chapter 4, the NRC staff determined that these emissions would have a SMALL impact on air quality during the renewal term; therefore, if emissions decrease, the impacts to air quality from the no-action alternative will be SMALL.

8.5.2 Groundwater Use and Quality

Chapter 4 of this SEIS discusses the impact on groundwater that is currently occurring as a result of operation of Davis-Besse. No groundwater is used to support operation of the plant. Tritium contamination has been detected in groundwater monitoring wells, though no concentrations have been detected at or above the EPA drinking water limit of 20,000 picocuries per liter (pCi/L) (FENOC 2010). Once the reactor ceases operating, the potential for additional releases of tritium to the groundwater is expected to diminish. However, releases of tritium may not totally cease until decommissioning is completed. NRC concludes that impacts on groundwater from the no-action alternative would be SMALL.

8.5.3 Surface Water Use and Quality

Chapter 4 of this SEIS discusses the impacts on surface water from plant operation. Operational impacts include water withdrawals from Lake Erie in association with operation of the closed-cycle cooling system. Impacts also include stormwater runoff from industrial areas of the plant, controlled through provisions of a stormwater general permit. Once reactor operation stops, impacts associated with water withdrawals would cease; however, stormwater discharges from industrialized portions of the site would continue largely unchanged until decommissioning activities commence. The current stormwater general permit would continue in effect after reactor operation stops and would be replaced by an amended permit once decommissioning actions commence. The NRC staff concludes that impacts on surface water from the no-action alternative would be SMALL.

8.5.4 Aquatic Resources

If the plant were to cease operating, impacts on aquatic ecology would decrease because the plant would withdraw and discharge less water than it does during operations. Shutdown would reduce the already SMALL impacts on aquatic ecology.

8.5.5 Terrestrial Resources

If the plant were to cease operating, the terrestrial ecology impacts would be SMALL, assuming that no additional land disturbances on or offsite would occur during decommissioning activities.

8.5.6 Human Health

In Chapter 4 of this SEIS, the NRC staff concluded that the impacts of continued plant operation on human health would be SMALL. After cessation of plant operations, the amounts of radioactive material released to the environment in gaseous and liquid forms, all of which are currently within respective regulatory limits, would be reduced or eliminated. Therefore, the NRC staff concludes that the impact of plant shutdown on human health would also be SMALL. In addition, the potential for a variety of accidents would also be reduced to only those associated specifically with shutdown activities and fuel handling. In Chapter 5 of this SEIS, the

NRC staff concluded that impacts of accidents during operation would be SMALL. It follows, therefore, that impacts on human health from a reduced suite of potential accidents after reactor operation ceases would also be SMALL. Therefore, the NRC staff concludes that impacts on human health from the no-action alternative would be SMALL.

8.5.7 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 Davis-Besse would remain in service after the plant stops operating. Maintenance of most existing transmission lines would continue as before. The transmission lines could be used to deliver new replacement electrical power from the Davis-Besse site. Impacts on land use from plant shutdown would be SMALL.

8.5.8 Socioeconomics

Plant shutdown would have a noticeable impact on socioeconomic conditions in the communities near Davis-Besse. Should the plant shut down, there would be immediate socioeconomic impacts from the loss of jobs (some, though not all, of the approximately 880 employees would begin to leave), and tax payments may be reduced. Impacts at the county level would be concentrated in Ottawa County as well as Lucas, Sandusky, and Wood counties, where the majority of Davis-Besse employees live. Revenue losses from Davis-Besse operations would directly affect Ottawa County and other local taxing districts and communities closest to, and most reliant on, the nuclear power plant's tax revenue. The impact of job loss, however, may not be as noticeable given the amount of time required to decontaminate and decommission the nuclear power plant and the proximity of Davis-Besse to the Toledo metropolitan area. The socioeconomic impacts of power plant shutdown (which may not entirely cease until after decommissioning) could, depending on the jurisdiction, range from SMALL to MODERATE. See Appendix J to NUREG-0596, Supplement 1 (NRC 2002) for a description of the potential socioeconomic impacts of plant decommissioning.

8.5.8.1 Transportation

Traffic volumes on the roads near Davis-Besse would be reduced after plant shutdown due to the loss of jobs. Deliveries of materials and equipment to Davis-Besse would also be reduced until decommissioning. Transportation impacts from the termination of power plant operations would be SMALL.

8.5.8.2 Aesthetics

Plant structures and other facilities would likely remain in place until decommissioning. Noise caused by reactor plants operation would cease. Therefore, aesthetic impacts of plant closure would be SMALL.

8.5.8.3 Historic and Archaeological Resources

Impacts from the no-action alternative on historic and archaeological resources would be SMALL. A separate environmental review would be conducted for decommissioning. That assessment would address the protection of historic and archaeological resources.

8.5.8.4 Environmental Justice

Impacts to minority and low-income populations when Davis-Besse ceases operations would depend on the number of jobs and the amount of tax revenues lost by the communities in the immediate vicinity of Davis-Besse after the termination of reactor operations. Closure of

Davis-Besse would reduce the overall number of jobs and tax revenue for social services attributed to nuclear power plant operations. Minority and low-income populations in the township vicinity of Davis-Besse could experience some socioeconomic effects from power plant shutdown, but these effects would not likely be disproportionately high and adverse.

8.5.9 Waste Management

The wastes generated by continued plant operation are discussed in Chapters 2 and 6 of this SEIS. The impacts of low-level and mixed waste from plant operation are characterized as SMALL. Once Davis-Besse stops operating, generation of high-level waste would cease, and generation of low-level and mixed wastes would be diminished, limited only to those wastes associated with reactor shutdown and fuel handling activities. Therefore, the NRC staff concludes that the impacts of waste generation after shutdown would be SMALL.

Significant amounts of waste would be generated as a result of decommissioning, regardless of whether that takes place immediately after license expiration or at some point beyond that. However, pursuit of the no-action alternative would not impact the amounts or types of wastes that would be generated during decommissioning.

8.6 Alternatives Summary

In this SEIS, the NRC staff has considered alternative actions to license renewal of Davis-Besse, including in-depth evaluations of new generation alternatives (Sections 8.1 through 8.3), alternatives that the NRC staff dismissed from detailed evaluation as infeasible or inappropriate (Section 8.4), and the no-action alternative in which the operating license is not renewed (Section 8.5). Impacts of all alternatives considered in detail are summarized in Table 8–6.

Table 8–6. Summary of Environmental Impacts of Proposed Action and Alternatives

	Impact Area								
Alternative	**Air Quality**	**Groundwater**	**Surface Water**	**Aquatic Resources**	**Terrestrial Resources**	**Human Health**	**Socioeconomics**	**Waste Management**	**Historic & Archeological Resources**
License renewal	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL to MODERATE
NGCC at Davis-Besse	SMALL to Moderate	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL to MODERATE	SMALL	SMALL to MODERATE
Combination	SMALL	SMALL	SMALL	SMALL	SMALL to MODERATE	SMALL	MODERATE	SMALL	SMALL to LARGE
Supercritical pulverized coal at an alternate site	MODERATE	SMALL	SMALL	SMALL to LARGE	SMALL	SMALL	SMALL to MODERATE	MODERATE	SMALL to MODERATE
No-action alternative	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL to MODERATE	SMALL	SMALL

Based on the above evaluations, the NRC staff concludes that the environmental impacts of renewal of the operating license for Davis-Besse would be smaller than those of feasible and commercially viable alternatives studied in this SEIS that satisfy the purpose and need of license renewal (provision of 908 MWe of baseload power to the grid). Impacts on air quality are less from continued operation of Davis-Besse than from any of the alternatives involving fossil fuels (including dismissed combinations that rely on CAES to support wind or solar power installations). The NRC staff considered a combination of alternatives that includes wind, solar, CAES, and a small amount of NGCC capacity, and it found that such a combination would have noticeable environmental impacts in more areas would have resulted from pursuit of NGCC generation alone or license renewal. Finally, the NRC concluded that under the no-action alternative, the act of shutting down Davis-Besse on or before its license expiration would have only SMALL impacts in all categories except socioeconomics, where it could have a MODERATE impact in areas immediately adjacent to Davis-Besse. However, depending on how the power lost to the region from reactor shutdown was replaced (decisions outside of NRC's authority and made instead by FirstEnergy, other power producers, and State or non-NRC Federal authorities or both), the net environmental impact of the no-action alternative could be greater than continued reactor operation, especially when fossil energy power plants were selected as full or partial replacements.

8.7 References

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

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

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 Part 75. *U.S. Code of Federal Regulations*, Title 40, "Protection of Environment," Part 75, "Continuous Emission Monitoring."

40 CFR 86. *U.S. Code of Federal Regulations*, Title 40, "Protection of Environment," Part 86, "Selective Enforcement Auditing of New Light-Duty Vehicles, Light-Duty Trucks, and Heavy-Duty Vehicles."

40 CFR 87. *U.S. Code of Federal Regulations*, Title 40, "Protection of Environment," Part 87, "Control of Air Pollution from Aircraft and Aircraft Engines."

40 CFR 89. *U.S. Code of Federal Regulations*, Title 40, "Protection of Environment," Part 89, "Control of Emissions from New and In-Use Nonroad Compression-Ignition Engines."

Archer, Cristina L., and Mark Z. Jacobsen. 2007. "Supplying Baseload Power and Reducing Transmission Requirements by Interconnecting Wind Farms." *Journal of Applied Meteorology and Climatology*. November 2007. Volume 46.

Atlantic Wind Connection. undated. "Right-of-Way Application—FAQs." Available at: <http://atlanticwindconnection.com/ferc/BOEM/ROW%20application%20FAQs.pdf>. Accessed on November 3, 2011.

[BLM] Department of the Interior, Bureau of Land Management. 2005. Final Programmatic Environmental Impact Statement on Wind Energy Development on BLM-Administered Lands in the Western United States. June. Available at: <http://windeis.anl.gov/documents/fpeis/index.cfm\>. Accessed May 17, 2011.

[Cape] Cape Wind Project Status & Timeline. 2014. Available at: <http://www.capewind.org/when>. Accessed September 2, 2014.

[Con Edison] Con Edison and LIPA. 2009. "Joint Con Edison—LIPA Offshore Wind Power Integration Project Feasibility Assessment." March 20, 2009. Available at: <http://www.linycoffshorewind.com/PDF/Feasibility%20Study.pdf>. Accessed on December 2, 2011.

[DOE] BLM and Department of Energy (DOE). 2010. *Draft Programmatic Environmental Impact Statement for Solar Energy Development in Six Southwestern States*. DES 10-59; DOE/EIS 0403. December. Available at: <http://www.solareis.anl.gov/documents/dpeis/index.cfm>. Accessed January 28, 2011.

[DSIRE] Database of State Incentives for Renewables and Efficiency. 2013. Available at: <http://www.dsireusa.org/>. Accessed May 20, 2013.

[EIA] U.S. Energy Information Administration. 2010a. *Table A4. Approximate Heat Content of Natural Gas, 1949-2008 (Btu per Cubic Foot)*. Washington, D.C. Available at: <http://www.eia.doe.gov/emeu/aer/txt/ptb1304.html>. Accessed March 2011.

[EIA] U.S. Energy Information Administration. 2010b. *Cost and Quality of Fuels for Electric Plants 2009 Edition, Table 15A Destination and Origin of Coal to Electric Plants by State: Total (All Sectors), 2010*. November. Available at: <http://www.eia.doe.gov/cneaf/electricity/cq/cqa2009.pdf>. Accessed May 10, 2011.

[EIA] U.S. Energy Information Administration. 2010c. *Assumptions to the Annual Energy Outlook 2010 with Projections to 2035*. DOE/EIA-0554(2010). Available at: <http://www.eia.doe.gov/oiaf/aeo/assumption/index.html>. Accessed December 7, 2010.

[EIA] U.S. Energy Information Administration. 2011a. *Electric Power Annual with Data for 2009, Summary Statistics for the United States*. Washington, D.C., April. Available at: <http://www.eia.doe.gov/cneaf/electricity/epa/epates.html>. Accessed May 5, 2011.

[EIA] U.S. Energy Information Administration. 2011b. *Ohio Energy Profile, 2009 Edition*. Washington, D.C., April. Available at: <http://www.eia.gov/state/state-energy-profiles.cfm?sid=OH>. Accessed May 10, 2011.

[EIA] U.S. Energy Information Administration. 2011c. *Ohio Renewable Energy Profile, 2008 Edition*. Washington, D.C. Available at: <http://www.eia.doe.gov/cneaf/solar.renewables/page/state_profiles/ohio.html>. Accessed March 3, 2011.

[EIA] U.S. Energy Information Administration. 2011d. International Energy Outlook 2011. Available at: <http://www.eia.gov/forecasts/archive/ieo11/pdf/0484(2011).pdf>. Accessed April 4, 2013.

[EIA] U.S. Energy Information Administration. 2012. "State Electricity Profiles 2010," DOE/EIA-0348/(01)/2. January 27, 2012.

[EIA] U.S. Energy Information Administration. 2012a. *Ohio Electricity Profile, 2010 Edition*. DOE/EIA-0348/(01)/2. Washington, D.C., April. Available at: <http://www.eia.doe.gov/cneaf/electricity/st_profiles/ohio.html>. Accessed March 21, 2013.

[EIA] U.S. Energy Information Administration. 2013. *Annual Energy Outlook for 2011 with Projections to 2040, Electricity*. DOE/EIA 0383(2010). Washington, D.C., April 26. Available at: <http://www.eia.doe.gov/oiaf/aeo/electricity.html>. Accessed May 5, 2013.

[EPA] U.S. Environmental Protection Agency. 1998. *Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources: AP 42, Fifth Edition*. Section 1.1: Bituminous and Sub bituminous Coal Combustion: Final Section Supplement E. Washington, D.C.

[EPA] U.S. Environmental Protection Agency. 2000a. *Air Pollution Control Technology Fact Sheet, Selective Catalytic Reduction (SCR)*. EPA-452/F-03-032. Available at: <www.epa.gov/ttn/catc/dir1/fscr.pdf>. Accessed November 9, 2010.

[EPA] U.S. Environmental Protection Agency. 2000b. "Regulatory Finding on the Emissions of Hazardous Air Pollutants from Electric Utility Steam Generating Units." *Federal Register*, Vol. 65, No. 245, pp. 79825–79831. Washington, D.C., December 20, 2000.

[EPA] U.S. Environmental Protection Agency. 2000c. "Notice of Regulatory Determination on Wastes from the Combustion of Fossil Fuels." *Federal Register*, Vol. 65, pp. 32214–32237. Washington, D.C., May 22, 2000.

[EPA] U.S. Environmental Protection Agency. 2005. *Emission Facts: Average Carbon Dioxide Emissions Resulting from Gasoline and Diesel Fuel*. EPA 420-F-05-001. Washington, D.C., February. Available at: <www.epa.gov/oms/climate/420f05001.htm>. Accessed December 21, 2010.

[EPA] U.S. Environmental Protection Agency. 2009a. *List of 156 Mandatory Class I Federal Areas*. Available at: <http://www.epa.gov/visibility/class1.html>. Accessed March 7, 2011.

[EPA] U.S. Environmental Protection Agency. 2009b. *NO_x Trading Programs*. Washington, D.C., April. Available at: <http://www.epa.gov/airmarkt/progsregs/nox/index.html>. Accessed March 3, 2011.

[EPA] U.S. Environmental Protection Agency. 2010a. *Greenhouse Gas Monitoring Program Web site, Final Mandatory Greenhouse Gas Reporting Rule*. Last updated November 9, 2010, Washington, D.C. Available at: <http://www.epa.gov/climatechange/emissions/ghgrulemaking.html>. Accessed November 9, 2010.

[EPA] U.S. Environmental Protection Agency. 2010b. *Municipal Solid Waste, Electricity from Municipal Solid Waste*. Last updated March 17, 2010, Washington, D.C. Available at: <http://www.epa.gov/cleanenergy/energy-and-you/affect/municipal-sw.html>. Accessed December 10, 2010.

[EPA] U.S. Environmental Protection Agency. 2010c. *Available and Emerging Technologies for Reducing Greenhouse Gas Emissions from Coal-Fired electric Generating Units, Office of Air and Radiation*. Washington, D.C., October. Available at: <http://www.epa.gov/airquality/nsr/ghgdocs/electricgeneration.pdf>. Accessed November 22, 2010.

[EPA] U.S. Environmental Protection Agency. 2011a. *Draft Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2009*. EPA 430-R-11-005. Washington, D.C., February 15. Available at: <http://www.epa.gov/climatechange/emissions/usinventoryreport.html>. Accessed March 2, 2011.

[EPA] U.S. Environmental Protection Agency. 2011b. *NO_x Trading Programs*. Available at: <http://www.epa.gov/airmarkt/progsregs/nox/index.html>. Accessed March 3, 2011.

[EPA] U.S. Environmental Protection Agency. 2011c. "National Emission Standards for Hazardous Air Pollutants From Coal and Oil-Fired Electric Utility Steam Generating Units and Standards of Performance for Fossil-Fuel-Fired Electric Utility, Industrial-Commercial-Institutional, and Small Industrial and Commercial-Institutional Steam Generating Units." *Federal Register* Vol. 76, No. 85. May 3, 2011. Accessed May 9, 2011 at: <http://www.epa.gov/ttn/atw/utility/fr03my11.pdf>.

[EPA] U.S. Environmental Protection Agency. 2012. "Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2010," EPA-430-R-12-001, April 15, 2012. Available at: <http://www.epa.gov/climatechange/ghgemissions/usinventoryreport.html>.

[EPA] U.S. Environmental Protection Agency. 2014. Memorandum: Next Steps and Preliminary Views on the Application of Clean Air Act Permitting Programs to Greenhouse Gases Following the Supreme Court's Decisions in Utility Air Regulatory Group v. Environmental Protection Agency. Available at: <http://www.epa.gov/airprogm/oar/oaqps/nsr/documents/20140724memo.pdf>. Accessed September 5, 2014.

[ERC] Energy Recovery Council. 2010. *The 2010 ERC Directory of Waste-To-Energy Plants*. October. Available at: <http://www.energyrecoverycouncil.org/erc-releases-directory-waste-energy-plants-a3045>. Accessed December 9, 2010.

[Exelon] Exelon Generation Company, LLC. 2011. License Renewal Application, Limerick Generating Station, Units 1 and 2, Appendix E, Applicant's Environmental Report, Operating License Renewal Stage. ADAMS Accession No. ML11179A104.

[FENOC] FirstEnergy Nuclear Operating Company. 2010. Davis-Besse Nuclear Power Station, License Renewal Application, Appendix E—Applicant's Environmental Report—Operating License Renewal Stage, August 2010. ADAMS Accession No. ML102450563 and ML102450568.

[FENOC] FirstEnergy Nuclear Operating Company. 2011. License Renewal Application Amendment No. 16, Supplemental Information for the Review of the Davis-Besse Nuclear Power Station, Unit No. 1, License Renewal Application Environmental Report (TAC No. ME4613). September 19, 2011. ADAMS Accession No. ML11266A009.

[FERC] Federal Energy Regulatory Commission. 2008. *2008 Assessment of Demand Response and Advanced Metering*. Staff Report, December. Available at: <www.ferc.gov/legal/staff-reports/12-08-demand-response.pdf>. Accessed December 16, 2009.

[FERC] Federal Energy Regulatory Commission. 2009. *A National Assessment of Demand Response Potential, Staff Report*. Prepared by The Brattle Group, Freeman, Sullivan, & Co. and Global Energy Partners, LLC, June. Available at: <http://www.ferc.gov/industries/electric/indus-act/demand-response/dr-potential.asp>. Accessed December 16, 2009.

[GCRP] Global Change Research Program. *Global Climate Change Impacts in the United States*. Cambridge University Press, 2009. Available at: <http://downloads.globalchange.gov/usimpacts/pdfs/climate-impacts-report.pdf>. Accessed December 22, 2010.

[GEA] Geothermal Energy Association. 2010. *U.S. Geothermal Power Production and Development Update—Special NYC Forum Edition*. Figure 4, January. Available at: http://www.geo-energy.org/reports.aspx. Accessed December 1, 2010.

[GLWEC] Great Lakes Wind Energy Center. 2009. *Feasibility Study—Final Feasibility Report*. April. Available at: <http://development.cuyahogacounty.us/en-US/GLWECF-Study.aspx>. Accessed March 3, 2011.

Heartland Wind, LLC. 2010. Blue Creek Wind Farm Application, April. Available at: <http://www.iberdrolarenewables.us/bluecreek/index.html>. Accessed March 3, 2011.

Hong, B.D., and E.R. Slatick. 1994. "Carbon Dioxide Emission Factors for Coal." Originally published in *Energy Information Administration Quarterly Coal Reports*, January–April 1994. DOE/EIA-0121(94Q1). Washington, D.C., August 1994, pp. 1–8. Available at: <http://www.eia.doe.gov/cneaf/coal/quarterly/co2_article/co2.html>. Accessed December 21, 2009.

[INEEL] Idaho National Engineering and Environmental Laboratory. 1998. *U.S. Hydropower Resource Assessment, Final Report*. DOE-ID/10430.2. Washington, D.C., December. <Available at: http://hydropower.inel.gov/resourceassessment/pdfs/doeid-10430.pdf>. Accessed December 6, 2010.

[ISEPA] Iowa Stored Energy Park Agency. 2011. "Iowa Stored Energy Park Project Terminated." Press release. July 28, 2011. Available at: <http://www.cipco.net/state-news_initiatives.cfm?action=article&page=0&id=084f54ef-69f3-4b3d-a496-dd441388da6b>. Accessed November 4, 2011.

[LEEDCo] Lake Erie Energy Development Corporation. 2013. Available at: <http://www.leedco.org/about-us/about-leedco>. Accessed April 4, 2013.

[MMS] Minerals Management Service. 2006. *Technology White Paper on Wave Energy Potential on the U.S. Outer Continental Shelf*. MMS Renewable Energy and Alternate Use Program. Available at: <http://ocsenergy.anl.gov>. Accessed December 13, 2010.

[MMS] Minerals Management Service. 2009. *Cape Wind Energy Project Final Environmental Impact Statement*. January. Available at: <http://www.boemre.gov/offshore/AlternativeEnergy/PDFs/FEIS/Cape%20Wind%20Energy%20Project%20FEIS.pdf>. Accessed December 20, 2010.

[NCDC] National Climatic Data Center. undated. "Climate of Ohio." Fact sheet. Accessed November 4, 2011.

[NERC] North American Electric Reliability Corporation. 2008. *2008 Long-Term Reliability Assessment: 2008–2017*. October. Available at: <http://www.nerc.com/files/LTRA2008%20v1.1.pdf>. Accessed May 19, 2011.

[NETL] National Energy Technology Laboratory. 2010. *Cost and Performance Baseline for Fossil Energy Plants, Vol. 1, Bituminous Coal and Natural Gas to Electricity*. DOE/NETL 2010/1397. Final Report, U.S. Department of Energy, Pittsburgh, PA, Revision 2, November. Available at: <http://www.netl.doe.gov/File%20Library/Research/Coal/ewr/water/BitBase_FinRep_Rev2.pdf>. Accessed March 2015.

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

[NRC] U.S. Nuclear Regulatory Commission. 1999. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*. Main Report, Section 6.3—Transportation; Table 9.1, Summary of Findings on NEPA Issues for License Renewal of Nuclear Power Plants. Final Report, NUREG-1437, Volume 1, Addendum 1. Washington, D.C.

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

[NREL] National Renewable Energy Laboratory. 2005. *A Geographic Perspective on the Current Biomass Resource Availability in the United States*. Technical Report NREL/TP 560 39181. A. Milbrandt, December. Available at: <http://www.nrel.gov/gis/biomass.html>. Accessed November 29, 2010.

[NREL] National Renewable Energy Laboratory. 2010a. *Assessment of Offshore Wind Energy Resources for the United States*. Available at: <http://www.nrel.gov/docs/fy10osti/45889.pdf>. Accessed December 22, 2010.

[NREL] National Renewable Energy Laboratory. 2010b. *Solar Insolation Maps, Dynamic Maps, GIS Data and Analysis Tools*. Interactive Web site, last updated November 9. Available at: <http://www.nrel.gov/gis/solar.html>. Accessed November 29, 2010.

[NREL] National Renewable Energy Laboratory. 2011. "Estimates of Windy Land Area and Wind Energy Potential, by State, for areas >= 30% Capacity Factor at 80m." Updated April 13, 2011. Available at: <http://www.windpoweringamerica.gov/docs/wind_potential_80m_30percent.xlsx>. Accessed April 2013.

[NWF] National Wildlife Federation. 2010. *Offshore Wind in the Atlantic: Growing Momentum for Jobs, Energy Independence, Clean Air, and Wildlife Protection*. Available at: <http://www.nwf.org/Global-Warming/Policy-Solutions/Climate-and-Energy/Promote-Clean-Energy/~/media/PDFs/Global%20Warming/Reports/NWF-Offshore-Wind-in-the-Atlantic.ashx>. Accessed December 22, 2010.

[OAQDA] Ohio Air Quality Development Authority. undated. "Turning Point Solar LLC Fact Sheet." Available at: <http://www.ohioairquality.org/advanced_energy_program/pdf/Turning_Point_Factsheet_10_22.pdf>. Accessed November 9, 2011.

[OECD/IEA] Organization for Economic Co-Operation and Development/International Energy Agency. 2005. Available at: (accessed 4 April 2013). PJM. 2010. *PJM Manual 21, Rules and Procedures for Determination of Generating Capability*. Revision 09. PJM System Planning Department. Effective Date: 05/01/2010. Available at: <http://pjm.com/documents/manuals.aspx>. Accessed May 5, 2013.

[OEPA] Ohio Environmental Protection Agency. 2012. Ohio Administrative Code (OAC) rules 34745-31-34 and 3745-77-11. Available at: <http://www.epa.state.oh.us/portals/27/regs/3745-77/3745-31-34_Final.pdf> and <http://www.epa.state.oh.us/portals/27/regs/3745-77/3745-77-11_Final.pdf>.

[OPSB] Ohio Power and Siting Board. 2014. Available at: <http://www.opsb.ohio.gov/opsb/index.cfm/information/wind-stats1/>. Accessed September 2, 2014.

Power-Gen Worldwide. 2011. "FENOC Signs PPA with Ohio Wind Farm." Available at: <http://www.powergenworldwide.com/index/display/articledisplay.articles.powergenworldwide.renewables.wind.2011.02.FENOC-to-buy-wind-farm-in-Ohio.QP129867.dcmp=rss.page=1.htm>. Accessed March 3, 2011.

[PSEG Solar] PSEG Solar Source, LLC. 2010. "Governor Strickland Helps Dedicate Ohio's Largest Solar Farm." Available at: <http://www.pseg.com/wyandot/pdf/wyandot_release081910.pdf>. August 19, 2010. Accessed March 28, 2013.

[PUCO] Public Utilities Commission of Ohio. 2011. *Annual Status Report and 2010 Compliance Review*. Submitted by Ohio Edison Company, the Cleveland Electric Illuminating Company, and the Toledo Edison Company, Case No. 11-2479-EL-ACP, April 15. Available at: <http://www.puco.ohio.gov/puco/>. Accessed April 4, 2013.

Reuters. 2011. "NYPA Pulls Plug on Great Lakes Offshore Wind Project." September 27, 2011. Available at: <http://www.reuters.com/assets/print?aid=USTRE78Q5SC20110927>. Accessed May 1, 2013.

[Siemens] Siemens Power Generation. 2011. "Power Plant SCC6-5000F 1x1 Flex-Plant 30." Siemens Combined Cycle Power Plants. Available at: <http://www.energy.siemens.com/us/en/power-generation/power-plants/gas-fired-power-plants/combined-cycle-power-plant-concept/scc6-5000f-1x1-flex-plant-30.htm>. Accessed November 9, 2011, and December 2, 2011.

[Siemens] Siemens Power Generation. 2012. "Siemens Combined Cycle Power Plants." Available at: <http://www.energy.siemens.com/hq/pool/hq/power-generation/power-plants/gas-fired-power-plants/combined-cycle-powerplants/Siemens%20Combined%20Cycle%20Plants.pdf>. Accessed March 2013.

Sovacool, B. 2008. *Valuing the Greenhouse Gas Emissions from Nuclear Power: A Critical Survey*. Energy Policy 36 (2008) 2940–2953. Available at: <http://www.nirs.org/climate/background/sovacool_nuclear_ghg.pdf>. Accessed December 16, 2010.

[TRC] TRC Environmental Corporation. 1995. *Emission Inventory Report, Centerior Energy Corporation, Davis-Besse Nuclear Power Station, Oak Harbor, OH*. February 10.

Wald, Matthew L. "Offshore Wind Is a Bit Closer, Backers Say." *Green: A Blog about Energy and the Environment. The New York Times*. October 13, 2011. Available at: <http://green.blogs.nytimes.com/2011/10/13/offshore-wind-is-inching-closer-backers-say/>. Accessed May 6, 2013.

Wind Powering America. 2011. "Installed Wind Capacity by State." Updated April 29, 2011. Available at: <http://www.windpoweringamerica.gov/docs/installed_wind_capacity_by_state.xls>. Accessed November 3, 2011.

9.0 CONCLUSION

This supplemental environmental impact statement (SEIS) contains the environmental review of FirstEnergy Nuclear Operating Company's (FENOC) application for a renewed operating license for the Davis-Besse Nuclear Power Station, Unit No. 1 (Davis-Besse), as required by Title 10 of the *Code of Federal Regulations* (CFR) Part 51 (10 CFR Part 51), which implements the National Environmental Policy Act (NEPA). Chapter 9 presents the conclusions and recommendations from the site-specific environmental review of Davis-Besse 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) staff recommendations are presented in Section 9.4.

9.1 Environmental Impacts of License Renewal

Based on the NRC staff's review of site-specific environmental impacts of license renewal presented in this SEIS, the staff concludes that issuing a renewed license would have SMALL impacts. The site-specific review included 12 Category 2 issues and 2 uncategorized issues. Section 1.4 in Chapter 1 explains the criteria for Category 1 and Category 2 issues and defines the impact designations of SMALL, MODERATE, and LARGE.

The NRC staff also considered cumulative impacts of past, present, and reasonably foreseeable future actions, regardless of what agency (Federal or non-Federal) or person undertakes them. The cumulative impacts of renewing Davis-Besse's operating license, described in Section 4.13, ranges from SMALL to LARGE depending on the resource. There would be SMALL cumulative impacts for Air and Meteorology, Human Health—Radiological, Socioeconomics, Historic and Archaeological Resources, and Environmental Justice. There would also be MODERATE cumulative impacts for Water Resources—Groundwater, Water Resources—Surface water, Terrestrial Resources, and Human Health—Microbiological Organisms, and there would be LARGE cumulative impacts to Aquatic Resources.

9.2 Comparison of the Environmental Impacts of License Renewal and Alternatives

In the conclusion to Chapter 8, the NRC staff determined that impacts from license renewal are generally less than the impacts of alternatives to license renewal. In comparing likely environmental impacts from natural-gas-fired combined-cycle (NGCC), combination alternative (wind, solar, NGCC, and compressed air energy storage), coal-fired power, and environmental impacts from license renewal, the NRC staff found that license renewal would result in the lowest environmental impact. Based on the NRC staff's analysis, 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 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 U.S. 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 (HAPs).

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 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 generates 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 they 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 commitment 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.

The implementation of any of the energy alternatives considered in this SEIS would entail the irreversible and irretrievable commitment 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 commitment of material resources includes 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

The recommendation of the NRC staff is that the adverse environmental impacts of license renewal for Davis-Besse are not so great that preserving the option of license renewal for energy-planning decisionmakers would be unreasonable. The NRC staff based this recommendation of the following:

- the analysis and findings in the generic environmental impact statement (GEIS);
- the analysis and findings in the continued storage GEIS;
- the Environmental Report and other information submitted by FENOC;
- consultation with Federal, State, Tribal, and local agencies;
- the staff's independent review;
- consideration of public comments received during scoping; and
- consideration of public comments received on the draft SEIS.

10.0 LIST OF PREPARERS

This supplemental environmental impact statement (SEIS) was prepared by members of the Office of Nuclear Reactor Regulation (NRR) with assistance from other U.S. Nuclear Regulatory Commission (NRC) organizations and contract support from Argonne National Laboratory (ANL) and Pacific Northwest National Laboratory (PNNL).

Table 10–1 provides a list of NRC staff that participated in the development of the SEIS. ANL provided contract support for terrestrial, socioeconomic, aquatic ecology, cultural resources, air quality, and hydrology, presented primarily in Chapters 2, 4, and 8. PNNL provided contract support for the severe accident mitigation alternatives (SAMAs) analysis, which is presented in Chapter 5 and Appendix F.

Table 10–1. List of Preparers

Name	Affiliation	Function or Expertise
NRC		
Allison Travers	NRR	Alternatives
Andrew Imboden	NRR	Branch Chief, Environmental
Andrew Stuyvenberg	NRR	Alternatives
April BeBault	NRR	Air & Meteorology Historic & Archeological Resources
Briana Grange	NRR	Aquatic Ecology Terrestrial Ecology Protected Species
David Wrona	NRR	Branch Chief
Brian Wittick	NRR	Branch Chief
Dennis Beissel	NRR	Hydrology
Emily Larson	NRR	Historic & Archeological Resources Socioeconomics
Jeff Rikhoff	NRR	Environmental Justice Land Use Socioeconomics
Kevin Folk	NRR	Hydrology
Jerry Dozier	NRR	SAMAs
John Parillo	NRR	SAMAs
Michelle Moser	NRR	Cumulative Impacts
Nancy Martinez	NRR	Air & Meteorology
Paula Cooper	NRR	Project Manager Hydrology
Elaine Keegan	NRR	Project Manager
Travis Tate	NRR	Branch Chief, SAMAs

Name	Affiliation	Function or Expertise
William Rautzen	NRR	Human Health Radiation Protection Solid Waste
Stephen Klementowicz	NRR	Human Health Radiation Protection Solid Waste
Lab Contractor[a]		
John Quinn	ANL	Hydrology
Konstance Wescott	ANL	Project Manager, Contract Staff Historic & Archeological Resources
Ron Kolpa	ANL	Alternatives
Youngsoo Chang	ANL	Air & Meteorology
SAMA Contractor[b]		
Steve Short	PNNL	SAMAs
G. Coles	PNNL	SAMA

[a] ANL is operated for the U.S. Department of Energy by the University of Chicago Argonne, LLC.
[b] PNNL is operated for the U.S. Department of Energy by Battelle.

11.0 LIST OF AGENCIES, ORGANIZATIONS, AND PERSONS TO WHOM COPIES OF THIS SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT WERE SENT

Commenter	Affiliation (If Stated)
Environmental Impact Statement (EIS) Filing Section	U.S. Environmental Protection Agency (EPA) 1200 Pennsylvania Ave NW Washington, D.C. 20004
EIS Filing Section	U.S. EPA, Region 5 National Environmental Policy Act (NEPA) Implementation Section (Mail Code E-19J) 77 W. Jackson Blvd Chicago, IL 60604
Mr. Reid Nelson Director, Office of Federal Agency Programs	Advisory Council on Historic Preservation (ACHP) 1100 Pennsylvania Ave NW, Suite 803 Old Post Office Building Washington, D.C. 20004
John P. Froman Chief, Peoria Tribe of Indians of Oklahoma	Peoria Tribe of Indians of Oklahoma P.O. Box 1527 Miami, OK 74355
Mr. Clyde Scoles Director	Toledo-Lucas County Public Library 325 Michigan St Toledo, OH 43604
Ms. Deborah Rossman Director	Ida Rupp Public Library 310 Madison St Port Clinton, OH 43452
Mr. Edgar L. French	Delaware Nation P.O. Box 825 Anadarko, OK 73005
Mr. Harold G. Frank	Forest County Potawatomi Community Community of Wisconsin P.O. Box 340 Crandon, WI 54520
Mr. Kenneth Meshigaud	Hannahville Indian Community Council N14911 Hannahville B1 Rd Wilson, MI 49896
Mr. Floyd E. Leonard Miami Tribe of Oklahoma	P.O. Box 1326 Miami, OK 74355
Mr. Ron Sparkman Shawnee Tribe	P.O. Box 189 Miami, OK 74355
Mr. Leaford Bearskin Wyandotte Nation	P.O. Box 250 Wyandotte, OK 74370
Mr. Charles Todd Ottawa Tribe of Oklahoma	P.O. Box 110 811 Third Ave NE Miami, OK 74355

List of Agencies, Organizations, and Persons to Whom Copies of This Supplemental Environmental Impact Statement Were Sent

Commenter	Affiliation (If Stated)
Ms. Patricia Kurkul Regional Administrator	National Oceanic & Atmospheric Administration (NOAA) Fisheries Service Northeast Regional Office 55 Great Republic Dr Gloucester, MA 01930-2276
Mr. Mark Epstein Department Head, Resource Protection & Review	Ohio Historic Preservation Office 182 Velma Ave Columbus, OH 43211-2497
Mr. Brian Mitch Environmental Review Manager	Ohio Department of Natural Resources Division of Engineering Environmental Services Section 2045 Morse Rd, Building F-3 Columbus, OH 43229-6693
Mark Stahl [Current President – James M. Sass]	President of the Ottawa County Commissioners 315 Madison Street, Rm 103 Port Clinton, OH 43452
Jere Witt [Current Administrator – Dennis C. Jensen]	County Administrator Ottawa County 315 Madison Street Port Clinton, OH 43452
Fred Petersen	Director of the Emergency Management Agency Ottawa County 315 Madison Street, Rm 056 Port Clinton, Ohio 43452
Chris Galvin Director, United Way Ottawa County	chris.galvin@unitedwayottawacounty.org
Jackie VanTress	Office & Professional Employees International Union (OPEIU) Local 19 jackiev@bex.net
Kimberly Kaufman Executive Director, Black Swamp Bird Observatory	Black Swamp Bird Observatory 13551 W. State Route 2 Oak Harbor, OH 43449 KimKaufman@bsbo.org
Steve Inchak	Representative Congressman Kucinich
Beth Leggett Director, American Red Cross Ottawa County	American Red Cross 1854 E. Perry St, Suite 600 Port Clinton, OH 43452 redcross@thirdplanet.net
Brad Goetz	International Brotherhood of Electrical Workers Local 1413 P.O. Box 122 Oak Harbor, OH 43449 bngoets@wcnet.org
Ann Heckerd Food Coordinator, St. Vincent DePaul Food Pantry	St. Vincent DePaul Food Pantry 1117 E. 3rd St Port Clinton, OH 43452 ajh1117@msn.com
Brian Boles Plant Manager, Davis-Besse	bdboles@firstenergycorp.com
Larry Tscherne International Brotherhood of Electrical Workers	larry@ibew245.com

Commenter	Affiliation (If Stated)
Mike Drusbacky	Deputy Director, Ottawa County 315 Madison Street Port Clinton, Ohio 43452
Joseph DeMare Ohio Green Party	Ohio Green Party 1111 West Elm Tree Rd Rossford, OH 43460 electricity2@cs.com
Jane Ridenour President, OPEIU Local 19	OPEIU Local 19 2300 Ashland Ave, Rm 224A Toledo, OH 43620 opeiu19@sbcglobal.net
Patricia Marida Chair, Nuclear Issues Committee Sierra Club	Sierra Club 1710 Dorsetshire Rd Columbus, OH 43229 marida@wideopenwest.com 131 North High St, Suite 605 Columbus, OH 43215-3026
Matthew Heyrman	No affiliation given
Anita Rios	Ohio Green Party
Kevin Kamps	Beyond Nuclear
Al Compaan	Professor, University of Toledo
Katie Hoepfl	Student, University of Toledo
Tony Szilagye	No affiliation given
Ed McArdle	Sierra Club of Michigan
Phyllis Oster	No affiliation given
Dave Ellison	No affiliation given
Michael Keegan	Coalition for a Nuclear Free Great Lakes, Don't Waste Michigan Monroe, Michigan 48161 mkeeganj@comcast.net
Ralph Semrock	Associate Professor, Owens
Mike Leonardi	No affiliation given
Eric Britton	No affiliation given
Suzanne Patser	No affiliation given
James Whitaker	No affiliation given
Scott Robinson	No affiliation given
Simone Morgan	Sierra Club
Emily Journey	No affiliation given
Bob Patraicus	No affiliation given
Kevin Malcolm	No affiliation given
Doug Todd	No affiliation given

List of Agencies, Organizations, and Persons to Whom Copies of This Supplemental Environmental Impact Statement Were Sent

Commenter	Affiliation (If Stated)
Connie Hammond	Sierra Club
Bernadine Kent	No affiliation given
Pete Johnson	No affiliation given
Connie Gadwell-Newton	Ohio Green Party Sierra Club
Lee Blackburn	Sierra Club
Mary Knapp Field Supervisor, U.S. Fish & Wildlife Service	Fish & Wildlife Serives, Ecological Services 4625 Morse Road, Suite 104 Columbus, OH 43230
Dennis Kucinich, Member of Congress, 10th District Ohio House of Representatives	14400 Detroit Ave Lakewood, OH 44107
Marilyn & Paul Nesser	No affiliation given
Jessica Lillian Weinberg	No affiliation given
Erika Agner Sierra Club	Sierra Club
Christian George	Sierra Club
Amanda Baldino	Sierra Club
Inez George Sierra Club	Sierra Club
Leeza Perry Sierra Club	Sierra Club
Jeremy Bantz	Sierra Club
David Greene	Sierra Club
Jean Puchstein	Sierra Club
Sandy Bihn	Sierra Club
Bob Greenbaum	Sierra Club
Carol Rainey	Sierra Club
Leonard Bildstein	Sierra Club
Cate Renner	Sierra Club
Karen Hansen	Sierra Club
Natalie Schafrath	Sierra Club
Kathleen Bodnar	Sierra Club
Margaret Holfinger	Sierra Club
Ben Shapiro	Sierra Club
Susan Jones	Sierra Club
Leslie Stansbery	Sierra Club
Stephen & Connie Caruso	Sierra Club

Commenter	Affiliation (If Stated)
Robert Kyle	Sierra Club
Andy Trokan	Sierra Club
Joan DeLauro	Sierra Club
Joan Lang	Sierra Club
Jim Wagner	Sierra Club
June Douglas	Sierra Club
Tekla Lewin	Sierra Club
Tim Wagner	Sierra Club
Virginia Douglas	Sierra Club
Mary Beth Lohse	Sierra Club
George M. Williams	Sierra Club
Donna Emig	Sierra Club
Liz Loring	Sierra Club
Lance Wilson	Sierra Club
Mike Fremont	Sierra Club
Nick Mellis	Sierra Club
Paul Wojoski	Sierra Club
Linda Milligan	Sierra Club
Elisa Young	Sierra Club
Matt Trokan	Sierra Club

12.0 INDEX

G

H

I

L

M

N

O

P

NRC FORM 335 (12-2010) NRCMD 3.7 — U.S. NUCLEAR REGULATORY COMMISSION — **BIBLIOGRAPHIC DATA SHEET** (*See instructions on the reverse*)		1. REPORT NUMBER (Assigned by NRC, Add Vol., Supp., Rev., and Addendum Numbers, if any.) NUREG-1437, Supplement 52, Volume 1	
2. TITLE AND SUBTITLE Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Supplement 52, Regarding the Davis-Besse Nuclear Power Station, Unit No. 1. Chapters 1 - 12. Volume 1.		3. DATE REPORT PUBLISHED	
		MONTH: April	YEAR: 2015
		4. FIN OR GRANT NUMBER	
5. AUTHOR(S) See Chapter 10.		6. TYPE OF REPORT Technical	
		7. PERIOD COVERED (Inclusive Dates)	

8. PERFORMING ORGANIZATION - NAME AND ADDRESS (If NRC, provide Division, Office or Region, U. S. Nuclear Regulatory Commission, and mailing address; if contractor, provide name and mailing address.)

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

9. SPONSORING ORGANIZATION - NAME AND ADDRESS (If NRC, type "Same as above", if contractor, provide NRC Division, Office or Region, U. S. Nuclear Regulatory Commission, and mailing address.)

Same as above.

10. SUPPLEMENTARY NOTES

Docket No. 50-346

11. ABSTRACT (200 words or less)

This supplemental environmental impact statement (SEIS) has been prepared in response to an application submitted by FirstEnergy Nuclear Operating Company (FENOC) to renew the operating license for the Davis-Besse Nuclear Power Station, Unit No. 1, for an additional 20 years.

This SEIS includes the final analysis that evaluates the environmental impacts of the proposed action and alternatives to the proposed action. Alternatives considered include natural gas combined-cycle (NGCC); combination alternative (wind, solar, NGCC and compressed air energy storage; coal-fired power; and not renewing the license (the no action alternative).

The U.S. Nuclear Regulatory Commission's final recommendation is that the adverse environmental impacts of license renewal for Davis-Besse are not so great that preserving the option of license renewal for energy-planning decision makers would be unreasonable. This recommendation is based on the following: the analysis and findings in NUREG 1437, Volumes 1 and 2, Generic Environmental Impact Statement for License Renewal of Nuclear Plants; the environmental report submitted by FENOC; consultation with Federal, state, Tribal, and local agencies; the NRC's environmental review; and consideration of public comments received during the scoping process and on the draft SEIS.

12. KEY WORDS/DESCRIPTORS (List words or phrases that will assist researchers in locating the report.)	13. AVAILABILITY STATEMENT
FirstEnergy Nuclear Operating Company	unlimited
FENOC	14. SECURITY CLASSIFICATION
Davis-Besse Nuclear Power Station, Unit No. 1	(*This Page*) unclassified
Davis-Besse	
Supplemental to the Generic Environmental Impact Statement, SEIS	(*This Report*) unclassified
Generic Environmental Impact Statement, GEIS	
National Environmental Policy Act, NEP A	15. NUMBER OF PAGES
NUREG-1437, Supplement 52	
	16. PRICE

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, DC 20555-0001

OFFICIAL BUSINESS

@NRCgov

NUREG-1437, Vol. 1
Supplement 52
Final

Generic Environmental Impact Statement for License Renewal of Nuclear Plants
Regarding Davis-Besse Nuclear Power Station

April 2015