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

NUREG-1437
Supplement 61

Generic Environmental Impact Statement for License Renewal of Nuclear Plants

Supplement 61

Regarding License Renewal of Perry Nuclear Power Plant

Draft Report for Comment

Office of Nuclear Material Safety and Safeguards

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 the NRC's Library at 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 Publishing Office
   Washington, DC 20402-0001
   Internet: https://bookstore.gpo.gov/
   Telephone: (202) 512-1800
   Fax: (202) 512-2104

2. **The National Technical Information Service**
   5301 Shawnee Road
   Alexandria, VA 22312-0002
   Internet: https://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
Digital Communications and Administrative Services Branch
Washington, DC 20555-0001
E-mail: Reproduction.Resource@nrc.gov
Facsimile: (301) 415-2289

Some publications in the NUREG series that are posted at the NRC's Web site address 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
Internet: www.ansi.org
(212) 642-4900

Legally binding regulatory requirements are stated only in laws; NRC regulations; licensee, 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 the Atomic and Safety Licensing Boards and of Directors' decisions under Section 2.206 of the NRC's regulations (NUREG-0750), (6) Knowledge Management prepared by NRC staff or agency contractors (NUREG/KM-XXXX).

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

NUREG-1437
Supplement 61

Generic Environmental Impact Statement for License Renewal of Nuclear Plants

Supplement 61

Regarding License Renewal of Perry Nuclear Power Plant

Draft Report for Comment

Manuscript Completed: August 2024
Date Published: August 2024

Office of Nuclear Material Safety and Safeguards

Proposed Action	Issuance of renewed facility operating license NPF-58 for Perry Nuclear Power Plant Unit 1 in Perry, Ohio
Type of Statement	Draft Supplemental Environmental Impact Statement
Agency Contact	Lance Rakovan U.S. Nuclear Regulatory Commission (NRC) Office of Nuclear Material Safety and Safeguards Mail Stop T-4B72 Washington, DC 20555-0001 Email: lance.rakovan@nrc.gov

Comments:
Any interested party may submit comments on this draft supplemental environmental impact statement (SEIS). Please specify "NUREG-1437, Supplement 61, draft," in the subject or title line for your comments. Comments on this draft SEIS should be filed no later than 45 days after the date on which the U.S. Environmental Protection Agency notice, stating that this draft SEIS has been filed with the U.S. Environmental Protection Agency, is published in the *Federal Register*. Comments received after the expiration of the comment period will be considered if it is practical to do so, but assurance of consideration of late comments cannot be given. You may submit comments electronically by searching for Docket ID NRC-2023-0136 at the website: http://www.regulations.gov.

The NRC cautions you not to include identifying or contact information that you do not want to be publicly disclosed in your comment submission. The NRC will post all comment submissions into the NRC's Agencywide Documents Access and Management System. The NRC does not routinely edit comment submissions to remove identifying or contact information.

COVER SHEET

Responsible Agency: U.S. Nuclear Regulatory Commission, Office of Nuclear Material Safety and Safeguards. There are no cooperating agencies involved in the preparation of this document.

Title: Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Supplement 61, Regarding Perry Nuclear Power Plant, Unit 1, Draft Report (NUREG-1437).

For additional information or copies of this document contact:

U.S. Nuclear Regulatory Commission
ATTN: Lance Rakovan
11555 Rockville Pike
Rockville, MD 20852
Phone: 1-800-368-5642, extension 2589, email: lance.rakovan@nrc.gov

ABSTRACT

The U.S. Nuclear Regulatory Commission (NRC) prepared this supplemental environmental impact statement (SEIS) in response to Energy Harbor Nuclear Corp.'s application to renew the operating license for Perry Nuclear Power Plant, Unit 1 (Perry Plant), for an additional 20 years. Since submittal of the license application, the direct and indirect transfer of control of Perry Plant has been transferred to Vistra Operations Company, LLC. This SEIS evaluates the environmental impacts of the proposed action and alternatives to the proposed action. Alternatives considered include: (1) natural gas-fired combined-cycle, (2) renewable and natural gas combination, and (3) not renewing the operating license (the no-action alternative). The NRC staff's preliminary recommendation is that Perry Plant license renewal is a reasonable option for energy -planning decision-makers. The NRC is making this preliminary recommendation after carrying out the following activities:

- examined the analysis and findings in NUREG-1437
- reviewed the information provided in the applicant's environmental report
- consulted with other Federal, State, and local agencies and Native American Tribes
- conducted an independent evaluation of the issues during the site audit
- considered the public comments received for the review (during the scoping process)
- evaluated new and significant information

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

EXECUTIVE SUMMARY

Background

By letter dated July 3, 2023, Energy Harbor Nuclear Corp. submitted an application to the U.S. Nuclear Regulatory Commission (NRC) to renew the operating license for Perry Nuclear Power Plant Unit 1 (Perry Plant) for an additional 20-year period. Since submittal of the license application, the direct and indirect control of Perry Plant was transferred to Vistra Operations Company, LLC (VistraOps). Thus, throughout this supplemental environmental impact statement (SEIS), VistraOps will be used to refer to the owner/operator of Perry Plant.

Pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 51.20(b)(2) (TN250), 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, in connection with the renewal of an operating license, the NRC shall prepare an EIS, which is a supplement to the Commission's NUREG-1437, *Generic Environmental Impact Statement (LR GEIS) for License Renewal of Nuclear Plants* (NRC 2013-TN2654).

Upon acceptance of VistraOps' application, the NRC began the environmental review process described in 10 CFR Part 51 (TN250), "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions," by publishing a notice of intent to prepare a supplemental environmental impact statement (SEIS) and to conduct scoping for Perry Plant. To prepare this SEIS, the NRC staff performed the following:

- conducted two public scoping meetings: a webinar on October 19, 2023, and an in-person meeting in Perry, Ohio, on October 25, 2023
- conducted a remote audit during the week of January 22, 2024, supplemented by a site visit on February 1, 2024, and additional discussions before a formal exit meeting conducted on February 8, 2024, to review the applicant's environmental report (ER) (EH 2023-TN9534) and compare it to the NRC's LR GEIS
- consulted with Federal, State, Tribal, and local agencies
- conducted a review of the issues following the guidance set forth in NUREG-1555, Supplement 1, Revision 1, *Standard Review Plans for Environmental Reviews for Nuclear Power Plants: Supplement 1: Operating License Renewal*, Final Report (NRC 2013-TN3547)
- considered public comments received during the scoping process

Proposed Action

The proposed Federal action (i.e., renewal of the Perry Plant operating license) was initiated by VistraOps submitting their license renewal application (LRA). The current Perry Plant operating license (NPF-58) is set to expire on November 7, 2026. The NRC's Federal action is to determine whether the operating license of Perry Plant should be renewed for an additional 20 years. The regulation at 10 CFR Part 2-TN6204, "Effect of Timely Renewal Application," states that 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 NRC completes its safety and environmental reviews, and makes a final decision about whether to issue a renewed license. As noticed in the *Federal Register* on

July 17, 2020, the NRC issued an exemption allowing VistraOps to submit a sufficient LRA for Perry Plant at least three years prior to the expiration of the existing license and still receive timely renewal protection (85 FR 43609-TN9977).

Purpose and Need for Action

The purpose and need for the proposed action (renewal of the Perry Plant operating license) are 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, as such needs may be determined by energy-planning decision-makers, such as State regulators, utility owners, and Federal agencies (other than the NRC). This definition of purpose and need reflects the Commission's recognition that, absent findings in the safety review required by the Atomic Energy Act of 1954 (TN663), as amended, or in the National Environmental Policy Act of 1969 (TN661) environmental analysis that would lead the NRC to reject a LRA, the NRC has no role in the energy-planning decisions of utility officials and State regulators as to whether a particular nuclear power plant should continue to operate (61 FR 28467-TN4491).

Environmental Impacts of License Renewal

This SEIS evaluates the potential environmental impacts of the proposed action. The environmental impacts of the proposed action are designated as SMALL, MODERATE, or LARGE.

> **SMALL:** Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.
>
> **MODERATE:** Environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.
>
> **LARGE:** Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

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

- The environmental impacts associated with the issue are determined to apply either to all nuclear power plants or, for some issues, to nuclear power plants having a specific type of cooling system or other specified plant or site characteristics.
- A single significance level 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 nuclear power plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation.

For Category 1 issues, no additional site-specific analysis is required in this SEIS unless new and significant information is identified. Site-specific issues (Category 2) are those that do not meet one or more of the criteria for Category 1 issues; therefore, an additional site-specific review for the non-generic issues is required, and the results are documented in this SEIS. Chapter 3 of this SEIS presents the process for identifying new and significant information.

Neither the applicant nor the NRC identified information that is both new and significant related to Category 1 issues that would call into question the conclusions in the LR GEIS. This conclusion is supported by the NRC staff's review of the applicant's ER and other documentation relevant to the applicant's activities, the public scoping process, and the findings from the site audits conducted by the NRC staff. Therefore, the NRC staff relied upon the conclusions of the LR GEIS for all Category 1 issues applicable to Perry Plant.

Table ES-1 summarizes the Category 2 issues relevant to Perry Plant and 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 in the LR GEIS, as documented in Appendix B to Subpart A of 10 CFR Part 51 (TN250), are incorporated for that resource area.

Table ES-1 Summary of NRC Conclusions Relating to Site-Specific Impacts of License Renewal at Perry Nuclear Power Plant

Resource Area	Relevant Category 2 Issues	Impact[(a)]
Groundwater Resources	Radionuclides released to groundwater	SMALL
Terrestrial Resources	Effects on terrestrial resources (non-cooling system impacts)	SMALL
Special Status Species and Habitats	Threatened, endangered, and protected species, critical habitat, and essential fish habitat	May affect, but is not likely to adversely affect the northern long -eared bat, Indiana bat, tricolored bat, piping plover, red knot, and monarch butterfly. No effect on essential fish habitat. No effect on sanctuary resources of national marine sanctuaries.
Historic and Cultural Resources	Historic and cultural resources	No effect on historic properties
Human Health	Microbiological hazards to the public (plants with cooling ponds or canals or cooling towers that discharge to a river)	SMALL
Human Health	Chronic effects of electromagnetic fields[(b)]	Uncertain Impact
Human Health	Electric shock hazards	SMALL
Postulated Accidents	Severe accidents	See Appendix F
Environmental Justice	Minority and low income populations	No disproportionate and adverse human health and environmental effects on minority and low -income populations. No disproportionate and adverse human health effects in special pathway receptor populations in the region because of subsistence consumption of water, local food, fish, and wildlife.
Cumulative Impacts	Cumulative impacts	See Section 3.16.

(a) Impact determinations for Category 2 issues based on findings described in Sections 3.2 to 3.13 as applicable, for the proposed action.
(b) This issue was not designated as Category 1 or 2 and is discussed in Section 3.11.6.2.
Source: Table B-1 in Appendix B, Subpart A, to 10 CFR Part 51-TN250; NRC 2013-TN2654.

Severe Accident Mitigation Alternatives

Since severe accident mitigation alternatives (SAMAs) have not been previously considered in an environmental impact statement or environmental assessment for Perry Plant, 10 CFR 51.53(c)(3)(ii)(L) required VistraOps to submit, with the ER, a consideration of alternatives to mitigate severe accidents. SAMAs are potential ways to reduce the risk or potential impacts of uncommon, but potentially severe accidents. SAMAs may include changes to plant components, systems, procedures, and training.

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

The NRC staff generally agrees with VistraOps' conclusion that none of the candidate SAMAs discussed in Appendix F, which are based on conservative treatment of costs, benefits, and uncertainties, are potentially cost beneficial. The exception is that the staff suggests three candidate SAMAs be considered for implementation since they are potentially cost-beneficial after consideration of sensitivity and uncertainty analyses. The small number of potentially cost beneficial SAMAs is consistent with the low residual level of risk indicated in the Perry Plant probabilistic safety assessment and the fact that VistraOps has already implemented many of the plant improvements identified from the individual plant examination, as well as individual plant examination of external events. Because the potentially cost beneficial SAMAs identified by the staff do not relate to aging management during the period of extended operation, they do not need to be implemented as part of LR in accordance with 10 CFR Part 54.

Alternatives

As part of its environmental review, the NRC is required to consider alternatives to LR and evaluate the environmental impacts associated with each alternative. These alternatives can include other methods of power generation (replacement energy alternatives), as well as not renewing the Perry Plant operating license (the no-action alternative).

The NRC considered 16 alternatives to the proposed action and eliminated 14 from detailed study due to technical, resource availability, or commercial limitations that are likely to exist when the Perry Plant operating license expires. Two replacement energy alternatives were determined to be commercially viable, and include:

- natural gas-fired combined-cycle
- renewable and natural gas combination

These alternatives, along with the no-action alternative, were evaluated in detail in this SEIS.

Recommendation

The NRC staff's preliminary recommendation is that the adverse environmental impacts of Perry Plant LR are not so great that preserving the LR option for energy-planning decision-makers would be unreasonable. The NRC is making this preliminary recommendation after carrying out the following activities:

- examined the analysis and findings in NUREG-1437
- reviewed the information provided in the applicant's ER

- consulted with other Federal, State, and local agencies and Native American Tribes
- conducted an independent evaluation of the issues during the site audit
- considered the public comments received for the review (during the scoping process)
- evaluated new and significant information

ABBREVIATIONS AND ACRONYMS

°C	degree(s) Celsius
^{14}C	carbon-14 (an isotope of carbon)
°F	degree(s) Fahrenheit
ac	acre(s)
ACC	averted cleanup and decontamination costs
ACHP	Advisory Council on Historic Preservation
AD	anno Domini—with respect to time period
ADAMS	Agencywide Documents Access and Management System
AEA	Atomic Energy Act
ALARA	as low as reasonably achievable
ANS	American Nuclear Society
APE	area of potential effect
APE	averted public exposure (Appendix F)
AQCR	air quality control region
ASME	American Society of Mechanical Engineers
ATWS	anticipated transient without scram
BC	before Christ—with respect to time period
BDTF	blowdown treatment facility
bgs	below ground surface
BMP	best management practice
BOC	break outside containment
BP	before present
BWR	boiling water reactor
CAA	Clean Air Act of 1963
CCDP	conditional core damage probability
CDF	core damage frequency
CET	containment event trees
CFR	*Code of Federal Regulations*
CH_4	methane
Ci	Curie
cm	centimeter(s)

CO	carbon monoxide
CO_2	carbon dioxide
CO_2eq	carbon dioxide equivalent
CPI	consumer price index
CWA	Clean Water Act of 1972, as amended (Federal Water Pollution Control Act)
CZMA	Coastal Zone Management Act
Davis-Besse	Davis-Besse Nuclear Power Station
dB	decibel(s)
dBA	A-weighted decibel(s)
DOE	U.S. Department of Energy
DOW	Division of Wildlife
EDG	emergency diesel generator
EFH	essential fish habitat
EIA	U.S. Energy Information Administration
EIS	environmental impact statement
EMF	electromagnetic field
EO	Executive Order
EPA	U.S. Environmental Protection Agency
ER	environmental report
ESA	Endangered Species Act
ESW	emergency service water
F&O	Facts and Observations
FES-O	Final Environmental Statement for operation of Perry
FIVE	Fire-Induced Vulnerability Evaluation
fps	foot (feet) per second
FR	*Federal Register*
FT	federally threatened
ft	foot (feet)
FWS	U.S. Fish and Wildlife Service
g	acceleration due to gravity on the surface of the Earth
gal	gallon(s)
gal/kWh	gallons per kilowatt-hour

g Ceq/kWh	grams carbon equivalent per kilowatt-hour
GHG	greenhouse gas
GLFC	Great Lakes Fishery Commission
gpd	gallons per day
gpm	gallons per minute
GPP	Groundwater Protection Plan
GWP	global warming potential
h	hour(s)
ha	hectare(s)
Hz	hertz
in.	inch(es)
in./h	inch(es)/hour
IPaC	Information for Planning and Conservation
IPCC	Intergovernmental Panel on Climate Change
IPE	Individual Plant Examination
IPEEE	individual plant examination of external events
ISFSI	independent spent fuel storage installation
kg	kilogram(s)
km	kilometer(s)
kmph	kilometer(s) per hour
kV	kilovolt(s)
kW	kilowatt(s)
kWh	kilowatt-hour(s)
l/day	liter(s) per day
l/min	liter(s) per minute
l/sec	liter(s) per second
lb	pound(s)
L/E	large/early
L/I	large/intermediate
L/L	large/late
LERF	Large Early Release Frequency
LIP	local intense precipitation

LLC	limited liability company
LLRW	low-level radioactive waste
lpm	liter(s) per minute
LR	license renewal
LRA	license renewal application
LR GEIS	*Generic Environmental Impact Statement for License Renewal of Nuclear Plants*
m	meter(s)
Ma	million years ago
mA	milliampere(s)
MAAP	Modular Accident Analysis Program
MBTA	Migratory Bird Treaty Act
MDCT	mechanical draft cooling tower
M/E	medium/early
M/I	medium/intermediate
M/L	medium/late
MG	million gallon(s)
mg/L	milligram(s) per liter
MGD	million(s) of gallons per day
MGM	million(s) of gallons per month
MGY	million(s) of gallons per year
mi	mile(s)
m^2	square mile(s)
min	minute(s)
mm	millimeter(s)
MMBtu	million British thermal units
mph	mile(s) per hour
mrem/yr	milli roentgen equivalent man per year
m/s	meter(s) per second
MSA	Magnuson-Stevens Fishery Conservation and Management Act
msl	mean sea level
MW	megawatt(s)
MWD/MTU	megawatt day(s) per metric ton uranium
MWe	megawatt(s) electric
MWt	megawatt(s) thermal

NA	not available/not applicable
NAAQS	National Ambient Air Quality Standards
NEI	Nuclear Energy Institute
NEPA	National Environmental Policy Act
NETL	National Energy Technology Laboratory
NGCC	natural gas-fired combined-cycle
ng/L	nanogram(s) per liter
NHPA	National Historic Preservation Act of 1966
NIEHS	National Institute of Environmental Health Sciences
NO_2	nitrogen dioxide
NO_x	nitrogen oxides
NOAA	National Oceanic and Atmospheric Administration
NMFS	National Marine Fisheries Service
NMSA	National Marine Sanctuaries Act
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
NRHP	National Register of Historic Places
NUREG	U.S. Nuclear Regulatory Commission technical report designation
OAC	Ohio Administrative Code
ODCM	Offsite Dose Calculation Manual
ODNR	Ohio Department of Natural Resources
OECR	offsite economic cost risk
OEPA	Ohio Environmental Protection Agency
ORC	Ohio Revised Code
OSHA	Occupational Safety and Health Administration
PBR	Permit by Rule
pCi/L	picocuries per liter
PDS	plant damage states
PDR	population dose risk
PE	particulate emissions
pH	potential of hydrogen
PM	particulate matter
$PM_{2.5}$	particulate matter less than 2.5 micrometers in diameter
PM_{10}	particulate matter less than 10 micrometers in diameter
PNNL	Pacific Northwest National Laboratory

PRA	probabilistic risk assessment
PV	photovoltaic
Perry Plant/PNPP	Perry Nuclear Power Plant
PZ	piezometer(s)
RAI	request for additional information
RCI	request for confirmation of information
RCP	representative concentration pathway
rem	roentgen equivalent man
REMP	radiological environmental monitoring program
ROI	region of influence
ROW	right-of-way
RPC	replacement power cost
SAMA	severe accident mitigation alternative
SBO	station blackout
SCRAM	Support Center for Regulatory Atmospheric Modeling
S/E	small/early
S/I	small/intermediate
SEIS	supplemental environmental impact statement
SER	safety evaluation report
SHPO	State Historic Preservation Office
SO_2	sulfur dioxide
SPCC	spill prevention, control, and countermeasure
SSC	systems, structures, and components
SSC	State species of special concern
SSP	shared socioeconomic pathway
STC	source term categories
SWPPP	stormwater pollution prevention plan
TMDL	total maximum daily load
U.S.	United States
USACE	U.S. Army Corps of Engineers
U.S.C.	U.S. Code
USCB	U.S. Census Bureau
USGCRP	U.S. Global Change Research Program

USGS	U.S. Geological Survey
VistraOps	Vistra Operations Company, LLC
VOC	volatile organic compound
yr	year(s)
yd	yard(s)

1 INTRODUCTION

Under the U.S. Nuclear Regulatory Commission's (NRC's) environmental protection regulations, which are found in Title 10 of the *Code of Federal Regulations* (10 CFR Part 51-TN250), "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions," and implement the National Environmental Policy Act (NEPA), issuance of a new nuclear power plant operating license requires the preparation of an environmental impact statement (EIS).

The Atomic Energy Act of 1954, as amended (TN663), specifies that licenses for commercial power reactors can be granted for up to 40 years. NRC regulations (10 CFR Part 54-TN4878) allow for an option to renew a license for up to an additional 20 years. The initial 40-year licensing period was based on economic and antitrust considerations rather than on technical limitations of the nuclear facility.

The decision to seek a license renewal (LR) 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 LR based on whether the applicant has demonstrated that the environmental and safety requirements in the agency's regulations can be met during the period of extended operation.

1.1 Proposed Action

Energy Harbor Nuclear Corp. initiated the proposed action by submitting an application for LR of Perry Nuclear Power Plant (Perry Plant) Unit 1 for which the existing license (NPF-58) expires on November 7, 2026. Since submittal of the license application, the direct and indirect control of Perry Plant was transferred to Vistra Operations Company, limited liability company (LLC) (VistraOps, the applicant). Thus, throughout this SEIS, VistraOps will be used to refer to the owner/operator of Perry Plant. The NRC's proposed action is to determine whether to renew the license for an additional 20 years.

1.2 Purpose and Need for the Proposed Agency Action

The purpose and need for the proposed action (renewal of an operating license) are 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 decision-makers. This definition of purpose and need reflects the Commission's recognition that, absent findings in the safety review required by the Atomic Energy Act of 1954, as amended, or in the NEPA environmental analysis that would lead the NRC to reject a license renewal application (LRA), the NRC has no role in the energy planning decisions of utility officials and State regulators as to whether a nuclear power plant continues to operate (61 FR 28467-TN4491).

If the renewed license is issued, State regulatory agencies and utility officials will ultimately decide whether the nuclear power plant will continue to operate based on economics, energy reliability goals, and other factors within the State's jurisdiction or owner's purview. If the operating license is not renewed, the nuclear power plant must shut down on or before the expiration date of the current operating license.

1.3 Major Environmental Review Milestones

The applicant submitted an environmental report (ER) as part of its LRA (EH 2023-TN9534) on July 3, 2023. After reviewing the LRA and ER for sufficiency, the NRC staff published a *Federal Register* Notice of Acceptability and Opportunity for Hearing (88 FR 67373-TN9927) on September 29, 2023. On October 10, 2023, the NRC published a notice in the *Federal Register* (88 FR 69967-TN9932) on the intent to conduct scoping, thereby beginning the scoping period that ended on November 9, 2023.

The NRC staff held two public scoping meetings: a webinar on October 19, 2023, and an in-person meeting on October 25, 2023, in Perry, Ohio (NRC 2023-TN9934). A summary of the comments received during the scoping process and NRC discussion are presented in their entirety in *Environmental Impact Statement Scoping Process, Summary Report, Perry Plant Nuclear Power Plant Unit 1* (NRC 2024-TN10204), and in Appendix A of this supplemental environmental impact statement (SEIS).

A review team consisting of staff from the NRC participated in a remote audit during the week of January 22, 2024. The remote audit was supplemented by a site visit on February 1, 2024, and additional discussions before a formal exit meeting conducted on February 8, 2024. During the audit and site visit, the NRC staff met with plant personnel, reviewed specific documentation, and toured the facility. A summary of that audit and site visit, including a list of attendees, is contained in the *Perry Plant Nuclear Power Plant Unit 1 Summary of the License Renewal Environmental Audit* (NRC 2024-TN9935).

Upon completion of the scoping process and environmental audit, the NRC staff compiled its findings in the draft SEIS (Figure 1-1). This document is made available for public comment for 45 days. During this time, the staff will host public meetings and collect public comments. Based on the information gathered, the NRC staff will amend the draft SEIS findings, as necessary, and publish the final SEIS for LR.

The NRC has a LR review process that can be completed in a reasonable period with clear requirements to assure safe nuclear power plant operation for up to an additional 20 years. The safety and environmental reviews are conducted simultaneously. The findings of the safety review are documented in a safety evaluation report (SER) and the findings of the environmental review in a SEIS. The findings in the SER and SEIS are both factors in the NRC's decision to either grant or deny the renewed operating license. The SER and the SEIS schedules are provided on the project website: https://www.nrc.gov/reactors/operating/licensing/renewal/applications/perry.html.

1.4 Generic Environmental Impact Statement

The NRC staff performed a generic assessment of the environmental impacts associated with LR to improve the efficiency of its LR review. The *Generic Environmental Impact Statement for License Renewal of Nuclear Power Plants* (LR GEIS), NUREG-1437, Revision 1 (NRC 2013-TN2654) 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 arrived at generic findings for those environmental issues that could be resolved generically in the LR GEIS.

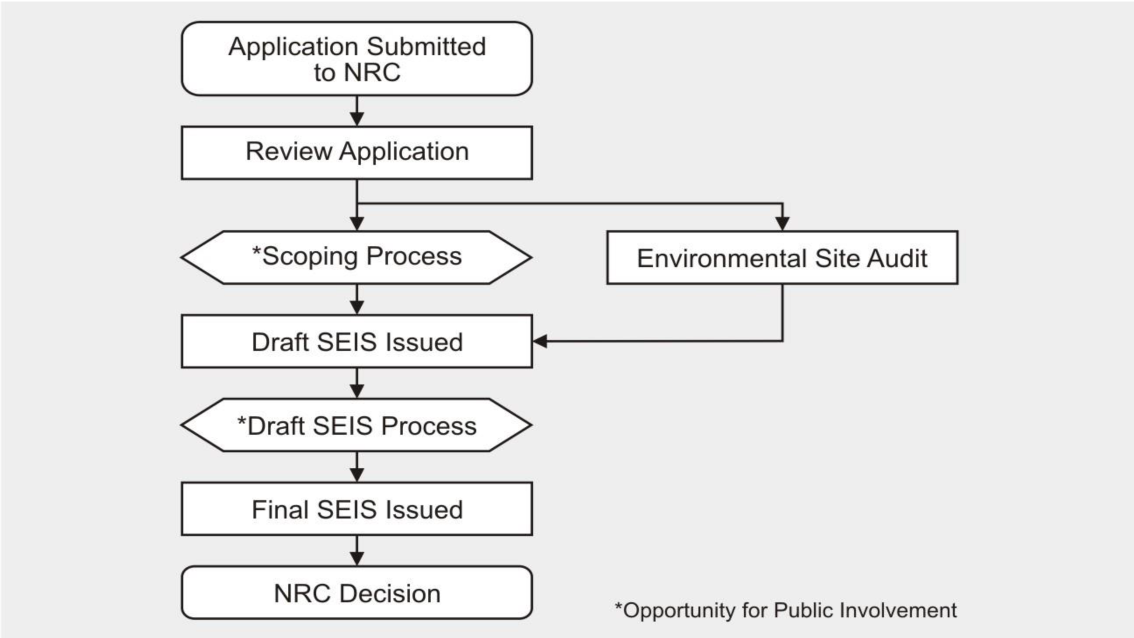


Figure 1-1 Environmental Review Process

The LR GEIS establishes separate environmental impact issues for the NRC staff to independently evaluate. Of these issues, the NRC staff determined that some issues are generic to all plants (Category 1). Other issues do not lend themselves to generic consideration (Category 2 or uncategorized). The NRC staff evaluates these issues on a site-specific basis in a SEIS to the LR GEIS. Appendix B to Subpart A of 10 CFR Part 51 (TN250) provides a summary of the staff findings in the LR GEIS.

For each potential environmental impact issue in the LR GEIS, the NRC staff performs 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 nuclear power plants
- considers whether additional mitigation measures would be warranted for impacts that would have the same significance level for all nuclear power plants

The NRC established three levels of significance for potential impacts—SMALL, MODERATE, and LARGE. The definitions are listed below.

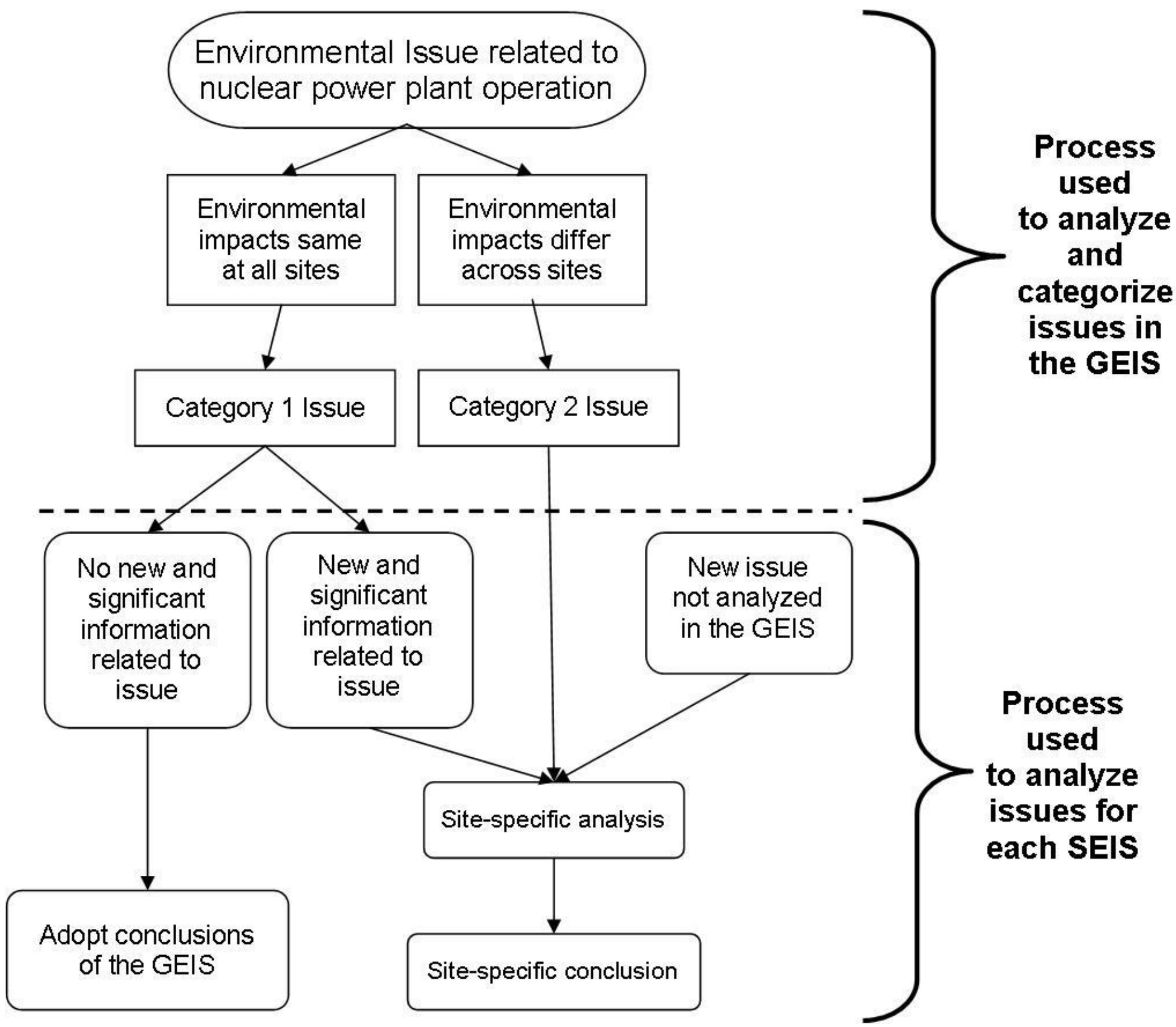
> **SMALL:** Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.

> **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.

Figure 1-2 illustrates the LR environmental review process. The results of that site-specific review are documented in this SEIS. The LR GEIS includes a determination of whether the analysis of the environmental issue could be applied to all plants and whether additional mitigation measures would be warranted. Issues are assigned a Category 1 or Category 2 designation. As set forth in the LR 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 nuclear power plants or, for some issues, to nuclear power 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 nuclear power plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation.



The LR GEIS evaluated 78 issues. Site-specific analysis is required for 17 of those 78 issues.

Figure 1-2 Environmental Issues Evaluated for License Renewal

For generic issues (Category 1), no additional site-specific analysis is required in the SEIS unless new and significant information is identified. The process for identifying new and significant information is presented in Chapter 3. 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.

> **New information** can be identified from many sources, including the applicant, the NRC, other agencies, or public comments. If a new issue is revealed, it is first analyzed to determine whether it is within the scope of the license renewal environmental evaluation. If the new issue is not addressed in the LR GEIS, the NRC staff would determine the significance of the issue and document the analysis in the SEIS.

> **New and significant information** either identifies a significant environmental issue that was not covered in the LR GEIS or was not considered in the analysis in the LR GEIS and leads to an impact finding that is different from the finding presented in the LR GEIS.

On August 6, 2024, the NRC published a final rule (89 FR 64166-TN10321) revising its environmental protection regulations in 10 CFR Part 51, “Environmental protection regulations for domestic licensing and related regulatory functions.” Specifically, the final rule updates the potential environmental impacts associated with the renewal of an operating license for a nuclear power plant for up to an additional 20 years, which could either be an initial or subsequent license renewal. The technical basis for the final rule is provided by Revision 2 to NUREG-1437, “Generic Environmental Impact Statement for License Renewal of Nuclear Plants” (the 2024 LR GEIS; NRC 2024-TN10161), which updates NUREG-1437, Revision 1 (the 2013 LR GEIS; NRC 2013-TN2654). Appendix G of this SEIS provides a crosswalk of the new and modified issues under the 2024 LR GEIS and final rule. As discussed in Appendix G, the site-specific analyses and findings in this SEIS bound the scope and associated impact findings for new and modified Category 1 and Category 2 environmental issues specified in the 2024 LR GEIS and final rule.

1.5 Supplemental Environmental Impact Statement

The SEIS presents an analysis that considers the environmental effects of the continued operation of Perry Plant, alternatives to LR, and mitigation measures for minimizing adverse environmental impacts. Chapter 2 describes the proposed action and alternatives. Chapter 3 contains analysis and comparison of the potential environmental impacts from alternatives, while Chapter 4 presents the preliminary recommendation of the NRC on whether the environmental impacts of LR are so great that preserving the option of LR would be unreasonable. The final recommendation will be made after consideration of comments received on the draft SEIS during the public comment period.

To prepare the SEIS for Perry Plant, the NRC staff carried out the following activities:

- examined the analysis and findings in NUREG-1437
- reviewed the information provided in the applicant’s ER
- consulted with other Federal, State, and local agencies and Native American Tribes
- conducted an independent evaluation of the issues during the site audit
- considered the public comments received for the review (during the scoping process)
- evaluated new and significant information

1.6 Decision to Be Supported by the SEIS

The decision to be supported by the SEIS is whether to renew the operating license for Perry Plant for an additional 20 years. The NRC decision standard is specified in 10 CFR 51.103 (TN250):

> In making a final decision on a license renewal action pursuant to Part 54 of this chapter, the Commission shall determine whether or not the adverse environmental impacts of license renewal are so great that preserving the option of license renewal for energy planning decisionmakers would be unreasonable.

In the statement of consideration for 10 CFR Part 51 (TN250), the Commission further explained:

> Given the uncertainties involved and the lack of control that the NRC has in the choice of energy alternatives in the future, the Commission believes that it is reasonable to exercise its NEPA authority to reject license renewal applications only when it has determined that the impacts of license renewal sufficiently exceed the impacts of all or almost all of the alternatives that preserving the option of license renewal for future decision makers would be unreasonable.

The analyses of environmental impacts evaluated in this SEIS will provide the NRC's decisionmaker (in this case, the Commission) with important environmental information for use in the overall decision-making process. There are decisions that are made outside the regulatory scope of LR. These include decisions related to (1) changes to plant cooling systems, (2) disposition of spent nuclear fuel, (3) emergency preparedness, (4) safeguards and security, (5) need for power, and (6) seismicity and flooding (NRC 2013-TN2654).

1.7 Cooperating Agencies

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

1.8 Consultations

The Endangered Species Act of 1973 (TN1010), as amended (ESA); Magnuson-Stevens Fishery Conservation and Management Act (MSA), as amended by the Sustainable Fisheries Act of 1996 (16 U.S.C. § 1801 et seq.) (TN9966, TN1061); and the National Historic Preservation Act of 1966 (TN4157) require that Federal agencies consult with applicable State and Federal agencies and groups prior to taking action that may affect endangered species, fisheries, and historic and archaeological resources, respectively. Appendix C includes copies of consultation documents.

1.9 Correspondence

Appendix D contains a chronological list of documents sent and received during the environmental review.

1.10 Status of Compliance

The applicant is responsible for complying with all NRC regulations and other applicable Federal, State, and local requirements. Appendix F of the LR GEIS describes some of the major applicable Federal statutes.

There are numerous permits and licenses issued by Federal, State, and local authorities for activities at Perry Plant. Appendix B of this SEIS contains further discussion about Perry Plant status of compliance.

1.11 Related Federal and State Activities

The NRC reviewed the possibility that activities of other Federal agencies might impact the renewal of the operating license for Perry Plant. 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 Tribal-owned lands or lands held in federal trust for Tribes within 50 miles (mi) (80 kilometers [km]) of Perry Plant. Consistent with Section 3.16, "Cumulative Effects of the Proposed Action," no Federal project was identified for which EISs would be prepared that might impact the renewal of the operating license for Perry Plant.

The NRC is required under Section 102(2)(C) of NEPA (TN661) to consult with and obtain the comments from any Federal agency that has jurisdiction by law or special expertise with respect to any environmental impact involved in the subject matter of the EISs. For example, during the preparation the SEIS, the NRC consulted with the U.S. Fish and Wildlife Service and the Ohio History Connection. Appendix C contains a complete list of all key consultation correspondence.

2 ALTERNATIVES INCLUDING THE PROPOSED ACTION

Although the NRC's decision-making authority in license renewal (LR) is limited to deciding whether to renew a nuclear power plant's operating license, the agency's implementation of the National Environmental Policy Act of 1969, as amended (National Environmental Policy Act of 1969-TN661), requires consideration of the environmental impacts of potential alternatives to renewing a plant's operating license. Although the ultimate decision about which alternative (or the proposed action) to implement falls on the operator, State, or other non-NRC Federal officials, comparing the impacts of renewing the operating license to the environmental impacts of alternatives allows the NRC to determine whether the environmental impacts of LR are so great that preserving the option of LR for energy-planning decision-makers would be unreasonable (10 CFR 51.95(c)(4)) (TN250).

Energy-planning decision-makers and owners of the nuclear power plant decide whether the nuclear plant will continue to operate, and economic and environmental considerations play important roles in making this decision. In general, the NRC's responsibility is to ensure the safe operation of nuclear power facilities, not to formulate energy policy or encourage or discourage the development of alternative power generation. The NRC does not engage in energy-planning decisions, and it makes no judgment about which energy alternatives evaluated would be the most likely alternative in any given case.

The remainder of this chapter provides (1) a description of the proposed action, renewal of the Perry Plant Unit 1 license; (2) a description of alternatives to the proposed action (including the no-action alternative); and (3) alternatives to the proposed action that the NRC staff considered and eliminated from detailed study.

2.1 Description of Nuclear Power Plant Facility and Operation

This section describes the Perry Plant operating systems, infrastructure, operations, and maintenance. A more detailed description of the Perry Plant facility and operation is found in VistraOps' ER, part of its LRA.

2.1.1 External Appearance and Setting

Perry Plant occupies a site on the southeastern shore of Lake Erie in Lake County, Ohio (Figure 2-1). The 6 mi (10 km) radius around Perry Plant can be seen in Figure 2-2. The 50 mi (80 km) radius around Perry Plant can be seen in Figure 2-3.

Figure 2-1 Perry Nuclear Power Plant Layout. Source: EH 2023-TN9534.

Figure 2-2 **Perry Nuclear Power Plant 6 mi (10 km) Radius Map. Source: EH 2023-TN9534.**

Figure 2-3 **Perry Nuclear Power Plant Site and 50 mi (80 km) Radius. Source: EH 2023-TN9534.**

2.1.2 Nuclear Reactor Systems

Perry Plant is a single unit plant with a domed cylindrical steel containment vessel. The plant has a boiling water reactor (BWR) nuclear steam supply system designed and supplied by the General Electric Company and designated BWR-6, with a Mark III containment. The NRC issued an operating license for Unit 1 in March 1986, and commercial operation began in November 1987. Perry Plant performed a 5 percent increase in rated core power uprate in the year 2000 to increase the maximum reactor core power level for facility operation from 3,579 megawatts thermal (MWt) to 3,758 MWt. The net electrical output is 1,277 megawatts electric (MWe), and the gross electrical output is 1,327.6 MWe (EH 2023-TN9534). Perry Plant uses low-enriched uranium dioxide (limited to 5 percent by weight uranium-235) fuel clad in Zircaloy. Refueling occurs approximately every 24 months (EH 2023-TN9534).

Perry was originally designed as a two-unit installation, but construction on Unit 2 was suspended in 1985 and formally cancelled in 1994. At the time of cancellation, all of the major buildings and structures for the second unit were completed, including the 500-foot tall (150 m) cooling tower.

2.1.3 Cooling and Auxiliary Water Systems

Perry Plant uses a closed-cycle cooling system featuring a natural draft cooling tower. Makeup water for the cooling system comes from Lake Erie through a submerged intake. The circulating water system provides cooling water to the main and auxiliary condensers. Auxiliary water systems include the service water systems, closed cooling water systems, demineralized water system, fire water system, potable water system, and ultimate heat sink. Chemicals and biocide are used to clean the main condenser tubes, and anti-scaling chemicals are added into the circulating water system as needed to prevent scale deposition on heat exchanger surfaces. The circulating water system and plant effluent water, which consists of both the cooling water discharge and the circulating water blowdown, are checked to ensure discharge effluent water is maintained in accordance with Perry Plant’s National Pollutant Discharge Elimination System (NPDES) permit.

2.1.3.1 Service Water Systems

Perry Plant’s service water is obtained from Lake Erie 2,600 feet (ft) (790 m) offshore and carried to the plant using an intake tunnel in the underlying bedrock. The water is returned to the lake after cooling through a comparable discharge tunnel. The service water system is non-safety-related and unnecessary for safe shutdown of the reactor. The emergency service water (ESW) system is a once-through system that supplies cooling water to equipment for both normal and emergency shutdown of the reactor. The emergency service water pumps can be found in the emergency service water pumphouse and withdraw water from Lake Erie. The system is designed with redundancy to ensure heat removal capability during shutdown, hot standby, accident conditions, and refueling operations. The quality of the discharged effluent water is maintained in accordance with Perry Plant’s NPDES permit.

2.1.3.2 Closed Cooling Water Systems

The closed cooling water systems include the nuclear closed cooling system, the turbine building closed cooling system, and the emergency closed cooling system. The nuclear closed cooling system supplies cooling water to the auxiliary nuclear plant equipment. The system consists of a closed loop that acts as a barrier to stop direct leakage of reactor water into the service water system. During normal operation, water is supplied from the service water system to the closed-loop heat exchangers. Demineralized water is used for initial system operation and system makeup. Chemical addition to the system is used to maintain quality (EH 2023-TN9534).

The turbine building closed cooling system supplies cooling water to the turbine plant components. The system is a closed cycle where treated condensate water is cooled with lake water in a heat exchanger. The shell and tube type heat exchangers have lake water in the tubes and closed cooling water in the shell (EH 2023-TN9534).

The emergency closed cooling system supplies cooling water to safety-related components necessary for specific modes of normal reactor operation, accident conditions, and loss of normal auxiliary power. The system has two independent loops. Each loop consists of a pump, heat exchanger, and surge tank. A chemical addition tank is shared by both loops. When needed, the system supplies cooling water during operation of the residual heat removal system, as well as portions of the emergency core cooling system for hot standby, normal shutdown, loss-of-coolant accident, and under loss of normal alternating current power (EH 2023-TN9534).

2.1.3.3 Demineralized Water System

Lake Erie supplies water to the demineralized water makeup system through the service water system. There is an alternate water supply from the potable water system. Lake Erie water is pretreated and transferred to the clearwell. The clearwell is used for miscellaneous services in the plant, plus the demineralizers. The system is not safety related but is designed to produce adequate water to meet plant makeup requirements (EH 2023-TN9534).

2.1.3.4 Fire Water System

Lake Erie supplies the water supply for fire protection. The fire protection program detects and suppresses fires that would endanger systems required for safe plant shutdown. The fire pumps are in the emergency service water pumphouse and are designed for automatic or manual starting.

2.1.3.5 Potable Water System

Hot and cold water is supplied and distributed throughout the plant by the potable water system for both potable and sanitary purposes. The supply of potable and sanitary water is acquired from the Lake County Department of Utilities. To inhibit flow from the site to the offsite water supply, backflow preventers have been placed in the system connection to the offsite water source (EH 2023-TN9534).

2.1.3.6 Ultimate Heat Sink

Heat discarded from the turbine cycle during normal operation is released to the atmosphere through a natural draft cooling tower. During startup, shutdown, and emergency operation, heat is provided to Lake Erie through the ESW system. This system draws water from the lake, cools the plant, and returns the water to the lake.

2.1.4 Radioactive Waste Management Systems

The NRC licenses nuclear power plants with the expectation that they will release a limited amount of radioactive material to both the air and water during normal operations. Perry Plant uses liquid, gaseous, and solid waste processing systems to collect and treat, as needed, radioactive materials produced as a byproduct of nuclear power plant operations. Section 2.2.6 of the VistraOps ER, submitted as part of its LRA, provides an expanded description of Perry Plant's radioactive waste management systems (EH 2023-TN9534: Section 2.2.6, pp. 2-15 to 2-21). The NRC staff discusses the radioactive waste management systems in Section 3.13.1, "Radioactive Waste" of this SEIS.

2.1.5 Nonradioactive Waste Management Systems

Perry Plant generates nonradioactive waste as a result of nuclear power plant maintenance, cleaning, and operational processes. Perry Plant manages nonradioactive wastes in accordance with applicable Federal and State regulations, as implemented through its corporate procedures. Section 2.2.7 of the VistraOps ER, submitted as part of its LRA, provides an expanded description of Perry Plant's nonradioactive waste management systems (EH 2023-TN9534: Section 2.2.7, p. 2-21). The NRC staff discusses the nonradioactive waste management systems in Section 3.13.2, "Nonradioactive Waste," of this SEIS.

2.1.6 Utility and Transportation Infrastructure

The utility and transportation infrastructure at Perry Plant interfaces with public infrastructure systems available in the region. Such infrastructure includes utilities, such as suppliers of electricity, fuel, and water, as well as roads and railroads that provide access to the Perry Plant site. The following sections briefly describe the existing utility and transportation infrastructure at Perry Plant. Site-specific information in this section is derived from VistraOps' ER unless otherwise cited.

2.1.6.1 Electricity

Nuclear power plants generate electricity for other users, but they also use electricity to operate. Offsite power sources provide power to engineered safety features and emergency equipment in the event of a malfunction or interruption of power generation at the plant. If power is interrupted, planned independent backup power sources provide power from both the plant itself and offsite power sources.

2.1.6.2 Fuel

Perry Plant utilizes low-enriched uranium dioxide fuel with enrichments below 5.0 percent by weight uranium-235 clad with Zircaloy. A refueling outage is scheduled approximately every 24 months. During each core reload, one-third of the core is removed and replaced with an equal number of fresh or reinserted bundles. Perry Plant stores spent fuel in the spent fuel pool or in dry cask storage containers at the onsite independent spent fuel storage installation (ISFSI).

2.1.6.3 Water

Perry Plant obtains its potable and sanitary water from the Lake County Department of Utilities. Perry Plant uses a closed-cycle cooling system with a natural draft cooling tower. Makeup water for the cooling system is obtained from Lake Erie.

2.1.6.4 Transportation Systems

Nuclear power plants are served by controlled access roads that are connected to U.S. highways and interstate highways. In addition to roads, many plants also have railroad connects for moving heavy equipment and other materials. Section 3.10.6, “Local Transportation,” describes the Perry Plant transportation systems.

2.1.6.5 Power Transmission Systems

For the LR, the NRC evaluates, as part of the proposed action, the continued operation of the Perry Plant power transmission lines that connect to the substation where it feeds the electricity into the regional power distribution system (NRC 2013-TN2654). The transmission lines that are in scope for the Perry Plant LR environmental review are onsite and are not accessible to the general public. The NRC also considers the continued operation of the transmission lines that supply outside power to the nuclear power plant from the grid. Sections 3.11.4 and 3.11.5 further describe these transmission lines.

2.1.7 Nuclear Power Plant Operations and Maintenance

Maintenance activities conducted at Perry Plant include inspection, testing, and surveillance to maintain the current licensing basis of the facility and to ensure compliance with environmental and safety requirements. These activities include in-service inspections of safety related structures, systems, and components (SSCs); quality assurance and fire protection programs; and radioactive and nonradioactive water chemistry monitoring.

Additional programs include those implemented to meet technical specification surveillance requirements and those implemented in response to NRC generic communications. Such additional programs include various periodic maintenance, testing, and inspection procedures necessary to manage the effects of aging on structures and components. Certain program activities are performed during the operation of the units, whereas others are performed during 24-month scheduled refueling outages (EH 2023-TN9534: Section 2.2.2)

2.2 Proposed Action

As stated in Section 1.1, the NRC’s proposed Federal action is to decide whether to renew the Perry Plant’s operating license for an additional 20 years. Section 2.1.1 provides a description of normal nuclear power plant operations during the LR term.

2.2.1 Plant Operations During the License Renewal Term

Nuclear power plant operation activities during the LR term would be the same as, or similar to, those occurring during the current license term. Section 2.1, “Description of Nuclear Power Plant Facility and Operation,” describes the general types of activities carried out during nuclear power plant operations. As part of its LRA, VistraOps submitted an ER stating that Perry Plant will continue to operate during the LR term in the same manner as it would during the current license term except for additional aging management programs, as necessary (EH 2023-TN9534). Such programs would address structure and component aging in accordance with 10 CFR Part 54 (TN4878), “Requirements for Renewal of Operating Licenses for Nuclear Power Plants.”

2.2.2 Refurbishment and Other Activities Associated with License Renewal

Refurbishment activities include replacement and repair of major SSCs. The major refurbishment class of activities characterized in the LR GEIS 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 BWR recirculation piping and pressurized water reactor steam generators. 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.

In preparation for its LRA, VistraOps performed an evaluation of the SSCs, in accordance with 10 CFR 54.21 (TN4878), to identify the need to undertake any major refurbishment activities that would be necessary to support the continued operation of Perry Plant during the proposed 20-year period of extended operation.

As a result of its evaluation of SSCs, VistraOps did not identify the need to undertake any major refurbishment or replacement activities associated with LR to support the continued operation of Perry Plant beyond the end of the existing operating license. Therefore, refurbishment activities are not discussed under the proposed action in Chapter 3.

2.2.3 Termination of Nuclear Power Plant Operation and Decommissioning After the License Renewal Term

NUREG-0586, Supplement 1, Volumes 1 and 2, Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities: Regarding the Decommissioning of Nuclear Power Reactors (the decommissioning GEIS) (NRC 2002-TN665), describes the impacts of decommissioning. The majority of plant operational activities would cease with reactor shutdown. However, some activities (e.g., security and oversight of spent nuclear fuel) would remain unchanged, whereas others (e.g., waste management, administrative work, laboratory analysis, surveillance, monitoring, and maintenance) would continue at reduced or altered levels. Systems dedicated to reactor operations would cease operations. However, if these systems are not removed from the site after reactor shutdown, their physical presence may continue to affect the environment. Impacts associated with dedicated systems that remain in place, or with shared systems that continue to operate at normal capacities, could remain unchanged.

As discussed during the audit, approximately every 2 to 3 years the site retrieves sediment from the ESW and Service Water Pump House (forebays and pump bays) to facilitate fluid flow and system operations. The removed material is stored in the Chemical Cleaning Lagoon and Unit 2 Circulating Water System Pumphouse flume area. The material is characterized, and the data is logged in the site 10 CFR 50.75(g) (TN249) file, which will be used to inform decommissioning activities (Vistra 2024-TN9925).

Decommissioning will occur whether Perry Plant is shut down at the end of its current operating license or at the end of the period of extended operation 20 years later. The LR GEIS concludes that LR would have a negligible (SMALL) effect on the impacts of terminating operations and decommissioning on all resources (NRC 2013-TN2654).

2.3 Alternatives

As stated above, NEPA requires the NRC to consider reasonable alternatives to the proposed action renewing the Perry Plant operating license. For a replacement energy alternative to be reasonable, it must be either (1) commercially viable on a utility scale and operational before the reactor's operating license expires or (2) expected to become commercially viable on a utility scale and operational before the reactor's operating license expires.

The first alternative to the proposed action, renewing the Perry Plant operating license, is for the NRC to not issue the license. This is called the no-action alternative and is described in Section 2.3.1. In addition to the no-action alternative, this section discusses two reasonable replacement energy alternatives. As described in Section 2.3.2, these alternatives seek to replace Perry Plant's generating capacity by meeting the region's energy needs through other means or sources.

2.3.1 No-Action Alternative

At some point, all operating nuclear power plants will permanently cease operations and undergo decommissioning. Under the no-action alternative, the NRC does not renew the Perry Plant operating license, and the reactor unit would shut down at or before the expiration of the current license.

After permanent reactor shutdown, nuclear power plant operators will initiate decommissioning in accordance with 10 CFR 50.82 (TN249), "Termination of License." The decommissioning GEIS (NUREG-0586) (NRC 2002-TN665) describes the environmental impacts from decommissioning a nuclear power plant and related activities. The analysis in the decommissioning GEIS bounds the environmental impacts of decommissioning when VistraOps terminates reactor operations at Perry. A licensee in decommissioning must assess in its post-shutdown decommissioning activities report submitted to the NRC, whether there are planned decommissioning activities with reasonably foreseeable environmental impacts that are not bounded in previous EISs. Section 3.15.2, "Terminating Plant Operations and Decommissioning," describes the incremental environmental impacts of LR on decommissioning activities.

Termination of reactor operations would result in the total cessation of electrical power production at Perry Plant. Unlike the replacement energy alternatives described in Section 2.3.2, the no-action alternative does not meet the purpose and need of the proposed action, as described in Section 1.2, because the no-action alternative does not provide a means of delivering baseload power to meet future electric system needs. Assuming that a need currently exists for the electrical power generated by Perry Plant, the no-action alternative would likely create a need for replacement energy.

2.3.2 Replacement Power Alternatives

The following sections describe replacement energy alternatives. The potential environmental impacts of these alternatives are described in Chapter 3. Although the NRC's authority only extends to deciding whether to renew the Perry Plant operating license, the replacement energy alternatives represent possible options for energy-planning decision-makers to consider if the operating license is not renewed. In evaluating replacement energy alternatives, the NRC considered energy technologies in commercial operation, as well as technologies likely to be commercially available by the time the current operating license expires. Because energy technologies continually evolve in capability and cost, and because regulatory structures change to either promote or impede the development of certain technologies, the evaluation determined which replacement energy alternatives would be available and commercially viable when the operating license expires. VistraOps' ER describes possible replacement energy alternatives. In addition, the alternatives considered information from the following sources:

- U.S. Department of Energy's (DOE), U.S. Energy Information Administration (EIA)
- other DOE offices
- the U.S. Environmental Protection Agency (EPA)
- other Federal agency and national laboratory publications
- industry sources and publications

In total, 14 of 16 alternatives considered were eliminated from detailed study, leaving 2 replacement energy alternatives. The 2 replacement energy alternatives and 14 eliminated alternatives include the following:

- Alternatives to the proposed action:
  - natural gas-fired combined-cycle (NGCC)
  - renewable and natural gas combination
- Alternatives eliminated from detailed study:
  - new nuclear
  - solar power
  - wind power
  - biomass power
  - hydroelectric power
  - geothermal power
  - ocean wave, current, and tide energy
  - municipal solid waste-fired power
  - petroleum-fired power
  - coal-fired power
  - fuel cells
  - purchased power
  - delayed retirement of other power producing facilities
  - demand-side management/energy conservation/energy efficiency

The two replacement energy alternatives are described in Sections 2.3.2.1 and 2.3.2.2. Table 2-1 summarizes key characteristics of the replacement energy alternatives. Although they could potentially be considered in combination, alternatives that could not provide the equivalent of Perry Plant's current generating capacity were eliminated from detailed study. Alternatives whose costs or benefits could not justify inclusion in the range of reasonable alternatives and alternatives not likely to be constructed and operational by the time the Perry Plant operating license expire were also eliminated from detailed study. Section 2.4 briefly describes the 14 alternatives eliminated from detailed study and provides the basis for their elimination.

Table 2-1 Summary of Replacement Power Alternatives and Key Characteristics Considered in Detail for Perry Nuclear Power Plant

Key Characteristics	Natural Gas-Fired Combined-Cycle	Renewable and Natural Gas Combination
Summary of Alternative	The alternative would consist of an NGCC plant with multiple natural gas-fired turbines and steam generators with a design capacity of 1,350 MWe of generation.	The combination alternative would include a 764 MW NGCC plant, six solar installations totaling 750 MW (with 450 MW battery storage), and three wind installations totaling 540 MW.
Location	On the Perry Plant site or at another site previously used for energy generation.	The NGCC plant would be located on the Perry Plant site or at another site previously used for energy generation. The solar and wind portions of the alternative would be sited at multiple locations somewhere in Ohio.
Cooling System	The required NGCC cooling system components and features would use a closed-cycle cooling system with mechanical draft cooling towers and associated intake structures, discharge structures, the BDTF, and connective pipelines. Cooling water withdrawal for the NGCC plant is estimated be approximately 7.8 MGD or 2,838 MGY, while consumptive use would be an estimated 6 MGD or 2,200 MGY.	The NGCC plant would use closed-cycle cooling with mechanical draft cooling towers and associated intake structures, discharge structures, BDTF, and connected pipelines. Cooling water withdrawal for the NGCC plant is estimated to be 4.8 MGD or 1,745 MGY, and consumptive water use would be 3.7 MGD or 1,352 MGY. No cooling system would be required for solar or wind components.
Land Requirements	The NGCC plant would require approximately 60 ac (24 ha) of land either at the Perry Plant or at a site previously used for energy generation. A new gas pipeline may be needed for sites previously used for energy generation.	The NGCC plant would require approximately 60 ac (24 ha) of land either at the Perry Plant or at a site previously used for energy generation. A new gas pipeline may be needed for sites previously used for energy generation. The solar power portion would require a total of approximately 6,000 ac (2,428 ha)**.** The wind power portion would require a total of approximately 46,000 ac (18,600 ha). Assuming 25 mi (40 km) of new 345-kV transmission lines in a 150 ft (46 m) corridor for each of the six solar and three wind installations, would add an additional 4,090 ac (1,655 ha) of land. A small amount of additional land would be needed to support the battery storage system.
Workforce	The workforce needed for the NGCC would be approximately 1,200 workers during peak construction and 150 workers during operations.	The workforce needed for the NGCC portion of the combination alternative would be approximately 800 workers during peak construction and 100 workers during operations. For the solar portion, approximately 500 workers during peak construction and 60 workers during operations. The workforce needed for the wind portion would be approximately 330 workers during peak construction and 35 workers during operations.

ac = acre(s); BDTF = blowdown treatment facility; ft = foot (feet); ha = hectare(s); m^3 = cubic meter(s); MGD = million(s) of gallons per day; mi = mile(s); MW = megawatt(s); MWe = megawatt(s) electric; NGCC = natural gas-fired combined-cycle; MGY = million(s) of gallons per year; Perry Plant = Perry Nuclear Power Plant.

The NRC assigns a significance level of SMALL, MODERATE, or LARGE for most site-specific issues. For ecological resources subject to the ESA as amended (Endangered Species Act of 1973-TN1010) and the MSA, as amended by the Sustainable Fisheries Act of 1996 (16 U.S.C. § 1801 et seq.) (TN9966, TN1061), and historic and cultural resources subject to the National Historic Preservation Act of 1966 (NHPA) (54 U.S.C. 300101 et seq.-TN4157), the impact significance determination language is specific to the authorizing legislation. The order in which this SEIS presents the different alternatives does not imply increasing or decreasing level of impact, nor does the order imply that an energy-planning decision-maker would be more (or less) likely to select any given alternative.

2.3.2.1 Natural Gas-Fired Combined-Cycle

This alternative would involve the construction and installation of multiple natural gas-fired turbines and steam generators with associated support structures, including exhaust stacks and mechanical draft cooling towers (MDCTs) on the Perry Plant site or at another site previously used for energy generation. This facility would have a design capacity of 1,350 MWe of generation to replace the 1,175 MWe of the existing Perry Plant (EH 2023-TN9534).

The new NGCC power plant would require approximately 60 ac (24 ha) of land according to the applicant's ER, and little to no additional land would be needed for new infrastructure. Additionally, a natural gas pipeline crosses the Perry Plant site requiring minimal new pipeline infrastructure. A new natural gas pipeline may be needed for other sites previously used for energy generation.

2.3.2.2 Renewable and Natural Gas Combination

This alternative would involve the construction and installation of a 764 MW NGCC plant, six 125 MW solar installations with battery storage, and three wind installations totaling 540 MW. For the solar installations, a total of 450 MW of battery backup is assumed, using DOE estimates of 60 MW of battery storage for each 100 MW of installed solar (DOE 2019-TN9717). Both the solar and wind portions of the combination alternative would be sited at multiple offsite locations somewhere in Ohio.

The new NGCC plant would require approximately 60 ac (24 ha), according to the applicant's ER, and would be located on the Perry Plant site or at a site previously used for energy generation. Little to no additional land would be needed for new infrastructure. Additionally, a natural gas pipeline crosses the Perry Plant site, requiring minimal new pipeline infrastructure. A new natural gas pipeline may be needed for other sites previously used for energy generation.

Solar power generation would require a total of approximately 6,000 ac (2,428 ha) (assuming 8 ac/MW, for 750 MW) or 1,000 ac (405 ha) per installation. Using DOE's estimates of land use for wind power projects (85 ac [34 ha] per MW for wind farms, 2.47 ac [1 ha] per MW for construction footprint, and 0.74 ac [0.3 ha] per MW for permanent structures) (DOE 2015-TN8757), wind power generation would require a total of approximately 46,000 ac (18,600 ha) or 15,300 ac (6,200 ha) per installation. Assuming 25 mi (40 km) of new 345-kV transmission lines in a 150 ft (46 m) corridor for each of the six solar and three wind installations, an additional 4,090 ac (1,655 ha) of land would be needed. A small amount of additional land would be needed to support the battery storage system.

2.4 Alternatives Considered but Dismissed

Fourteen alternatives were eliminated from detailed study due to resource availability and commercial or regulatory limitations when the current Perry Plant operating license expires. This section briefly describes the 14 alternatives as well as the reasons underlying their elimination from the detailed study.

2.4.1 New Nuclear

While a new nuclear alternative (i.e., new small modular reactors) has been considered in other LR reviews, the Perry Plant operating license currently expires in 2026, which is not enough time to construct a replacement power plant. As stated previously, for a replacement energy alternative to be reasonable, it must be either (1) commercially viable on a utility scale and operational before the reactor's operating license expires or (2) expected to become commercially viable on a utility scale and operational before the reactor's operating license expires. Based on the expiration date for the Perry Plant's current operating license, licensing, constructing, and operating a replacement nuclear power plant by the time the Perry Plant operating license expires in 2026 is unfeasible, and is therefore not a reasonable alternative.

2.4.2 Solar Power

Solar power, including photovoltaic and concentrating solar power technologies, generates power from sunlight. Solar photovoltaic components convert sunlight directly into electricity using solar cells made from silicon or cadmium telluride. Concentrating solar power uses heat from the sun to boil water and produce steam. Steam drives a turbine connected to a generator to produce electricity (NREL Undated-TN7710).

Solar generators are considered an intermittent electrical power resource because their availability depends on exposure to the sun, also known as solar insolation. To be viable, a utility-scale solar alternative must replace the amount of electrical power that Perry Plant currently provides. Assuming a capacity factor of 25 percent (DOE/EIA 2023-TN8821), approximately 4,700 MW of additional solar energy capacity would need to be installed to replace the 1,175 MWe of Perry Plant's generating capacity. Based on an estimate of 8 ac (3 ha) of land per MW in Ohio, this would require over 37,000 ac (14,973 ha) of land (FD 2021-TN9549).

Based on this information, a utility-scale solar energy alternative would not be a reasonable alternative to Perry Plant's LR. However, a limited amount of solar power generation, in combination with other energy generating technologies, could be a reasonable alternative to Perry Plant's LR, as explained in Section 2.3.2.2.

It is unlikely that Perry Plant's generating capacity would be replaced by intermittent electricity generation, including utility-scale baseload solar. A combination of energy generating sources discussed in Section 2.3.2.2 such as natural gas, wind, solar, and battery backup, would complement each other and reduce intermittent electricity generation issues.

The resource requirements of a standalone baseload solar energy alternative would be similar to those described in Section 2.3.2.2, although the magnitude would differ based on the amount of solar energy capacity to be constructed. As a result, a standalone baseload solar alternative was considered but eliminated from detailed analysis.

2.4.3 Wind Power

As is the case with other renewable energy sources, the feasibility of wind energy providing baseload power depends on the location (relative to electricity users), value, accessibility, and constancy of the resource. Wind energy must be converted to electricity at or near the point where it is used, and there are limited energy storage opportunities available to overcome the intermittency and variability of wind resources.

The American Clean Power Association reports a total of more than 122,000 MW of installed wind energy capacity nationwide as of December 31, 2020 (DOE Undated-TN8431). To be considered a reasonable replacement energy alternative to Perry Plant's LR, a wind power alternative must replace the amount of electrical power that Perry Plant provides. Assuming a capacity factor of 41.4 percent for onshore wind facilities, land-based wind energy facilities would need to generate 2,800 MW of electricity to replace 1,175 MWe of Perry Plant's generating capacity (DOE 2021-TN9562). Based on DOE estimates of 85 ac/MW (34 ha/MW) for wind farm boundaries, 2.47 ac/MW (1 ha/MW) for construction footprint, and 0.74 ac/MW (0.3 ha/MW) for permanent structures, nearly 250,000 total ac (101,171 ha) of land would be required (DOE 2015-TN8757). Additionally, because wind is an intermittent energy source, energy storage would be needed, increasing land requirements.

It is unlikely that Perry Plant's generating capacity would be replaced by intermittent electricity generation, including utility-scale baseload wind power. A combination of energy generating sources discussed in Section 2.3.2, such as natural gas, wind, solar, and battery backup, would complement each other and reduce intermittent electricity generation issues.

The resource requirements of a standalone baseload wind energy alternative would be similar to those described in Section 2.3.2.2, although the magnitude would differ based on the amount of wind energy capacity to be constructed. As a result, a standalone baseload wind alternative was considered but eliminated from detailed analysis.

2.4.4 Biomass Power

Biomass fuels used for power generation include agricultural residues, animal manure, wood wastes from forestry and industry, residues from food and paper industries, municipal green wastes, dedicated energy crops, and methane from landfills (IEA 2007-TN8436). Baseload biomass fuel-fired power generation depends on the geographic distribution, available quantities, constancy of supply, and energy content of biomass resources. As of 2022, there were 11 utility-scale biomass fueled power plants in Ohio, comprising one-tenth of Ohio's total renewable electricity generation (EIA 2023-TN9563). For this analysis, biomass fuel would be combusted for power generation in the electricity sector.

For utility-scale biomass fuel-fired electricity generation, technologies used for biomass energy conversion would be similar to the technology used in other fossil fuel-fired power plants, including the direct combustion of biomass fuel in a boiler to produce steam (NRC 2013-TN2654). Accordingly, biomass electricity generation is considered a carbon emitting technology.

Biomass energy generation is generally more cost-effective when co-located with coal-fired power plants (IEA 2007-TN8436). However, most biomass fuel-fired power plants only generate 50 MWe, which means replacing Perry Plant's generating capacity, using only biomass fuel, would require the equivalent of 24 power plants.

Increasing biomass fuel-fired generation capacity by expanding existing or constructing new units by the time Perry Plant's operating license expires is unlikely. For these reasons, biomass fuel-fired power generation would not be a reasonable alternative to Perry Plant's LR.

2.4.5 Hydroelectric Power

There are about 2,000 operating hydroelectric power facilities in the United States. Hydropower technologies capture flowing water and direct it to turbine generators to produce electricity (NRC 2013-TN2654). There are three variants of hydroelectric power generation: (1) run of the river (diversion) facilities that redirect the natural flow of a river, stream, or canal through a hydroelectric power facility; (2) store and release facilities that block the flow of the river by using dams that cause water to accumulate in an upstream reservoir; and (3) pumped storage facilities that use electricity from other power sources to pump water to higher elevations during off peak hours to be released during peak load periods to generate electricity (EIA 2020-TN8352, EIA 2021-TN8353).

Although EIA projects hydropower will remain a leading source of renewable power generation in the United States through 2040, there is little expected new large-scale hydropower development (DOE/EIA 2013-TN2590). The potential for new large hydropower facilities has diminished out of public concern over flooding, habitat alteration and loss, and the impact on unaffected rivers (NRC 2013-TN2654).

Existing dams in Ohio with the greatest generation potential provide approximately 15 MWe. Therefore, such dams are unlikely to provide the scale of power needed to replace Perry Plant's power generation. Given the lack of growth in hydroelectric power, competing demands for water resources, and public opposition to the environmental impacts from the construction of large-scale hydroelectric power facilities, the use of hydroelectric power would not be a reasonable alternative to Perry Plant's LR.

2.4.6 Geothermal Power

Geothermal energy generating technologies extract heat from geologic formations to produce steam to drive steam turbine generators. Electricity production from geothermal energy has demonstrated 95 percent or greater capacity factors, making geothermal energy a potential source of baseload electric power. However, the feasibility of geothermal energy generation to provide baseload power depends on the accessibility of geothermal resources. Utility-scale geothermal resources are concentrated in the western United States, specifically Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming, and most assessments of geothermal energy generation resources have been conducted in these States (DOE Undated-TN7698; USGS 2008-TN7697). There is currently no utility-scale geothermal power production in Ohio. Given its low potential, geothermal energy generation would not be a reasonable alternative to Perry Plant's LR.

2.4.7 Ocean Wave, Current, and Tide Energy

Ocean waves, currents, and tides are generally predictable and reliable, making them attractive candidates for potential renewable energy generation. Four major technologies can be used to harness wave energy: (1) terminator devices that range from 500 kilowatts (kW) to 2 MW, (2) attenuators, (3) point absorbers, and (4) overtopping devices (BOEM Undated-TN7696). Point absorbers and attenuators use floating buoys to convert wave motion into mechanical energy, driving turbine generators to produce electricity. Overtopping devices trap a portion of a wave at a higher elevation than the sea surface; waves enter a tube and compress air that is then used to drive a turbine generator producing electricity (NRC 2013-TN2654). Some of these technologies are undergoing demonstration testing at commercial scales, but none of the technologies are currently used to provide baseload power (BOEM Undated-TN7696). In the United States, there are currently several projects licensed or seeking permits, the largest of which is 20 MW (Duke Energy 2021-TN8897).

While Perry Plant borders Lake Erie, application of wave energy technologies is unlikely to be viable, as wave and ocean energy-generation technologies are still in their infancy and currently lack commercial application (EPRI 2011-TN8442). For these reasons, wave and ocean energy generation would not be a reasonable alternative to Perry Plant's LR.

2.4.8 Municipal Solid Waste-to-Energy Power

Energy recovery from municipal solid waste converts nonrecyclable waste materials into usable heat, electricity, or fuel through combustion. Three types of municipal solid waste combustion technologies include mass burning, modular systems, and refuse derived fuel systems. Mass burning is the method used most frequently in the United States. The heat released from combustion is used to convert water to steam, which is then used to drive turbine generators to produce electricity. After combustion, ash is collected and taken to a landfill, and particulates are captured through a filtering system (EPA 2023-TN8443).

Currently, 75 waste-to-energy power plants are in operation in 21 States, processing approximately 29 million tons (26,308 kg) of waste per year. These waste-to-energy power plants have an aggregate capacity of 2,725 MWe (Michaels and Krishnan 2019-TN7700). Although some power plants have expanded to handle additional waste and to produce more energy, only one new municipal solid waste combustion power plant has been built in the United States since 1995 (Maize 2019-TN7699). Because the average waste-to-energy power plant only produces about 50 MWe, each unit would provide a very small portion of the energy currently produced by Perry Plant.

The decision to burn municipal solid waste to generate electricity is usually driven by the need for a waste disposal alternative to landfills rather than a need to generate energy. Stable supplies of municipal solid waste would be needed to support a new waste-to-energy power plant. Based on this information, municipal solid waste-to-energy power plants would not be a reasonable alternative to Perry Plant's LR.

2.4.9 Petroleum-Fired Power

The cost and environmental impacts of petroleum-fired electrical power generation tend to be greater than those for NGCC-based generation. Historically, the higher cost of oil has resulted in a steady decline in its use for electricity generation, and the EIA forecasts no increase in the use of petroleum-fired power plants through 2040 (DOE/EIA 2013-TN2590, DOE/EIA 2015-TN4585).

Based on cost and environmental impacts, petroleum-fired electricity generation would not be a reasonable alternative to Perry Plant's LR.

2.4.10 Coal-Fired Power

Although coal has historically been the largest source of baseload electric power generation in the United States, both natural gas and nuclear surpassed coal-fired power in 2020. Coal-fired electricity generation in the United States has continued to decrease as units have been retired or converted to other fuels and the remaining units have been used less often (DOE/EIA 2021-TN7718).

Baseload coal-fired power plants have proven their reliability and can routinely sustain capacity factors as high as 85 percent. Among the available technologies, pulverized-coal boilers producing supercritical steam (supercritical pulverized-coal boilers) have become more common, given their generally high thermal efficiencies and overall reliability.

Supercritical pulverized-coal facilities are more expensive to build than subcritical coal-fired power plants but consume less fuel per unit of energy output. Integrated gasification combined cycle merges modern coal gasification technology with both gas turbine and steam turbine power generation. The technology is cleaner than conventional pulverized-coal-fired power plants because some pollutants are removed before combustion. Although several smaller, integrated gasification combined-cycle power plants have been in operation since the mid-1990s, large-scale projects have experienced setbacks, and public opposition has hindered them from being fully integrated into the energy market.

As stated in the ER (EH 2023-TN9534), VistraOps currently operates two coal-fired power plants with a total of 2,790 MWe of baseload generation, and is considering selling or closing these power plants. Based on previous LR environmental reviews, including the review for the River Bend Station Unit 1 nuclear plant, coal-fired alternatives would have greater operating impacts than LR (NRC 2018-TN7313). Based on these considerations, new coal-fired replacement power plants would not be a reasonable alternative to Perry Plant's LR.

2.4.11 Fuel Cells

Fuel cells oxidize fuels without combustion and, therefore, without the environmental effects of combustion. Fuel cells use a fuel (e.g., hydrogen) and oxygen to create electricity through an electrochemical process. The only byproducts are heat, water, and carbon dioxide (depending on the hydrogen fuel type) (DOE Undated-TN7695). Hydrogen fuel can come from a variety of hydrocarbon resources, including natural gas. As of October 2020, the United States had only 250 MW of fuel cell power generation (EIA 2022-TN8955).

Currently, fuel cells are not economically or technologically competitive with other electricity generating alternatives. The EIA estimates that fuel cells may cost $6,639 per installed kilowatt (in 2021 dollars), which is high compared to other replacement energy alternatives (DOE/EIA 2022-TN7694). In June 2021, DOE launched an initiative to reduce the cost of hydrogen production to spur fuel cell and energy storage development over the next decade (DOE 2021-TN7693). It is unclear to what degree this initiative will lead to increased future development and deployment of fuel cell technologies.

More importantly, fuel cell units used for power production are likely to be small (approximately 10 MW). The world's largest industrial hydrogen fuel cell power plant is a 50 MWe plant in South Korea (Larson 2020-TN8401). Using fuel cells to replace the power that Perry Plant provides would require the construction of approximately 64 units. Given the limited deployment and high cost of fuel cell technology, fuel cells would not be a reasonable alternative to Perry Plant's LR.

2.4.12 Purchased Power

Electric power can be purchased and imported from outside the region during nuclear power plant maintenance and refueling outages. Although the importation of electric power would have no measurable environmental effect on the communities receiving and using the power, environmental impacts would be occurring where power is being generated. The impact significance would depend on the technologies used to generate the electric power.

Although it could potentially be used in combination with other alternatives, purchasing electric power off the grid under long-term contract generally costs more than generating the power (NRC 2013-TN2654). There is also the risk that the supplier may not be able to deliver all of the contracted power during peak demand. Based on these considerations, purchased power would not be a reasonable alternative to Perry Plant's LR.

2.4.13 Delayed Retirement of Other Generating Facilities

Delaying the retirement of a power generating facility provides for the continued supply of electricity. Due to new regulations requiring significant reductions in power plant emissions, some owners may opt to retire their older, less efficient units rather than incur the cost for compliance. Retirements may also be driven by low competing commodity prices (such as low natural gas prices), slow growth in electricity demand, and EPA's Mercury and Air Toxics Standards for fossil-fueled power plants (DOE/EIA 2015-TN4585; EPA 2020-TN8379, EPA 2024-TN10375).

VistraOps currently operates two other nuclear power plants; Beaver Valley Unit 1, which has its operating license expiring 2036 and Unit 2 in 2047; and Davis-Besse Nuclear Power Station's (Davis-Besse's) operating license expiring in 2037. VistraOps also operates two coal-fired plants, W.H. Sammis Power Plant and Pleasants Power Station, both of which are for sale or scheduled for closure. Although it could potentially be used in combination with other alternatives, delaying the retirement of power generating facilities could result in higher, less economical operating costs, and is therefore not considered to be a reasonable alternative to the proposed action.

2.4.14 Demand-Side Management/Energy Conservation/Energy Efficiency

Demand-side management refers to energy conservation and efficiency programs that do not require the addition of new generating capacity. Demand-side management programs can include reducing energy demand through consumer behavioral changes or through altering the characteristics of the electrical load. These programs can be initiated by a utility, transmission operators, the State, or other load serving entities. In general, residential electricity consumers have been responsible for the majority of peak load reductions, and participation in most demand-side management programs is voluntary (NRC 2013-TN2654).

Therefore, the existence of a demand-side management program does not guarantee that reductions in electricity demand will occur. The LR GEIS concludes that, although the energy conservation or energy efficiency potential in the United States is substantial, there have been no cases in which an energy efficiency or conservation program alone has been implemented expressly to replace or offset large baseload power generation (NRC 2013-TN2654). Therefore, baseload demand-side management programs alone would not be a reasonable alternative to Perry Plant's LR. However, in combination with other power generating technologies, demand-side management could be a reasonable alternative to Perry Plant's LR.

2.5 Comparison of Alternatives

In this chapter, the NRC staff present two alternatives to the proposed action (renewing the Perry Plant operating license): (1) NGCC and (2) renewable and natural gas combination (i.e., natural gas, wind, solar, and battery backup). Chapter 3 describes the environmental impacts of the proposed action and the alternatives. Table 2-2 summarizes the environmental impacts of the proposed action and the alternatives considered in this SEIS.

The environmental impacts of the proposed action would be SMALL for all impact categories. In comparison, both replacement power alternatives would have environmental impacts in at least six resource areas with the potential to be greater than the environmental impacts of the proposed LR action. In addition, the replacement energy alternatives would also result in construction impacts. If the NRC does not renew the Perry Plant operating license (no-action alternative), energy-planning decision-makers would have to choose a replacement power alternative similar to the ones evaluated in this SEIS. Based on the review of the replacement energy alternatives, the no-action alternative, and the proposed action, the environmentally preferred alternative is the proposed LR action. Therefore, the NRC staff's recommendation is to renew the Perry Plant operating license.

1 **Table 2-2 Summary of Environmental Impacts of Proposed Action and Alternatives**

Resource Area	Proposed Action – License Renewal	No Action	Natural Gas-Fired Combined-Cycle	Combination Alternative
Land Use	SMALL	SMALL	SMALL to MODERATE	MODERATE to LARGE
Visual Resources	SMALL	SMALL	SMALL	MODERATE
Air Quality	SMALL	SMALL	SMALL to MODERATE	SMALL to MODERATE
Noise	SMALL	SMALL	SMALL to MODERATE	SMALL to MODERATE
Geologic Environment	SMALL	SMALL	SMALL	SMALL to MODERATE
Groundwater and Surface Water	SMALL	SMALL	SMALL to MODERATE	SMALL to MODERATE
Terrestrial Resources	SMALL	SMALL	SMALL	SMALL to LARGE
Aquatic Resources	SMALL	SMALL	SMALL	SMALL to MODERATE
Special Status Species and Habitat	(a)	(b)	(c)	(c)
Historic and Cultural Resources	(d)	(e)	(f)	(f)
Socioeconomics	SMALL	SMALL to MODERATE	SMALL to LARGE	SMALL to MODERATE
Transportation	SMALL	SMALL	SMALL to LARGE	SMALL to MODERATE
Human Health	SMALL(g)	SMALL(g)	SMALL(g)	SMALL(g)
Environmental Justice	(h)	(i)	(j)	(j)
Waste Management	SMALL	SMALL	SMALL	SMALL

(a) May affect but is not likely to adversely affect northern long-eared bat, Indiana bat, tricolored bat, piping plover, red knot, and monarch butterfly. No effect on essential fish habitat (EFH). No effect on sanctuary resources of national marine sanctuaries.
(b) Overall, the effects on federally listed species, critical habitat, and EFH would likely be smaller under the no-action alternative than the effects under continued operation but would depend on the specific shutdown activities as well as the listed species, critical habitats, and designated EFH present when the no-action alternative is implemented.
(c) The types and magnitudes of adverse impacts to species listed in the Endangered Species Act of 1973, as amended (TN1010), designated critical habitat, and EFH would depend on the proposed alternative site, facility design and operation, as well as listed species and habitats present when the alternative is implemented. Therefore, the U.S. Nuclear Regulatory Commission (NRC) staff cannot forecast a level of impact for this alternative.
(d) Based on the absence of previously recorded cultural resources or historic properties within the area of potential effects, Tribal input, VistraOps' administrative procedures, and no planned physical changes or land disturbance activities, the proposed action would have no effect on historic properties.
(e) Until the post-shutdown decommissioning activities report is submitted, the NRC staff cannot determine whether historic properties would be affected outside the existing industrial site boundary after the nuclear power plant is shut down.
(f) The impact determination of this alternative would depend on the specific sites at which ground disturbing activities would occur. Impacts would be assessed, determined, and mitigated with the State Historic Preservation Office and any American Indian Tribe that attaches religious and cultural significance to identified historic properties through the Section 106 consultation process.

1 **Table 2-2 Summary of Environmental Impacts of Proposed Action and Alternatives (Continued)**

Resource Area	Proposed Action – License Renewal	No Action	Natural Gas-Fired Combined-Cycle	Combination Alternative

(g) The chronic effects of electromagnetic fields on human health associated with operating nuclear power and other electricity generating plants are uncertain.
(h) Minority and low-income populations would not likely experience disproportionate and adverse human health and environmental effects from the proposed action.
(i) A reduction in tax revenue resulting from the shutdown of Perry Plant could decrease the availability of public services. Minority and low-income populations dependent on these services could be disproportionately affected.
(j) Based on the analysis of human health and environmental effects presented in this supplemental environmental impact statement (SEIS), this alternative would not likely have disproportionate and adverse human health and environmental effects on minority and low-income populations. However, this determination would depend on the onsite location, plant design, and operational characteristics of the new power plant, unique consumption practices and interactions with the environment of nearby populations, and the location of minority and low-income populations.

3 AFFECTED ENVIRONMENT, ENVIRONMENTAL CONSEQUENCES AND MITIGATING ACTIONS

3.1 Introduction

In conducting its review of the environmental effects of renewing the Perry Plant Unit 1 operating license, the NRC describes the environment that could be affected by the proposed action (renewing the operating license authorizing an additional 20 years of reactor operation). The NRC also evaluates the environmental consequences of the proposed action as well as reasonable alternatives to the proposed action.

In this chapter, the affected environment is the environment that currently exists at and around the Perry Plant site. Because existing conditions are at least partially the result of past construction and nuclear power plant operations, this chapter considers the nature and impacts of past and ongoing operations and evaluates how, together, these actions have shaped the current environment. This chapter also describes reasonably foreseeable environmental trends. The effects of ongoing reactor operations at the Perry Plant site have become well established as environmental conditions have adjusted to the presence of the facility[1]. Sections 3.2 through 3.13 describe the affected environment for each resource area, followed by the NRC staff's evaluation of the environmental consequences of the proposed action and alternatives to the proposed action. The NRC staff compares the environmental impacts of LR with those of the no-action alternative and replacement power alternatives to determine whether the adverse environmental impacts of LR are so great that it would be unreasonable to preserve the option for energy-planning decision-makers.

The evaluation of environmental consequences includes the following:

- impacts associated with continued operations during the period of extended operation
- impacts of the reasonable power replacement alternatives to the proposed action and the no-action alternative (not issuing the renewed license)
- impacts common to all alternatives: (1) fuel cycle including uranium fuel cycle, (2) terminating power plant operations and decommissioning, and (3) greenhouse gas emissions (GHG) and climate change
- impacts associated with the uranium fuel cycle
- impacts of postulated accidents (design-basis accidents and severe accidents)
- cumulative impacts of the proposed action
- resource commitments associated with the proposed action, including unavoidable adverse impacts, the relationship between short-term use and long-term productivity, and irreversible and irretrievable commitment of resources
- new and potentially significant information about environmental issues related to the impacts of operation during the renewal term

[1] Where appropriate, the NRC staff has summarized referenced information (incorporated information by reference) in this supplemental environmental impact statement. This allows the staff to focus on new and potentially significant information identified since the initial Perry Plant EIS in 1982.

As stated in Sections 1.4 and 1.5, this SEIS documents the NRC staff's environmental review of the LRA (EH 2023-TN9533) and supplements the information provided in NUREG-1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants (LR GEIS)* (NRC 2013-TN2654). The LR GEIS identifies 78 issues (divided into Category 1 [generic] and Category 2 [site-specific] issues) to be evaluated for the proposed action. Section 1.4 of this SEIS provides an explanation of the criteria for Category 1 issues and Category 2 issues, as well as the definitions of SMALL, MODERATE, and LARGE impact significance.

For Category 1 issues, the NRC staff relies on the analysis in the LR GEIS unless otherwise noted. Table 3-1 lists the applicable Category 1 issues for Perry Plant. For these issues, the NRC staff did not identify any new and significant information that would change the conclusions of the LR GEIS (see Section 3.14 of this SEIS). Therefore, there are no impacts related to these issues beyond those discussed in the LR GEIS (Table 3-1 and Table 3-2) as cited in Sections 3.2 to 3.13 of this SEIS. Section 3.14 of this SEIS describes the NRC staff's process for evaluating new and significant information.

Table 3-1 Applicable Category 1 (Generic) Conclusions Regarding the Perry Nuclear Power Plant License Renewal

Issue	LR GEIS Section	Impact
Land Use – Onsite land use	4.2.1.1	SMALL
Land Use – Offsite land use	4.2.1.1	SMALL
Land Use – Offsite land use in transmission line right-of-ways (ROWs)	4.2.1.1	SMALL
Visual Resources – Aesthetic impacts	4.2.1.2	SMALL
Air Quality – Air quality impacts (all plants)	4.3.1.1	SMALL
Air Quality – Air quality effects of transmission lines	4.3.1.1	SMALL
Noise – Noise impacts	4.3.1.2	SMALL
Geologic Environment – Geology and soils	4.4.1	SMALL
Surface Water Resources – Surface water use and quality (non-cooling system impacts)	4.5.1.1	SMALL
Surface Water Resources – Altered current patterns at intake and discharge structures	4.5.1.1	SMALL
Surface Water Resources – Altered thermal stratification of lakes	4.5.1.1	SMALL
Surface Water Resources – Scouring caused by discharged cooling water	4.5.1.1	SMALL
Surface Water Resources – Discharge of metals in cooling system effluent	4.5.1.1	SMALL
Surface Water Resources – Discharge of biocides, sanitary wastes, and minor chemical spills	4.5.1.1	SMALL
Surface Water Resources – Temperature effects on sediment transport capacity	4.5.1.1	SMALL
Groundwater Resources – Groundwater contamination and use (non-cooling system impacts)	4.5.1.2	SMALL
Groundwater Resources – Groundwater use conflicts (plants that withdraw less than 100 gallons per minute [gpm])	4.5.1.2	SMALL
Terrestrial Resources – Exposure of terrestrial organisms to radionuclides	4.6.1.1	SMALL
Terrestrial Resources – Cooling tower impacts on vegetation (plants with cooling towers)	4.6.1.1	SMALL
Terrestrial Resources – Bird collisions with plant structures and transmission lines	4.6.1.1	SMALL

Table 3-1 Applicable Category 1 (Generic) Conclusions Regarding the Perry Nuclear Power Plant License Renewal (Continued)

Issue	LR GEIS Section	Impact
Terrestrial Resources – Electromagnetic fields on flora and fauna (plants, agricultural crops, honeybees, wildlife, livestock)	4.6.1.1	SMALL
Aquatic Resources – Impingement and entrainment of aquatic organisms (plants with cooling towers)	4.6.1.1	SMALL
Aquatic Resources – Entrainment of phytoplankton and zooplankton (all plants)	4.6.1.2	SMALL
Aquatic Resources – Thermal impacts on aquatic organisms (plants with cooling towers)	4.6.1.2	SMALL
Aquatic Resources – Infrequently reported thermal impacts (all plants)	4.6.1.2	SMALL
Aquatic Resources – Effects of cooling water discharge on dissolved oxygen, gas supersaturation, and eutrophication	4.6.1.2	SMALL
Aquatic Resources – Effects of nonradiological contaminants on aquatic organisms	4.6.1.2	SMALL
Aquatic Resources – Exposure of aquatic organisms to radionuclides	4.6.1.2	SMALL
Aquatic Resources – Effects on aquatic resources (non-cooling system impacts)	4.6.1.2	SMALL
Aquatic Resources – Impacts of transmission line right-of-way (ROW) management on aquatic resources	4.6.1.2	SMALL
Aquatic Resources – Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses	4.6.1.2	SMALL
Socioeconomics – Employment and income, recreation, and tourism	4.8.1.1	SMALL
Socioeconomics – Tax revenues	4.8.1.2	SMALL
Socioeconomics – Community services and education	4.8.1.3	SMALL
Socioeconomics – Population and housing	4.8.1.4	SMALL
Socioeconomics – Transportation	4.8.1.5	SMALL
Human Health – Radiation exposures to the public	4.9.1.1.1	SMALL
Human Health – Radiation exposures to plant workers	4.9.1.1.1	SMALL
Human Health – Human health impact from chemicals	4.9.1.1.2	SMALL
Human Health – Microbiological hazards to plant workers	4.9.1.1.3	SMALL
Human Health – Physical occupational hazards	4.9.4.1.5	SMALL
Postulated Accidents – Design-basis accidents	4.9.1.2	SMALL
Waste Management – Low-level waste storage and disposal	4.11.1.1	SMALL
Waste Management – Onsite storage of spent nuclear fuel	4.11.1.2	SMALL
Waste Management – Offsite radiological impacts of spent nuclear fuel and high-level waste disposal	4.11.1.3	(a)
Waste Management – Mixed waste storage and disposal	4.11.1.4	SMALL
Waste Management – Nonradioactive waste storage and disposal	4.11.1.4	SMALL
Uranium Fuel Cycle – Offsite radiological impacts—individual impacts from other than the disposal of spent fuel and high-level waste	4.12.1.1	SMALL
Uranium Fuel Cycle – Offsite radiological impacts—collective impacts from other than the disposal of spent fuel and high-level waste	4.12.1.1	(b)
Uranium Fuel Cycle – Nonradiological impacts of the uranium fuel cycle	4.12.1.1	SMALL

Table 3-1 Applicable Category 1 (Generic) Conclusions Regarding the Perry Nuclear Power Plant License Renewal (Continued)

Issue	LR GEIS Section	Impact
Uranium Fuel Cycle – Transportation	4.12.1.1	SMALL
Termination of plant operations and decommissioning	4.12.2.1	SMALL

CFR = *Code of Federal Regulation*; gpm = gallon(s) per minute; LR GEIS = license renewal generic environmental impact statement; NEPA = National Environmental Policy Act; ROW = right-of-way; SEIS = supplemental environmental impact statement.

(a) The ultimate disposal of spent fuel in a potential future geologic repository is a separate and independent licensing action that is outside the regulatory scope of this review. Per 10 CFR Part 51 (TN250) Subpart A, Appendix B, the Commission concludes that the impacts presented in NUREG-2157 (NRC 2014-TN4117) would not be sufficiently large to require the NEPA conclusion, for any plant, that the option of extended operation under 10 CFR Part 54 (TN4878) should be eliminated. Accordingly, while the Commission has not assigned a single level of significance for the impacts of spent nuclear fuel and high-level waste disposal, this issue is considered generic to all nuclear power plants.

(b) There are no regulatory limits applicable to collective doses to the general public from fuel cycle facilities. The practice of estimating health effects on the basis of collective doses may not be meaningful. All fuel cycle facilities are designed and operated to meet the applicable regulatory limits and standards. As stated in the 2013 LR GEIS, “The Commission concludes that the impacts are acceptable in that these impacts would not be sufficiently large to require the NEPA conclusion, for any plant, that the option of extended operation under 10 CFR Part 54 should be eliminated” (10 CFR Part 54; TN4878).

Source: Table B-1 in Appendix B, Subpart A, to 10 CFR Part 51-TN250; NRC 2013-TN2654

The NRC staff analyzed the applicable Category 2 (site-specific) issues for Perry Plant and assigned impacts for these issues as shown in Table 3-2.

Table 3-2 Applicable Category 2 (Site-Specific) Conclusions Regarding the Perry Nuclear Power Plant License Renewal

Issue	LR GEIS Section	Impact[a]
Groundwater Resources – Radionuclides released to groundwater	4.5.1.2	SMALL
Terrestrial Resources – Effects on terrestrial resources (non-cooling system impacts)	4.6.1.1	SMALL
Special Status Species and Habitats – Threatened, endangered, and protected species and essential fish habitat	4.6.1.3	May affect, but is not likely to adversely affect, the northern long-eared bat, Indiana bat, tricolored bat, piping plover, red knot, and monarch butterfly. No effect on essential fish habitat. No effect on sanctuary resources of national marine sanctuaries.
Historic and Cultural Resources – Historic and cultural resources	4.7.1	No effect on historic properties
Human Health – Microbiological hazards to the public (plants with cooling ponds or canals or cooling towers that discharge to a river)	4.9.1.1.1	SMALL
Human Health – Chronic effects of electromagnetic fields[b]	4.9.1.1.1	Uncertain Impact
Human Health – Electric shock hazards	4.9.1.1.1	SMALL
Postulated Accidents – Severe accidents	4.9.1.2	See Appendix F

Table 3-2 Applicable Category 2 (Site-Specific) Conclusions Regarding the Perry Nuclear Power Plant License Renewal (Continued)

Issue	LR GEIS Section	Impact(a)
Environmental Justice – Minority and low-income populations	4.10.1	No disproportionate and adverse human health and environmental effects on minority and low-income populations. No disproportionate and adverse human health effects in special pathway receptor populations in the region because of subsistence consumption of water, local food, fish, and wildlife.
Cumulative Impacts – Cumulative impacts	4.13	See SEIS Section 3.16

LR GEIS = license renewal generic environmental impact statement.
(a) Impact determinations for Category 2 issues based on findings described in Sections 3.2 to 3.13, as applicable, for the proposed action.
(b) This issue was not designated as Category 1 or 2 and is discussed in Section 3.11.6.2.
Source: Table B-1 in Appendix B, Subpart A, to 10 CFR Part 51-TN250; NRC 2013-TN2654.

3.2 Land Use and Visual Resources

3.2.1 Land Use

3.2.1.1 Onsite Land Use

The Perry Plant site comprises approximately 1,023 ac (414 ha) along the southeastern shore of Lake Erie in Lake County, Ohio, with the eastern portion of the site within the boundaries of North Perry Village and the western portion of the site within Perry Township. The site's industrial area comprises approximately 250 ac (100 ha), with the remainder of the site comprising forested areas and grasslands. The nearest residence to Perry Plant is about 1 mi (1.6 km) to the northeast.

As shown in Table 3-3, the primary land cover within the site boundary is deciduous forest (58 percent). Other predominant land cover includes grassland/herbaceous cover (9 percent) and woody wetlands (3 percent). Approximately 25 percent of the site is developed.

North Perry Village has zoned the portion of the Perry Plant site within its boundary as a General Industrial District (I-2), which includes industrial uses "that have a generally clean character, and which normally generate only limited outdoor activities that are clean, quiet, and free of hazardous or objectionable elements such as noise, odor, smoke, contaminants, and glare" (NPV 2021-TN9605). The portion of the Perry Plant site within Perry Township is zoned as a Heavy Industrial District (I-3), which allows for "manufacturing, assembly, processing, storage, and similar industrial operations that may require outdoor storage of products or raw materials and may generate significant volumes of heavy vehicular traffic" (PT 2022-TN9728).

VistraOps owns and controls the land within the Perry Plant exclusion area boundary, except for the electric switchyard and substation on site, which are owned by subsidiaries of FirstEnergy (LCO Undated-TN9734), and a sewer pump station owned by Lake County, Ohio.

Table 3-3 Land Use/Land Cover, Perry Nuclear Power Plant Site

Category	Acres	Percentage
Open Water	12.9	1.3
Developed, Open Space	41.4	4.0
Developed, Low Intensity	57.4	5.6
Developed, Medium Intensity	58.9	5.8
Developed, High Intensity	95.6	9.3
Deciduous Forest	594.7	58.1
Mixed Forest	8.2	0.8
Shrub/Scrub	10.2	1.0
Grassland/Herbaceous	92.7	9.1
Hay/Pasture	17.8	1.7
Woody Wetlands	30.5	3.0
Emergent Herbaceous Wetlands	2.9	0.3
Total	1,023.2	100

Source: EH 2023-TN9534

As shown in Figure 3.1-1 in the ER (EH 2023-TN9534), access to the Perry Plant site is via Center Road north of its intersection with Parmly Road. The closest commercial harbor is Fairport Harbor (2022-TN9718), which is approximately 2 mi (3 km) to the southwest of Perry Plant, and the closest commercial port is Ashtabula Harbor (City of Ashtabula 2020-TN9719), which is approximately 19 mi (31 km) northeast of Perry Plant. Perry Plant previously had an onsite rail spur; however, a portion of this spur has been paved over, and the spur is no longer in use. Equipment is brought to the site using the road network.

3.2.1.2 Coastal Zone

Section 307(c)(3)(A) of the Coastal Zone Management Act of 1972, as amended (16 U.S.C. 1456(c)(3)(A)) (TN1243) requires that applicants for Federal licenses who conduct activities in a coastal zone provide a certification to the licensing agency that the proposed activity complies with the enforceable policies of the State's coastal zone program. The Federal regulations that implement the Coastal Zone Management Act indicate that this requirement is applicable to renewal of Federal licenses for actions not previously reviewed by the State (15 CFR 930.51(b)(1)) (TN4475).

Perry Plant is in Ohio's designated coastal zone on Lake Erie. As such, VistraOps is required to certify consistency with the Ohio Coastal Management Program. On June 30, 2022, VistraOps submitted a request for certification from the Ohio Department of Natural Resources Office of Coastal Management, which administers the Ohio Coastal Management Program (EH 2023-TN9534: Attachment F). VistraOps' request certified that there were no plans to modify current Perry Plant operations over the license renewal (LR) period, and that all maintenance activities would be limited to previously disturbed areas. On October 19, 2022, the Ohio Department of Natural Resources Office of Coastal Management concurred with VistraOps' determination that there would be minimal environmental impacts associated with LR and that no further coordination regarding Federal consistency is required (EH 2023-TN9534).

3.2.1.3 Offsite Land Use

The 6 mi (10 km) radius surrounding the Perry Plant site comprises a portion of Lake Erie and Lake County, Ohio, and includes a mix of residential and agricultural lands with interspersed forested and natural areas. As shown in Table 3-4, the primary land cover in the 6 mi (10 km) radius surrounding Perry Plant is open water (49 percent). Other predominant land cover includes deciduous forest (17 percent), hay/pasture (12 percent), low intensity development (9 percent), and open space (5 percent).

Table 3-4 Land Use/Land Cover, 6 mi (10 km) Radius of Perry Nuclear Power Plant

Category	Acres	Percentage
Open Water	35,801.1	49.4
Developed, Open Space	3,480.0	4.8
Developed, Low Intensity	6,405.2	8.8
Developed, Medium Intensity	2,048.9	2.8
Developed, High Intensity	499.7	0.7
Barren Land	144.8	0.2
Deciduous Forest	12,294.2	17.0
Evergreen Forest	16.5	0.02
Mixed Forest	815.5	1.1
Shrub/Scrub	183.9	0.3
Grassland/Herbaceous	1,085.3	1.5
Hay/Pasture	8,513.3	11.8
Cultivated Crops	316.9	0.4
Woody Wetlands	789.1	1.1
Emergent Herbaceous Wetlands	42.5	0.1
Total	**72,436.9**	**100**

Source: EH 2023-TN9534

Lake County is approximately 147,000 ac (59,000 ha) of which 13,100 ac (5,300 ha) (9 percent) is farmland, with a total of 214 farms within the county. Primary agricultural products include forage, soybeans, orchards, wheat, and potatoes, as well as livestock and chickens. Other agricultural uses include woodlands and pastureland.

The Lake County Planning Commission oversees the subdivision of land and provides planning and zoning services to Perry Township. The North Perry Comprehensive Plan provides guidance on housing, land use, economic development, utilities, and natural resources, among other land uses.

3.2.2 Visual Resources

As noted earlier in Section 3.2.1, the Perry Plant site is located on the southeastern shore of Lake Erie in Lake County, Ohio. Prominent visual features at Perry Plant include the cooling towers, meteorological tower, reactor domes, and turbine buildings. The tallest structures on the Perry Plant site are the cooling towers, which are approximately 500 ft (150 m) high. While forested areas on site and surrounding the Perry Plant site screen certain visual features, the Perry Plant structures are visible from certain areas surrounding the site, from Perry Township, and from Lake Erie.

3.2.3 Proposed Action

3.2.3.1 Land Use

According to both the 1996 and 2013 LR GEIS (NRC 1996-TN288, NRC 2013-TN2654), land use at nuclear power plant sites would not be affected by continued operations and refurbishment associated with LR. Consistent with this determination, nuclear plant operations at Perry Plant have not changed appreciably with time, and no change in land use impacts are expected during the LR term.

The NRC staff did not identify any new or significant information that would affect land use during the agency's review of the VistraOps' ER (EH 2023-TN9534), site visit, scoping process, or evaluation of other available information. The communities in the vicinity of Perry Plant have adequate public services to support and guide development. Consequently, people living in the vicinity of Perry Plant would not experience any land use changes during the renewal term beyond what they have already experienced since the plant commenced operations in 1987. Therefore, the impact of continued reactor operations during the LR term would not exceed the land use impacts predicted in the LR GEIS. Thus, as concluded in the LR GEIS, for this Category 1 (generic) issue, the impacts of continued operation of Perry Plant on land use associated with both onsite, offsite, and offsite transmission rights-of-way would be SMALL.

3.2.3.2 Visual Resources

According to both the 1996 and 2013 LR GEIS (NRC 1996-TN288, NRC 2013-TN2654), visual resources would not be affected by continued operations and refurbishment associated with LR. Consistent with this determination, nuclear plant operations at Perry Plant have not changed appreciably with time, and there are no plans for new construction or refurbishment that would result in new visual impacts during the renewal term.

The NRC staff did not identify any new or significant information that would affect visual resources during the agency's review of the ER (EH 2023-TN9534), site audit, scoping process, or evaluation of other available information. Therefore, the impact of continued reactor operations during the LR term would not exceed the visual impacts predicted in the LR GEIS. Thus, as concluded in the LR GEIS, for this Category 1 (generic) issue, the impacts of continued operation of Perry Plant on visual resources would be SMALL.

3.2.4 No-Action Alternative

3.2.4.1 Land Use

If the NRC does not issue a renewed operating license, Perry Plant would shut down on or before midnight on November 7, 2026, when its current license expires. Perry Plant shutdown would not immediately affect onsite land use. Plant structures and other facilities would remain in place until decommissioning. Grounds and facilities maintenance and other human activities would continue onsite, though at lower intensity. The LR GEIS (NRC 2013-TN2654) notes that land use impacts could occur beyond the immediate nuclear plant site as a result of the no-action alternative if new power generating facilities are needed. Most transmission lines would remain in service after Perry Plant ceases operations. Maintenance of most existing infrastructure would continue as before. Therefore, the NRC staff concludes that the onsite land use impacts from the termination of nuclear reactor operations at the Perry Plant site would be SMALL.

3.2.4.2 Visual Resources

Shutdown of reactor operations would not significantly change the visual appearance of the Perry Plant site. Therefore, the NRC staff concludes that the visual impacts from the termination of reactor operations at the Perry Plant site would be SMALL.

3.2.5 Replacement Power Alternatives

As described in Section 2.3 of this report, NEPA requires the NRC to consider reasonable alternatives to the proposed action of Perry Plant LR. The NRC staff identified two replacement energy alternatives that would likely be available and commercially viable before the Perry Plant operating license expires These are (1) an NGCC and (2) a combination alternative comprising renewables (wind and solar) and natural gas.

3.2.5.1 Land Use

The following analysis of land use impacts focuses on the land area that would be affected by the construction and operation of a replacement power generating facility or facilities.

Construction would require the permanent commitment of land chosen for industrial use at the site(s) and supporting infrastructure. Material laydown areas and onsite concrete batch plants could also result in temporary land use changes. As much as possible, existing transmission lines and infrastructure would be used to support each of the replacement power alternatives, thus reducing the need for additional land commitments.

Operation of new power generating facilities would have impacts associated with the amount of land committed for the permanent use of the replacement power plant(s). Additional land may be required to support power plant operations, including land for mining, extraction, and waste disposal activities associated with each alternative. Table 3-5 below summarizes the land use impacts of the two replacement power alternatives.

3.2.5.2 Visual Resources

The following visual resources impact analysis focuses on the degree of contrast between the replacement power plants and the surrounding landscape and the visibility of the replacement power plants.

Construction of any replacement power generating facilities would require clearing, excavation, and the use of construction equipment. The use of equipment and cranes may create short-term visual impacts during the construction. Table 3-6 summarizes visual resource impacts of the two replacement power alternatives.

1 **Table 3-5 Land Use Impacts of Replacement Power Alternatives**

Alternative	Resource Requirements	Impacts	Discussion
NGCC Alternative	Construction and installation of multiple natural gas-fired turbines and steam generators with associated support structures, including exhaust stacks and MDCTs.	SMALL to MODERATE	The new NGCC plant would be located on the Perry Plant site or at another brownfield site previously used for energy generation, requiring approximately 60 ac (24 ha) (NETL 2012-TN9604). Because the new power plant could be installed on the Perry Plant site, little to no additional land would be needed for new infrastructure. Additionally, a natural gas pipeline crosses the Perry Plant site requiring minimal new pipeline infrastructure. For brownfield sites without existing natural gas pipelines, new infrastructure may be needed.
Combination Alternative: Renewables (Wind, Solar) and Natural Gas	Construction and installation of a 764 MW NGCC plant, six 125 MW solar installations with battery storage, and three wind installations totaling 540 MW. The NGCC plant would be built at the Perry Plant site or at a site previously used for energy generation. The solar and wind portions of the combination alternative would be located offsite from Perry, somewhere in Ohio.	MODERATE to LARGE	The new NGCC power plant would be located on the Perry Plant site or at another brownfield site previously used for energy generation, requiring approximately 60 ac (24 ha) (NETL 2012-TN9604). Solar power generation would require approximately 6,000 ac (2,400 ha) (assuming 8 ac [3.2 ha]/MW, for 750 MW). Using DOE's estimates of land use for wind power projects (85 ac [34 ha] per MW for wind farms, 2.47 ac [1 ha] per MW for construction footprint, and 0.74 ac [0.3 ha] per MW for permanent structures [DOE 2015-TN8757]), wind power generation would require approximately 46,000 ac (19,000 ha). Assuming 25 mi (40 km) of new 345 kV transmission lines in a 150 ft (46 m) wide corridor for each of the six solar and three wind installations, an estimated additional 4,090 ac (1,655 ha) of land would be needed.

ac = acre(s); DOE = U.S. Department of Energy; ft = foot (feet); ha = hectare(s); kV = kilovolt(s); m = meter(s); MDCT = mechanical draft cooling towers; mi = mile(s); MW = megawatt(s); NGCC = natural gas-fired combined-cycle.

Table 3-6 Visual Resource Impacts of Replacement Power Alternatives

Alternative	Resource Requirements	Impacts	Discussion
NGCC Alternative	Installation of power generating facilities and support structures at existing power plant sites would be consistent with the visual character of the industrial site. Combustion turbines would be tall enough to be seen offsite from a distance, depending on landscape and screening vegetation. Transmission lines would be visible, unless screened.	SMALL	Because the components of this alternative are proposed to be constructed at the existing Perry Plant site or at another brownfield site previously used for energy generation, new visual impacts may be minimal.
Combination Alternative: Renewables (Wind, Solar) and Natural Gas	Installation of new power generating facilities and support structures at existing power plants sites would be consistent with the visual industrial character of the site. Exhaust stacks would be the tallest structures and could be visible for over a mile, depending on the landscape and screening vegetation. New MDCTs or use of existing MDCTs would result in similar visual impacts at existing power plant sites. Wind turbines would be tall enough to be seen from a distance. Solar panels could also be seen depending on the size of the facility and on screening vegetation. Transmission lines would also be visible, unless screened by vegetation.	MODERATE	If most of the components of this alternative are constructed at existing power plant sites, new visual impacts may be minimal. However, construction at greenfield sites may present new visual impacts. Construction of new onshore wind turbines would likely be visible across a large area regardless of their location.

MDCT = mechanical draft cooling towers; NGCC = natural gas-fired combined-cycle.

3.3 Meteorology, Air Quality, and Noise

3.3.1 Meteorology and Climatology

Ohio’s climate is humid continental characterized by seasonal variability, cold winters, and warm, humid summers. The absence of mountains to the north and south expose Ohio to very cold air masses from the Arctic in winter, and humid air masses from the Gulf of Mexico in the summer. Lake Erie has a noticeable influence on the local climate, including warmer winters and cooler summers for near-shore locations and lake-effect snow along the southeastern shoreline. West to northerly winds blowing off Lake Erie result in a lowering of daily high temperatures in summer and increasing temperatures in winter (NOAA 2022-TN9965). Annual precipitation varies regionally, with the northwestern part of the State averaging 32 in. (0.8 m) each year and the southern part of the State averaging 42 in. (1.1 m) each year.

VistraOps maintains a meteorological monitoring system comprising a meteorological tower. The meteorological tower is located approximately 4,300 ft (1,300 m) from the cooling tower and measures wind speed and direction, ambient air temperatures, dew point temperature, precipitation, and pressure. In the ER, VistraOps provided meteorological observations from the meteorological monitoring system for the 1992–2021 period (EH 2023-TN9534). The NRC staff obtained climatological data from Cleveland Hopkins International Airport weather station (NOAA 2022-TN9965). This station is approximately 60 mi (97 km) from Perry Plant and used to characterize the region's climate because of its relative location and long period of record.

The mean annual temperature from the Cleveland Hopkins International Airport weather station for the period of record (1896–2022) is 50.1°F (10.1°C), with a mean monthly temperature ranging from a low of 27.2°F (-2.7°C) in February to a high of 72.8°F (22.7°C) in July. The mean annual temperature from Perry Plant's onsite meteorological tower is 50.5°F (10.3°C), with a mean monthly temperature ranging from a low of 28.3°F (-2.1°C) in January to a high of 71.6°F (22°C) in July (EH 2023-TN9534).

The mean annual total precipitation from the Cleveland Hopkins International Airport weather station for the period of record (1896–2022) is 36.05 in. (0.92 m), with a mean monthly precipitation ranging from a low of 2.26 in. (5.74 centimeters [cm]) in February to a high of 3.5 in. (8.9 cm) in July (EH 2023-TN9534). The mean annual total precipitation from Perry Plant's onsite meteorological tower is 38.8 in. (0.98 m), with a mean monthly precipitation ranging from a low of 1.8 in. (45.7 cm) in February to a high of 4.1 in. (10.4 cm) in October (EH 2023-TN9534).

The mean annual wind speed from the Cleveland Hopkins International Airport weather station for the period of record (1983–2022) is 9.6 miles per hour (mph) (15.4 kilometers per hour [kmph]), with a prevailing wind direction of west–southwest (EH 2023-TN9534). The mean annual wind speed from Perry Plant's onsite meteorological tower is 7.0 mph (11.3 kmph), with a prevailing wind direction of west–southwest (EH 2023-TN9534).

Ohio is subject to extreme weather events (NOAA 2022-TN9965). The following numbers of severe weather events have been reported in Lake County from January 1, 1950, to January 31, 2024 (NOAA 2024-TN9936):

- tornadoes: 3 events
- flood: 23 events
- hail: 97 events
- thunderstorm winds: 200 events

3.3.2 Air Quality

Under the Clean Air Act of 1963, as amended (TN1141), the EPA has set primary and secondary National Ambient Air Quality Standards (NAAQSs), "National Primary and Secondary Ambient Air Quality Standards" (40 CFR Part 50-TN1089), for six common criteria pollutants to protect sensitive populations and the environment. The NAAQS criteria pollutants include carbon monoxide (CO), lead, nitrogen dioxide, ozone, sulfur dioxide, and particulate matter (PM). PM is further categorized by size—PM_{10} (diameter of 10 micrometers or less) and $PM_{2.5}$ (diameter of 2.5 micrometers or less).

The EPA designates areas of attainment and nonattainment with respect to meeting NAAQSs. Areas for which there are insufficient data to determine attainment or nonattainment are designated as unclassifiable. Areas that were once in nonattainment, but are now in attainment, are called maintenance areas; these areas are under a 10-year monitoring plan to maintain their attainment designation status. States have primary responsibility for ensuring attainment and maintenance of the NAAQSs. Under the Clean Air Act of 1963, Section 110 (42 U.S.C. § 7410-TN4851) (Clean Air Act-TN1141) and related provisions, States are to submit, for EPA approval, State implementation plans that provide for the timely attainment and maintenance of the NAAQSs.

In Ohio, air quality designations are made at the county level. For the purpose of planning and maintaining ambient air quality with respect to the NAAQSs, EPA has developed air quality control regions (AQCRs). AQCRs are intra-State or inter-State areas that share a common airshed. Perry Plant is located in Lake County, which is part of the Greater Metropolitan Cleveland Intrastate AQCR (40 CFR 81.22 [TN7226]). With respect to NAAQSs, EPA designates Lake County a maintenance area with respect to ozone, $PM_{2.5}$, and sulfur dioxide and in attainment for the remaining criteria pollutants (EPA 2023-TN9567).

The Ohio Environmental Protection Agency (OEPA) regulates air emissions at Perry Plant under an air permit. OEPA has issued two air pollution Permit-to-Install and Operate permits to Perry Plant authorizing the operation of two auxiliary boilers (Permit Nos. P0111998) and a natural draft cooling tower (Permit No. P0134322). The permit conditions for these emission sources are provided in Table 3-7. In addition to the permitted sources in Table 3-7, Perry Plant has three onsite diesel generators that qualify as Permit by Rule (PBR) emission units (Vistra 2024-TN9925). A PBR exempts an air pollution source from the Permit-to-Install and Operate process if the air pollution source meets the qualifying criteria associated with the PBR. Table 3-8 presents annual air emissions for 2017–2021 for the auxiliary boilers and diesel generators. VistraOps reports that it has not received any notices of violation of noncompliance associated with Perry Plant's air permits between 2017 and 2023 (Vistra 2024-TN9925).

Small amounts of ozone and substantially smaller amounts of nitrogen oxides are produced during a corona event, a phenomenon that occurs when air ionizes near isolated irregularities on the conductor surface of transmission lines. During a corona event, ozone is approximately 90 percent of the oxidants generated, and 10 percent is nitrogen oxides (BLM 2010-TN9626). VistraOps has not conducted field tests of ozone or nitrogen oxide emissions generated by Perry Plant's 22-kV and 345-kV in-scope transmission lines (Vistra 2024-TN9925). However, field studies have shown that high voltage lines up to 765 kV do not generate emissions above ambient measurements (Lee et al. 1989-TN7481; TVA 2013-TN7899; NRC 2015-TN5842).

Table 3-8 presents 2020 annual air emissions from Lake County (EPA 2020-TN9962). The contributions of air emissions from sources at Perry Plant represent a fraction of the annual emissions from Lake County. The EPA promulgated the Regional Haze Rule to improve and protect visibility in national parks and wilderness areas from haze, which is caused by numerous, diverse air pollutant sources located across a broad region (40 CFR 51.308–309 [TN1090]). Specifically, 40 CFR 81 Subpart D (TN7226), "Identification of Mandatory Class I Federal Areas Where Visibility Is an Important Value," lists mandatory Federal areas where visibility is an important value. The Regional Haze Rule requires States to develop State implementation plans to reduce visibility impairment at Class I Federal Areas. There are no Class I Federal Areas in Ohio or adjacent States. Given that there are no Class I Federal Areas in Ohio or adjacent States, emissions at Perry Plant would not adversely affect the air quality of Class I Federal Areas.

Table 3-7 Permitted Air Emission Sources at Perry Nuclear Power Plant

Source/Equipment	Condition
Auxiliary Boiler (2)	Opacity shall not exceed 20 percent as a 6 min average. Total PE limited to 0.020 lb/MMBtu. SO_2 emissions shall not exceed 1.6 lb/MMBtu.
Natural Draft Cooling Tower	PM/PM_{10} emissions should not exceed 16.5 lb/hr and 72.3 ton/year Total water flow should not exceed 37,000,000 gal/hr Monthly average total dissolved solids should not exceed 535 ppm

h = hour(s); lb/MMBtu= pound(s) per million British Thermal Unit(s); lb/hr= pound(s) per hour; minute(s) = min; ppm = parts per million; PE = particulate emissions; PM = particulate matter; PM_{10} = particulate matter less than 10 microns; SO_2 = sulfur dioxide.
Source: OEPA 2023-TN10050 and OEPA 2023-TN10051.

Table 3-8 Annual Air Emissions from Perry Nuclear Power Plant and Lake County

Year	PM	SO_2	NO_x	CO	VOC
2017	0.40	0.252	9.791	2.50	0.25
2018	0.23	0.052	7.188	1.91	0.20
2019	0.44	0.267	11.158	2.793	0.28
2020	0.22	0.027	6.901	1.82	0.19
2021	0.39	0.048	10.616	2.76	0.28
Lake County	3.045	39	3,290	20,400	6,360

CO = carbon monoxide; NO_x = nitrogen oxides; PM = particulate matter; SO_2 = sulfur dioxide; VOC= volatile organic compounds.
Source: EH 2023-TN9534; Vistra 2024-TN9925; EPA 2020-TN9962.

3.3.3 Noise

Noise is unwanted sound and can be generated by many sources. Sound intensity is measured in logarithmic units called decibels (dB). A dB is the ratio of the measured sound pressure level to a reference level equal to a normal person's threshold of hearing. Most people barely notice a difference of 3 dB or less. Another characteristic of sound is frequency or pitch. Noise may be composed of many frequencies, but the human ear does not hear very low or very high frequencies. To represent noise as closely as possible to the noise levels people experience, sounds are measured using a frequency-weighting scheme known as the A-scale. Sound levels measured on this A-scale are given in units of A-weighted decibels (dBA). Levels can become annoying at 80 dBA and very annoying at 90 dBA. To the human ear, each increase of 10 dBA sounds twice as loud (EPA 1981-TN7412).

Several different terms are commonly used to describe sounds that vary in intensity over time. The equivalent sound intensity level (Leq) represents the average sound intensity level over a specified interval, often 1 hour (h). The day-night sound intensity level is a single value calculated from hourly Leq during a 24 h period, with the addition of 10 dBA to sound levels from 10 p.m. to 7 a.m. This addition accounts for the greater sensitivity of most people to nighttime noise. Statistical sound level is the sound level that is exceeded n Percent of the time during a given period. For example, L_{90}, is the sound level exceeded 90 percent of time and is considered the background level.

Primary offsite noise sources in the immediate vicinity of Perry Plant include traffic. The nearest resident is located approximately 0.9 mi (1.4 km) northeast from Perry Plant (EH 2023-TN9534). Primary noise sources at Perry Plant include pumps, turbines, diesel generators, switchyard equipment, transformers, a cooling tower, a firing range, and loudspeakers (EH 2023-TN9534). VistraOps has not conducted onsite or offsite noise surveys (EH 2023-TN9534). Between 2017 and 2023, VistraOps did not received noise complaints because of operation of Perry Plant (EH 2023-TN9534 and Vistra 2024-TN9925).

3.3.4 Proposed Action

Air Quality

As described in the GEIS (NRC 2013-TN2654) and as cited in Table 3-1 for generic issues related to air quality, the impacts of nuclear power plant LR and continued operations would be SMALL. The NRC staff's review did not identify any new and significant information that would change the conclusion in the GEIS. As discussed in Section 3.3, air emissions from sources at Perry Plant represent a fraction of the annual emissions from Lake County. VistraOps does not anticipate future upgrades or replacement activities of air emission sources during the LR term to support plant operation. Thus, as concluded in the GEIS, for these Category 1 (generic) issues, the impacts of continued operation of Perry Plant on air quality would be SMALL. There are no site-specific (Category 2) air quality issues applicable to Perry Plant.

Noise Impacts

As described in the GEIS (NRC 2013-TN2654) and as cited in Table 3-1 for generic issues related to noise, the impacts of nuclear power plant LR and continued operations would be SMALL. The NRC staff's review did not identify any new and significant information that would change the conclusion in the GEIS. Thus, as concluded in the GEIS, for these Category 1 (generic) issues, the impacts of continued operation of Perry Plant on noise would be SMALL. There are no site-specific (Category 2) air quality issues applicable to Perry Plant (Table 3-2).

3.3.5 No-Action Alternative

Air Quality

Under the no-action alternative, the permanent cessation of Perry Plant operations would reduce overall air emissions (e.g., from boiler and vehicle traffic). Therefore, the NRC staff concludes that if emissions decrease, the impact on air quality from the shutdown of Perry Plant would be SMALL.

Noise

The permanent cessation of Perry Plant operations would result in a reduction in noise from the pumps, turbines, diesel generators, switchyard equipment, transformers, cooling tower, firing range, loudspeakers, and vehicle traffic (e.g., workers, deliveries). As site activities are reduced, the NRC staff expects the impact on ambient noise levels to be less than current plant operations; therefore, the NRC staff concludes that impacts on noise levels from the no-action alternative would be SMALL.

3.3.6 Replacement Power Alternatives: Common Impacts

3.3.6.1 Air Quality

<u>Construction</u>

Construction of a replacement power alternative and associated transmission lines would result in temporary impacts on local air quality. Air emissions include criteria air pollutants (particulate matter, nitrogen oxides, carbon monoxide, and sulfur dioxide), volatile organic compounds, hazardous air pollutants, and GHGs. Air emissions would be intermittent and would vary based on the level and duration of specific activities throughout the construction phase. During the construction phase, the primary sources of air emissions would consist of engine exhaust and fugitive dust emissions. Engine exhaust emissions would be from heavy construction equipment and commuter, delivery, and support vehicular traffic traveling to and from the facility as well as within the site. Fugitive dust emissions would be from soil disturbances by heavy construction equipment (e.g., earthmoving, excavating, and bulldozing), vehicle traffic on unpaved surfaces, concrete batch plant operations, and wind erosion to a lesser extent.

Various mitigation techniques and best management practices (e.g., watering disturbed areas, reducing equipment idle times, and using ultra-low sulfur diesel fuel) could be used to minimize air emissions and to reduce fugitive dust.

<u>Operations</u>

The impacts on air quality from operation of a facility for a replacement power alternative would depend on the energy technology (e.g., natural gas or renewable). Worker vehicles will result in additional emissions.

3.3.6.2 Noise

<u>Construction</u>

Construction of a replacement power facility would be similar to the construction of any industrial facility in that they all involve many noise-generating activities. In general, noise emissions would vary during each phase of construction, depending on the level of activity, types of equipment and machinery used, and site-specific conditions. Typical construction equipment, such as dump trucks, loaders, bulldozers, graders, scrapers, air compressors, generators, and mobile cranes, would be used, and pile-driving and blasting activities could take place. Other noise sources include construction worker vehicle and truck delivery traffic. However, noise from vehicular traffic would be intermittent. Noise impacts during construction would not be limited to the immediate vicinity of the sites where each alternative is located, since the construction of transmission corridors would be required for the replacement power alternatives considered.

<u>Operations</u>

Noise generated during operations could include noise from transformers, mechanical equipment, speakers, as well as offsite sources, such as employees and delivery vehicular traffic. Noise from vehicles would be intermittent.

3.3.7 Natural Gas-Fired Combined-Cycle Alternative

3.3.7.1 Air Quality

<u>Construction</u>

Air emissions and sources for construction of the NGCC alternative would include those identified as common to all replacement power alternatives in Section 3.3.6.2. There would also be air emissions resulting from construction of necessary natural gas pipelines. The NGCC alternative could be located at the Perry Plant site or a brownfield site and requires 60 ac (24 ha). Use of the existing infrastructure would be maximized at the Perry Plant site. For instance, at the Perry Plant site, the existing mechanical draft cooling towers would be used, and a natural gas pipeline crosses Perry Plant site, which would require minimal new pipeline infrastructure. At a brownfield site, construction of a new natural gas pipeline may be needed as well as installation of mechanical draft cooling towers. However, given the relatively small land requirement, fugitive dust emissions would not be significant. Overall, air emissions from construction of the NGCC alternative would be intermittent, short-term, and temporary. Therefore, the NRC staff concludes that air quality impacts from construction of an NGCC alternative would be SMALL.

<u>Operations</u>

Operation of an NGCC alternative would result in emissions of criteria pollutants and GHGs. The facility would have a design capacity of 1,350 MWe of generation. The NRC staff estimated air emissions for the NGCC alternative using emission factors developed by the DOE's National Energy Technology Laboratory (NETL 2019-TN7484). The NRC staff estimates the following air emissions would result from operation of an NGCC alternative:

- carbon monoxide – 71 tons (65 MT)
- nitrogen oxides – 130 tons (118 MT)
- sulfur dioxide – 36 tons (32 MT)
- particulate matter – 71 tons (64 MT)
- carbon dioxide – 4.38 million tons (3.98 million MT)

Operation of mechanical draft cooling towers and up to 150 worker vehicles would result in additional air emissions. A new NGCC alternative would need to secure a permit from the Ohio Environmental Protection Agency for air pollutants associated with its operation. The natural alternative would emit more than 100 tons/year of nitrogen oxides and therefore qualify as a major emitting industrial facility. As such, the new NGCC plant would be subject to Prevention of Significant Deterioration and Title V air permitting requirements under the Clean Air Act of 1970, as amended (42 U.S.C. 7661 et seq. [TN5268]), to ensure that air emissions are minimized and that the local air quality is not degraded substantially. Depending on the location of the NGCC plant, sulfur dioxide emissions could be noticeable and significant. For instance, sulfur dioxide emissions would almost double annual emissions in Lake County (see Table 3-8) if the plant is located at the Perry Plant site.

Based on NRC staff's air emissions, nitrogen oxide, carbon dioxide, and sulfur dioxide emissions from an NGCC plant would be significant. Therefore, the NRC staff concludes that the overall air quality impacts associated with operation of an NGCC alternative would be MODERATE.

3.3.7.2 Noise

Construction

Noise generated during the construction and operation of an NGCC plant would be similar to noise for all replacement power alternatives, as discussed in Section 3.3.6.2. Noise impacts during construction would be limited to the immediate vicinity of the site. The nearest resident is located approximately 0.9 mi (1.4 km) northeast from the Perry Plant site; noise generated as a result of construction of an NGCC alternative at the Perry Plant site would not be noticeable. Depending on the location of the brownfield site and existing infrastructure, construction of a natural gas pipeline may be needed. Noise generated during construction of a natural gas pipeline may be noticeable, depending on the location of and distance to nearby noise-sensitive receptors relative to the natural gas pipeline corridor. Therefore, the NRC staff concludes that the potential noise impacts of construction activities from an NGCC alternative would be SMALL to MODERATE.

Operations

During operations, noise sources from an NGCC alternative would include those discussed in Section 3.3.6.2, as well as offsite mechanical noise from compressor stations and pipeline blowdowns. The majority of noise-producing equipment (turbines, pumps, mechanical draft cooling towers) would be located inside the power block. Since the NGCC alternative could be located at the Perry Plant site or a brownfield site, the NRC staff does not anticipate noise levels at noise-sensitive receptors to be significantly greater than currently or previously experienced. The Federal Energy Regulatory Commission requires that any new compressor station or any modification, upgrade, or update of an existing station must not exceed day-night sound intensity level of 55 dBA at the closest noise sensitive area (18 CFR 157.206 [TN7483]). Day-night sound intensity level of 55 dBA was designated by the EPA as a noise level that is adequate to protect against outdoor activities (EPA 1974-TN3941). Additionally, noise from pipeline blowdowns would not constitute a new noise source at the Perry Plant site given the existing natural gas pipeline that crosses the site. At a brownfield site, noise from pipeline blowdowns would be consistent with noise sources at an industrial site. Therefore, noise from pipeline blowdowns is not expected to be significantly greater from current levels. The NRC staff concludes that the noise impacts from operation of an NGCC alternative would be SMALL.

3.3.8 Renewable and Natural Gas Combination Alternative

3.3.8.1 Air Quality

Construction

Air emissions associated with construction of the natural gas portion of the combination alternative would be similar to those associated with the NGCC alternative discussed in Section 3.3.7.2, since it would consist of one 764 MW NGCC plant at the Perry Plant site or a brownfield site. Therefore, the NRC staff concludes that the air quality impacts associated with construction of the natural gas portion of the combination alternative would be SMALL.

Air emissions and sources for construction of the renewable portion of this alternative would include those identified as common to all replacement power alternatives in Section 3.3.6.1. The solar panels with battery storage and wind portion would not have power block buildings. Accordingly, the number of heavy equipment and workforce, level of activities, and construction duration would be lower, and consequently less air emissions would be generated. However, a significant amount of land would be required for installation for the solar power generation portion (6,000 ac [2,428 ha]), wind power generation portion (46,000 ac [18,600 ha]), and transmission lines (4,090 ac [1,655 ha]). This can result in noticeable particulate air emissions during the construction phase.

Overall, the NRC staff concludes that the air quality impacts associated with construction of the renewable and NGCC alternative would be SMALL to MODERATE.

Operations

Air emissions associated with operation of the natural gas portion of the combination alternative would be similar, but less than, those associated with the NGCC alternative discussed in Section 3.3.7.1, since it would consist of one 764 MW natural gas plant at the Perry Plant site or a brownfield site. The NRC staff estimated air emissions for the NGCC alternative using emission factors developed by the DOE's National Energy Technology Laboratory (NETL) (NETL 2019-TN7484). The NRC staff estimates the following air emissions would result from operation of a natural gas alternative:

- carbon monoxide – 40 tons (36 MT)
- nitrogen oxides – 74 tons (67 MT)
- sulfur dioxide – 20 tons (28 MT)
- particulate matter – 40 tons (36 MT)
- carbon dioxide – 2.48 million tons (2.25 million MT)

Operation of mechanical draft cooling towers and up to 100 worker vehicles would result in additional air emissions. A new NGCC plant would need to secure a permit from the Ohio Environmental Protection Agency for air pollutants associated with its operation. The natural gas portion of the combination alternative would not emit more than 100 tons/year of any one criteria pollutant. However, sulfur dioxide emission could be noticeable and significant. For instance, if the NGCC plant is located in Lake County, sulfur dioxide emissions could increase by 57 percent of the annual emissions.

Direct air emissions associated with operation of the solar with battery storage and wind portions of this alternative are negligible because no fossil fuels are burned to generate electricity. Emissions would include fugitive dust and engine exhaust from worker vehicles and heavy equipment associated with site inspections, maintenance activities, and wind erosion from cleared lands and access roads. Emissions would be localized and intermittent.

Given the significant sulfur dioxide and carbon dioxide emissions associated with the NGCC plant of the combination alternative, the NRC staff concludes that the overall air quality impacts associated with operation of the combination alternative would be SMALL to MODERATE.

3.3.8.2 Noise

Construction

Construction-related noise sources for the natural gas portion of the combination alternative would be similar to the NGCC alternative discussed in Section 3.3.7.2 of this SEIS since it would consist of one 764 MW NGCC plant at the Perry Plant site or a brownfield site.

The solar with battery and wind portions of this alternative would have no power block buildings requiring construction. The number of heavy equipment and workforce, level of activities, and construction duration would be lower than those for other alternatives. However, noise levels generated by construction activities of a solar facility can range from 70 to 80 dBA at 50 ft (15 m) (BLM 2019-TN8386). Blasting may be required during construction for turbine foundations (WAPA/FWS 2015-TN8725; BLM 2013-TN8882). Noise levels during construction to nearby sensitive receptors of the solar and wind components of this alternative would depend on the distance from the site to nearby receptors and may be noticeable. Construction of transmission lines would be needed, and noise levels may be noticeable to nearby noise-sensitive receptors along transmission corridors.

The NRC staff concludes that the noise impacts associated with construction of the combination alternative would be SMALL to MODERATE.

Operation

Operation-related noise sources for the natural gas portion of the combination alternative would be similar to the NGCC alternative discussed in Section 3.3.7.2 of this SEIS since it would consist of one 764 MW NGCC plant at the Perry Plant site or a brownfield site. Noise generated by wind turbines would include aerodynamic noise from the blades and mechanical noise from turbine drivetrain components (generator, gearbox). Depending on the location, layout, and proximity of wind turbines to noise-sensitive receptors, noise associated with operation of the wind portion of the combination alternative could be noticeable. Because the solar portion with battery storage of this alternative would have no power block or cooling towers, a minimal number of noise sources, such as transformers and vehicular traffic, would be associated with maintenance and inspection activities.

Given that noise associated with operation of the wind of the portion of the combination could be noticeable, the NRC staff concludes that the noise impacts associated with the combination alternative would be SMALL to MODERATE.

3.4 Geologic Environment

This SEIS section summarizes descriptive information related to the geologic environment of the Perry Plant site and vicinity as provided in Section 3.5 of VistraOps' ER (EH 2023-TN9534), including physiography and landforms, regional and site geology, soils, and seismic history. The descriptive summary is followed by the NRC staff's analysis of the potential impacts on geology and soils from the proposed LR action and alternatives to the proposed action.

3.4.1 Physiography and Geology

Perry Plant is located within the eastern portion of the Central Lowlands physiographic province, a region that covers approximately 585,000 square miles (mi^2) (1,515,143 square kilometers [km^2]). The site lies in the Lake Plains section of that physiographic province. In the site vicinity, the Lake Plains section is approximately 5 mi (8.0 km) wide and characterized by generally low relief terrain along the southeastern shore of Lake Erie. Crystalline basement rocks in the region are Precambrian age (i.e., >541 million years ago [Ma]) and occur at a depth of about 5,000 ft (1,524 m) below ground surface (bgs) in the site region. Crystalline basement is overlain by variable thicknesses of Paleozoic age (541 to 252 Ma) sedimentary rocks and is not exposed anywhere in Ohio. Paleozoic age bedrock directly beneath the Perry Plant site belongs to the Devonian age (419 to 358.9 Ma) Ohio Shale Formation. To the south, the Devonian strata are overlain by younger Paleozoic sediments and Pleistocene age (2.58 to 0.0117 Ma) glacial deposits. The rock units dip gently to the south. Repeated glaciation during the Pleistocene produced the glacial deposits that consist of glacial till and lacustrine deposits of sand, silt, and clay.

Perry Plant is situated near the shoreline of Lake Erie, with the northern boundary of the Perry Plant site along a shoreline bluff approximately 45 ft (13.7 m) high. The bluff consists of three geologic units of Pleistocene age, namely a basal glacial till (silt, sand, and clay) up to 15 ft (4.6 m) thick, overlain by glaciolacustrine silt and clay (i.e., deposits composed of suspended materials carried by glacial meltwater streams that flow into lakes bordering the glaciers) topped by approximately 4 to 7 ft (1.2 to 2.1 m) of silty fine sand. The site of Perry Plant is characterized by relatively flat topography, and the power block structures are about 800 ft (243.8 m) from the bluff. Geologic logs at the Perry Plant site indicate the presence of four geologic units that underlie the site. A cross section of the geology at the Perry Plant site is shown in Figure 3-1. Glacial lacustrine deposits occur from the ground surface down to a depth of approximately 20 ft (6.1 m) bgs. Glacial till is divided into an upper till at a depth of approximately 20 to 30 ft (6.1 to 9.1 m) bgs and a lower till at a depth of approximately 30 to 60 ft (9.1 to 18.2 m) bgs. The lower layer is composed of firmer materials and includes a boulder layer at its base. The basal rock unit in this sequence at the site is Paleozoic age shale starting at a depth of about 50 ft (15.2 m) bgs. All four geologic units at the site generally slope toward Lake Erie. The grade level elevation of the Perry Plant is approximately 620 ft (189.0 m) (EH 2023-TN9534).

3.4.2 Geologic Resources

Ohio is a major producer of salt in the United States. Salt is room-and-pillar mined in Lake County by the Morton Salt Division of Morton Thiokol, Inc. at Fairport Harbor approximately 7.7 mi (12.4 km) west of Perry Plant. Salt was solution mined by the Diamond Shamrock Corp at a facility located approximately 5.6 mi (9.3 km) southwest of Perry Plant. That facility operated from 1912 through 1977 (EPA 2024-TN9937). Offshore salt mining is not allowed near the site by a lease agreement between VistraOps and the State of Ohio (EH 2023-TN9534). Onshore mining near Perry Plant that might be a safety concern would trigger the installation of a subsidence monitoring system to mitigate potential effects on the plant. Sand, gravel, and sandstone deposits are quarried in Lake and surrounding counties (USGS 2024-TN9808). Six active mining permits for industrial materials (sand, gravel, and sandstone) are located within 10 mi (16.1 km) of the Perry Plant site (ODNR 2024-TN9918).

3.4.3 Soils

Natural soils and weathered rock material across the Perry Plant site were graded and disturbed during nuclear power plant construction. Where soils are present and undisturbed in the Perry Plant boundary, mapping by the U.S. Department of Agriculture Natural Resources Conservation Service shows that they consist primarily of Minoa fine sandy loam and Elnora loamy fine sand, which formed on slopes of 1 to 5 percent from parent material of glaciolacustrine deposits. Minoa and Elnora soils cover approximately 29 percent and 30 percent of the total Perry Plant site, respectively, (EH 2023-TN9534: Figure 3.1-2). Additional soils present within the Perry Plant boundary consist of Stafford loamy fine sand (16 percent), Kingsville fine sand (12 percent), Colonie loamy fine sand (7 percent), Lobdell silt loam (4 percent), and Adrian muck (1 percent) (USDA 2024-TN9887). Undisturbed areas of the Perry Plant site with Elnora, Stafford, Kingsville, and Colonie soils on 2 to 6 percent slopes are designated as farmland of unique importance (USDA 2024-TN9887). Minoa and Lobdell soils are designated as prime farmland if they are drained, do not flood, or are protected from flooding during the growing season.

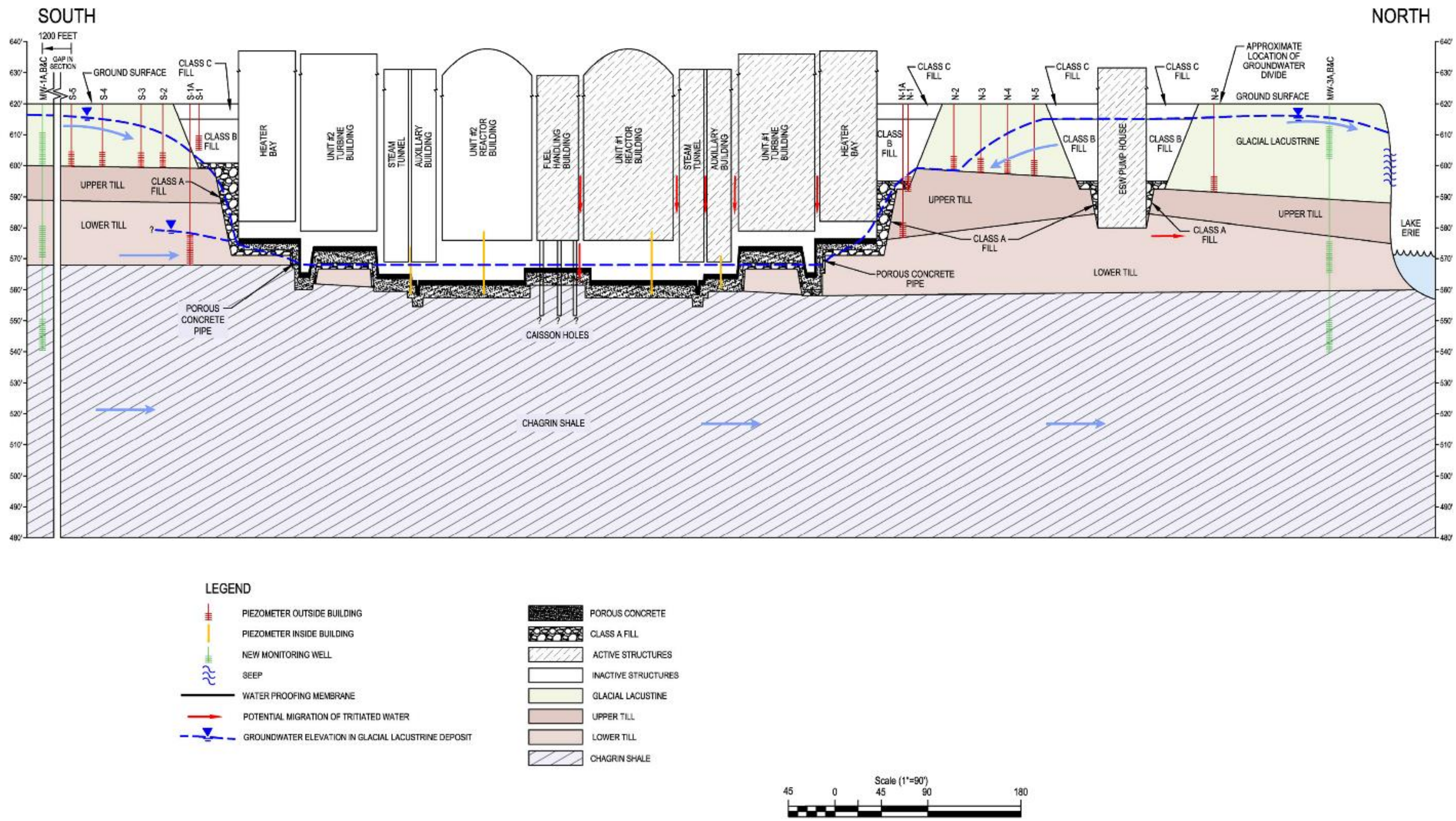


Figure 3-1 Geologic Cross Section of the Perry Nuclear Power Plant Site and Conceptual Model of Groundwater Flow Characteristics. Source: EH 2023-TN9534.

The Natural Resources Conservation Service rates the Adrian, Colonie, Elnora, Kingsville, Lobdell, Minoa, and Stafford soils as very limited for site development with shallow excavations (USDA 2024-TN9887). Aside from areas with severe slopes, the soils have slight erosion potential. The Colonie loamy fine sand on 25 to 50 percent slopes has severe erosion potential, indicating that erosion is very likely (USDA 2024-TN9887). This soil appears on the Perry Plant site on slopes along streams and on the bluffs adjoining Lake Erie. Stabilization measures are used at Perry Plant to prevent erosion and sedimentation impacts (EH 2023-TN9534). Additionally, as required by its State-issued NPDES permit (No. 3IB00016*LD), Energy Harbor, now VistraOps, has also developed and implemented a stormwater pollution prevention plan (SWPPP). This plan identifies best management practices, including nonstructural preventative measures and source controls and structural (engineering) controls, to prevent erosion and to prevent or reduce pollutants, including total suspended solids, in stormwater discharges (EH 2023-TN9534).

Bluff erosion along Lake Erie is managed with two separate revetments along the Perry Plant shoreline and monitored with annual surveys to assess the combined effects of shoreline recession and bluff erosion over time. From 2018 to 2022, approximately 49 ft (14.9 m) of shoreline was lost to erosion. The majority of this loss occurred along a section of shoreline approximately 700 ft (213.4 m) northeast of the Unit 1 cooling tower where current plant erosion protection measures have been implemented with riprap rocks and sheet pile (Vistra 2024-TN9925). This area is outside the boundary of the environmental monitoring and reporting program, as it is beyond the end of sheet piling, However, it is visually monitored on a periodic basis. Additional shoreline protection measures for that area along the northeast shoreline of Lake Erie within the Perry Plant boundary are planned for 2024 (Vistra 2024-TN9925).

3.4.4 Seismic Setting

The NRC evaluates the potential effects of natural hazards, including seismic events, on nuclear power plants on an ongoing basis that is separate from the LR process. All nuclear power plants in the United States are designed and built to withstand strong earthquakes based on their location and nearby earthquake activity. The NRC’s understanding of seismic hazards for a given nuclear power plant may change as the methods of assessing seismic hazards evolve and the scientific understanding of earthquake hazards improves (NRC 2014-TN8997, NRC 2018-TN8998).

Earthquake activity in Ohio has historically been shallow events occurring in the crystalline basement rocks of Precambrian age along pre-existing zones of weakness. Very few faults have surface expressions in Ohio, and no surface faults are known to have had historic earthquakes (Hansen and Fox 2020-TN9938). Between 1970 and April 5, 2024, 49 earthquakes with a magnitude greater than or equal to 3.0 have been recorded within 200 mi (322 km) of Perry Plant (USGS 2024-TN9939). No mining explosions with a magnitude equal to or greater than 3.0 occurred between 1970 and April 5, 2024, within 200 mi (322 km) of Perry Plant.

Following the accident at the Fukushima Dai-ichi nuclear power plant resulting from the March 11, 2011, Great Tohoku Earthquake and subsequent tsunami, the NRC established the Near-Term Task Force to review regulatory insights from the Fukushima Dai-ichi accident as directed by the Commission on March 23, 2011 in COMGBJ-11-0002 (NRC 2011-TN7448). The Near-Term Task Force assessment resulted in the NRC issuing Order EA-12-049 (NRC 2012-TN7947) on March 12, 2012, to nuclear power plant licensees requiring them to mitigate beyond-design-basis external events, and issuing 10 CFR 50.54(f) (TN249) letters directing licensees to conduct seismic and flooding reevaluations (NRC 2012-TN2198). In August 2020, the NRC staff issued its determination that VistraOps had completed its response to the order and the 10 CFR 50.54(f) letter (NRC 2020-TN9941) for Perry Plant.

In 2023, the U.S. Geological Survey published updated seismic hazard maps that included the region encompassing the Perry Plant site (Petersen et al. 2024-TN9940). Seismic hazard (i.e., peak ground acceleration) for a specific location due to shaking induced by an earthquake is expressed as a percentage of *g*, the gravitational acceleration near the Earth's surface, to assess the potential impact of the earthquake on engineered structures. Several factors, including the properties of rock and sedimentary materials through which the earthquake waves travel as well as earthquake magnitude and location, control the level of ground shaking that can occur. Based on the 2023 seismic hazard maps, the Perry Plant site is in an area with a predicted peak horizontal ground acceleration between 0.12–0.16 *g* (acceleration due to gravity on the surface of the Earth) for a 2 percent probability of exceedance in 50 years, corresponding to a return period of about 2,500 years. This acceleration corresponds to a Modified Mercalli Intensity level of VI for a 2 percent probability of exceedance in 50 years, indicating a very low risk for damaging ground shaking of intensity V or greater in the next 50 years. Previous peak horizontal acceleration estimates and intensity levels for the site were 0.12–0.20 *g* and V, respectively (Petersen et al. 2020-TN7281).

The impacts of natural phenomena, including geologic and seismic hazards, on nuclear power plant systems, structures, and components, are outside the scope of the NRC's LR environmental review. Perry Plant was originally sited, designed, and licensed with due consideration for applicable geologic and seismic criteria. Seismic issues at operating nuclear power plants are assessed as part of the NRC's ongoing regulatory oversight. Furthermore, the NRC requires all licensees to consider seismic activity in order to maintain safe operating conditions at all nuclear power plants. When new seismic hazard information becomes available, NRC staff evaluates that information to determine whether any changes are necessary at existing nuclear power plants. This Reactor Oversight Process, which considers seismic safety, is separate and distinct from the staff's LR environmental review.

3.4.5 Proposed Action

The following section addresses the site-specific environmental impacts of Perry Plant LR on the environmental issues identified in Table 3-1 that relate to geology and soils.

NRC staff did not identify any new and significant information associated with the Category 1 geology and soils issues identified in Table 3-1 during the review of the applicant's ER (EH 2023-TN9534), the site audit, the scoping process, or the evaluation of other available information. As a result, no information or impacts related to this issue were identified that would change the conclusions presented in the LR GEIS (NRC 2013-TN2654). For this issue, the LR GEIS concludes that the impacts are SMALL. No incremental impacts related to this Category 1 issue during the renewal term, beyond those discussed in the LR GEIS, are expected to occur.

3.4.6 No-Action Alternative

Under the no-action alternative, there would be few or no incremental impacts on site geology and soils associated with closure of Perry Plant because, prior to initiation of decommissioning activities, little or no new ground disturbance would occur at the Perry Plant site as operational activities are reduced and eventually cease. As a result, NRC staff concludes that the impact of the no-action alternative on geology and soils would be SMALL.

3.4.7 Replacement Power Alternatives: Common Impacts

Construction

During facility construction for replacement power alternatives and associated components, aggregate material (such as crushed stone, riprap, sand, and gravel) would be required to construct buildings, foundations, roads, parking lots, pad sites, transmission lines, and other supporting infrastructure, as applicable. NRC staff presumes these resources would be obtained by commercial suppliers from local or regional sources. Land clearing, grading, and excavation expose soils to erosion and alter surface drainage. NRC staff also presumes that best management practices (BMPs) would be implemented in accordance with applicable State and local permitting requirements to reduce soil erosion and associated offsite impacts. These practices would include measures such as the use of sediment fencing, staked hay bales, check dams, sediment ponds, riprap aprons at construction and laydown yard entrances, mulching and geotextile matting of disturbed areas, and rapid reseeding of temporarily disturbed areas, where applicable. Standard construction practice dictates that topsoil removed during construction and any suitable excavated materials would be stored onsite for redistribution such as for backfill at the end of construction.

Operations

Replacement power facilities would be built in accordance with applicable State and local building codes and would consider such siting and design factors to mitigate potential impacts from natural phenomena. Once facility construction is completed, areas disturbed during construction would be within the footprint of the completed facilities, overlain by other impervious surfaces (such as roadways and parking lots), or revegetated or stabilized as appropriate, so there would be no additional land disturbance and no direct operational impacts on geology and soils. Consumption of aggregate materials or topsoil for maintenance purposes during operations would be negligible.

3.4.8 Natural Gas-Fired Combined-Cycle Alternative

The impacts on geologic and soil resources from construction and operations associated with the NGCC alternative would likely be similar to those described and assumed as being common to all alternatives described in Section 3.4.7. According to the applicant's ER, the NGCC would be constructed on the Perry Plant site or at another site previously used for energy generation. NRC staff estimated the land use requirements as noted in Section 3.2.5.1 for the NGCC facility, MDCTs, and associated structures including but not limited to support structures and exhaust stacks. New pipeline infrastructure would be minimal if located on the Perry Plant site as a natural gas pipeline crosses the site.

Implementation of the NGCC alternative would use existing transportation and transmission line infrastructure, which would reduce construction impacts and related impacts on site geology and soils, as well as consumption of geologic resources. Disturbance of geologic strata and soil erosion and loss under this alternative would generally be localized to the construction sites, and offsite soil erosion impacts would be mitigated by using BMPs. Based on these considerations, the NRC staff concludes that the potential impacts on geology and soil resources from the NGCC would be SMALL.

3.4.9 Renewable and Natural Gas Combination Alternative

Under this combination alternative, the impacts on geologic and soil resources would likely be similar to, but greater in overall magnitude, than those described and assumed to be common to all alternatives in Section 3.4.7, and greater than those under the NGCC alternative in Section 3.4.8. This greater potential for impacts is driven primarily by the substantial land area that would be disturbed at multiple offsite locations for new wind and solar installations, transmission lines, and development of new transmission corridors, in addition to the impacts associated with the NGCC component of this alternative. Overall impacts would be driven by the potential for soil erosion and loss of natural soils and sediments from the conversion of land to industrial uses for the buildout of the solar and wind components of the alternative. NRC staff presumes that potential soil erosion impacts would be mitigated by the implementation of BMPs in accordance with applicable State and local permitting requirements. Based on these considerations, NRC staff concludes that potential impacts on geology and soil resources from the combination alternative could range from SMALL to MODERATE.

3.5 Water Resources

This section describes surface water and groundwater resources at and around the Perry Plant site. The description of the resources is followed by the NRC staff’s analysis of the potential impacts on surface water and groundwater resources of the proposed action (LR) and alternatives to the proposed action.

3.5.1 Surface Water Resources

Surface water encompasses all water bodies that occur above the ground surface, including rivers, streams, lakes, ponds, and human-made reservoirs or impoundments.

3.5.1.1 Surface Water Hydrology

Local and Regional Hydrology

The Perry Plant site is located along the southern shore of Lake Erie (Figure 3-2). Lake Erie is the major surface water feature near the site. Lake Erie, one of the five Great Lakes of North America, has a surface area of 9,910 mi^2 (25,700 km^2), and the Lake Erie watershed encompasses approximately 30,140 mi^2 (78,060 km^2) (ODNR 2018-TN9608). Lake Erie stores around 127.7 trillion gal (119 cubic miles [mi^3]) of fresh water (ODNR 2018-TN9608). The Perry Plant site is located in a small, 27.7 mi^2 (71.7 km^2) gently sloping coastal watershed with U.S. Geological Survey (USGS) hydrologic unit code 041100030204 (USGS 2024-TN9942). The site is located in the Erie Lake Plains physiographic region characterized by beach ridges and coastal bluffs (ODNR 2018-TN9608). Several small streams drain the coastal watershed via northward flow into Lake Erie (Figure 3-2). The stream morphology near the site is described as generally having narrow, deeply incised channels (EH 2023-TN9979). Grand River, the major stream in the area, runs east–west approximately 4 mi (6 km) south of the site (Figure 3-2). Grand River is separated from the coastal watershed by a steep ridgeline.

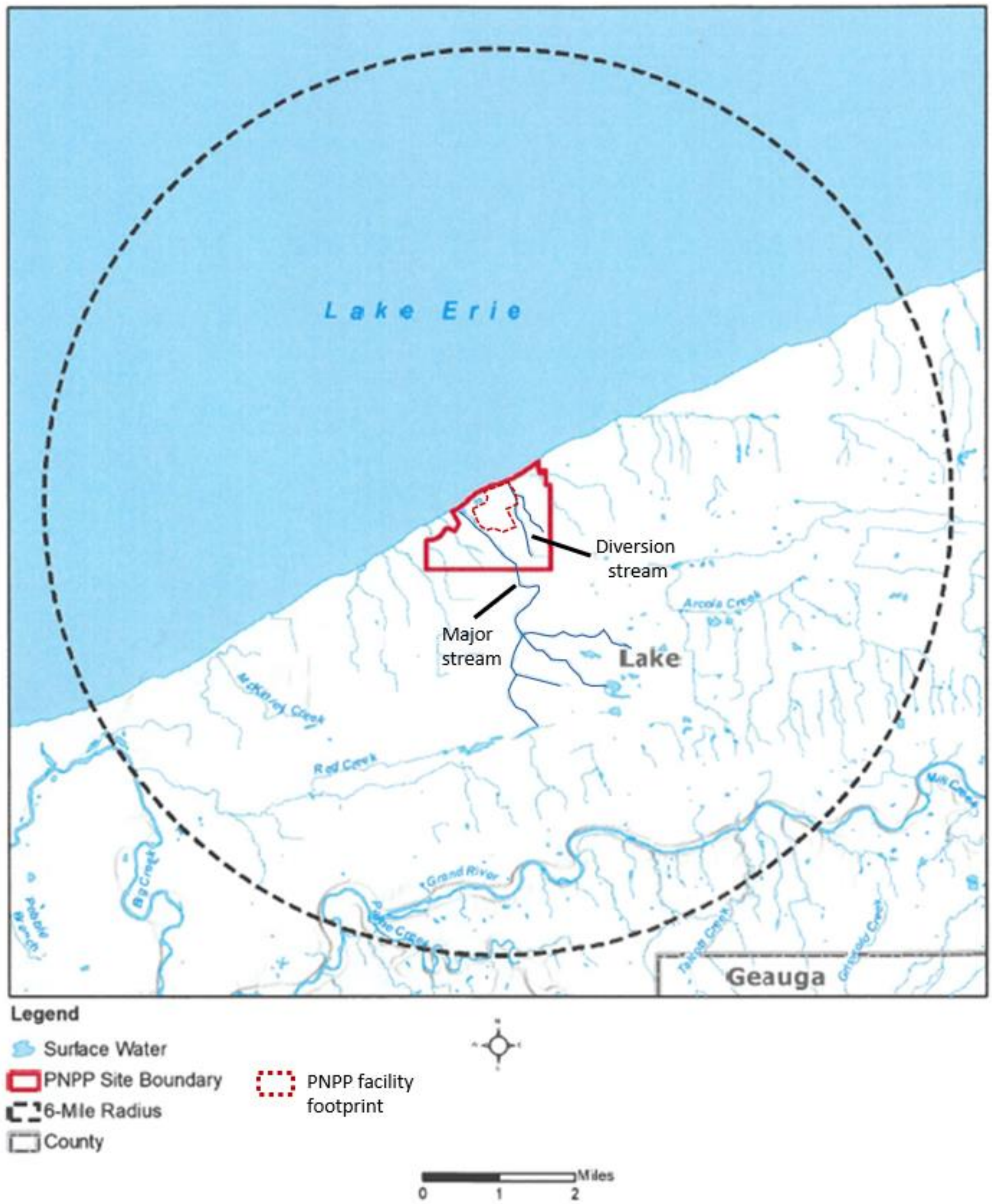


Figure 3-2 Major Surface Water Features near the Perry Nuclear Power Plant Site. Adapted from: EH 2023-TN9534.

The two closest streams to Perry Plant are unnamed but are referred to in planning documents as the Major Stream, located to the west and south of the site, and the Diversion Stream, located to the east of the site (Figure 3-2). None of the streams support any surface water users (EH 2023-TN9534). The Major Stream has a drainage area of 7.44 mi^2 (19.3 km^2) and is located within 1,000 ft (305 m) of the southwestern boundary of the plant site. The Diversion Stream has a drainage area of 0.59 mi^2 (1.5 km^2) and lies along the eastern boundary of the Perry Plant site. Stream gage records are not available for either of the nearby streams. Estimated average flows for the Major Stream and Diversion Stream are 5 cubic feet per second and 0.78 cubic feet per second, respectively (EH 2023-TN9979).

Due to its large surface area and volume, wet hydroclimate, and large watershed, Lake Erie is a highly reliable source of freshwater. In an over 124-year period of record (January 1900–March 2024) at National Oceanic and Atmospheric Administration (NOAA) tidal gauge 9063063 located in Cleveland, Ohio, the monthly water level of Lake Erie fluctuated less than 10 ft (3 m), with a low water level of 566.31 ft mean sea level (msl) and a high of 575.34 ft msl (NOAA 2024-TN10013). Lake Erie is the only source of service and makeup water for Perry Plant. The intake is located at a depth of 20 to 23 ft (6.1 to 7.0 m) below mean water level and 12 ft (3.7 m) below the historical low lake level (EH 2023-TN9979).

Flooding

Potential sources of flooding for the Perry Plant site are the two streams to the east and west of the Perry Plant site, Lake Erie to the north, and local runoff generated from precipitation within the site footprint. There are no records of flooding in the plant facility area from either of the nearby streams or from Lake Erie (EH 2023-TN9534). The Federal Emergency Management Agency classifies a small area within the site boundary bordering the Major Stream as lying within the estimated 100-year floodplain (Zone A), while the rest of the area within the site boundary is classified as an area of minimal flood hazard (Zone X) (Figure 3-3 – Adapted from EH 2023-TN9534). The entirety of the Perry Plant facility footprint is designated as having minimal flood hazard (Figure 3-3). The northern site boundary bordered by Lake Erie is classified by the Federal Emergency Management Agency as a coastal area with a greater than 1 percent coastal flooding (Zone VE) and with additional hazard from storm waves. Grade elevations of the plant area range from 617 to 620 ft msl, while the maximum monthly mean lake elevation is 575.4 ft msl (EH 2023-TN9979). Windy conditions can cause several additional feet of water level fluctuation, but even under severe conditions, Lake Erie is unlikely to cause flooding of the plant area, which lies more than 40 ft above the mean high monthly water level of Lake Erie.

The onsite drainage system is designed for peak rainfall intensities of 13.19 inches/hour (in./h) or (33.5 cm/hour) and a 48 hour precipitation of 34.72 in. (88.19 cm) (EH 2023-TN9534). During a local intense precipitation event, the drainage system reduces the effects of flooding, but some onsite floodwater accumulation is possible.

In accordance with the NRC's General Design Criteria (Appendix A to 10 CFR Part 50 [TN249]), plant SSCs important to safety are designed to withstand the effects of natural phenomena, such as flooding, without loss of capability to perform safety functions. The Perry Plant site is designed and located such that the site is protected from flooding by the nearby small streams and Lake Erie. The plant grade lies over 40 ft (12 m) above the maximum monthly mean recorded water surface elevation in Lake Erie, and possible wind and wave action would only add several additional feet to the maximum water surface (EH 2023-TN9534).

Additionally, the NRC evaluates nuclear power plant operating conditions and physical infrastructure to ensure ongoing safe operations through its Reactor Oversight Process. If new information about changing environmental conditions becomes available, the NRC will evaluate the new information to determine whether any safety-related changes are needed.

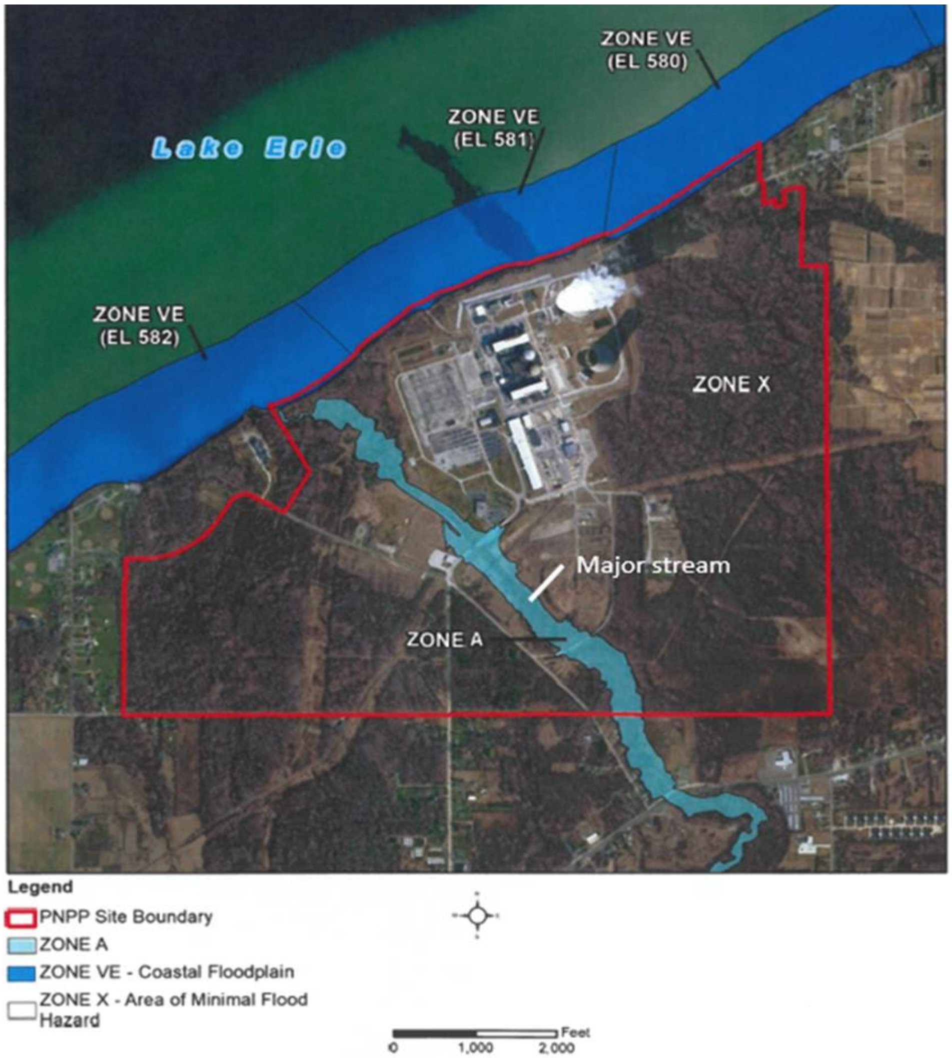


Figure 3-3 Federal Emergency Management Agency Flood Zone Classification for the Perry Nuclear Power Plant Site. Adapted from: EH 2023-TN9534.

3.5.1.2 Surface Water Use

In the vicinity of Perry Plant, potable water for municipalities is primarily obtained from Lake Erie (EH 2023-TN9534). Some domestic users also have private wells. Perry Plant obtains its potable and sanitary water from the Lake County Department of Utilities (EH 2023-TN9534). Perry Plant uses a closed-cycled circulating cooling system (EH 2023-TN9534). Perry Plant withdraws water from Lake Erie using two 6 ft (2 m) diameter intake structures located 2,600 ft (790 m) offshore (Table 3-4). Water from Lake Erie is moved on shore through a 10 ft (3 m) diameter tunnel that connects the intake structures to two onshore pumphouses, referred to as the service water and ESW pumphouses. The service water system is an open-loop network where water sourced from the intake structures is pumped through the heat exchangers and routed to the cooling tower basin as makeup. Excess water not required for makeup is returned to Lake Erie via the discharge water return. Flow rates of makeup flow routed to the cooling tower range from 16,000 to 25,979 gallons per minute (gpm) (60,567 to 98,341 liters per minute [lpm]) (EH 2023-TN9979).

Lake Erie is the only source of service and makeup water for Perry Plant. Perry Plant is registered as a water withdrawal facility with the Ohio Department of Natural Resources. There is no annual limit on water withdrawals from Lake Erie by Perry Plant, and no permit is required for water withdrawal from Lake Erie (EH 2023-TN9534).

None of the nearby streams are sources of water (EH 2023-TN9534). The former Neff Perkins Corporation used to withdraw water from a pond near the Major Stream, but is no longer in operation (EH 2023-TN9534).

As shown in Table 3-9 below, between 2019 and 2023, the annual total surface water withdrawals from Lake Erie averaged 31,887 millions of gallons per year (MGY) (87.36 millions of gallons per day [MGD]); 2019 to 2021 data were reported in ER Table 3.6-4a (EH 2023-TN9534), and 2022 to 2023 data were provided by VistraOps in response to a request for confirmation of information (RCI) (Vistra 2024-TN9925). Total annual surface withdrawals ranged from a minimum of 29,676 MGY (81.3 MGD) in 2022 to a maximum of 34,344 MGY (94.09 MGD) in 2019. Monthly withdrawals over the same period ranged from 2,007 millions of gallons per month (MGM) to a maximum of 3,656 MGM, as reported in ER Table 3.6-4a (EH 2023-TN9534) and data provided as RCI by VistraOps (Vistra 2024-TN9925). The average total monthly surface withdrawal from Lake Erie between 2019 and 2023 was 2,657 MGM.

Table 3-9 Surface Water Withdrawals from Lake Erie for Perry Nuclear Power Plant Operations

Year	Monthly Average (MGM)	Monthly Minimum (MGM)	Monthly Maximum (MGM)	Yearly Total (MGY)
2019	2,862	2,326	3,656	34,344
2020	2,750	2,326	3,411	32,999
2021	2,642	2,208	3,235	31,703
2022	2,472	2,007	3,036	29,676
2023	2,559	2,152	3,524	30,714

All reported values are rounded. MGM = million gallon(s) per month, MGY = million gallon(s) per year.
Source: EH 2023-TN9534, Vistra 2024-TN9925.

The closest water intake structure on Lake Erie is located 3.5 mi (5.6 km) west–southwest of the Perry Plant site but is not in use and is associated with the former IRC Fiber plant (EH 2023-TN9534).

3.5.1.3 Surface Water Quality and Effluents

<u>Water Quality Assessment and Regulation</u>

In accordance with Section 303(c) of the Federal Water Pollution Control Act (i.e., Clean Water Act of 1972, as amended [CWA; 33 U.S.C. 1251-1388; TN662]), states have the primary responsibility for establishing, reviewing, and revising water quality standards for the Nation’s navigable waters. Such standards specify the designated uses of a water body or water body segment, the water quality criteria necessary to protect those designated uses, and an anti-degradation policy with respect to ambient water quality. As established under Section 101(a) of the CWA, water quality standards are intended to restore and maintain the chemical, physical, and biological integrity of the Nation’s waters and to attain a level of water quality that provides for designated uses. The EPA reviews each State’s water quality standards to ensure they meet the goals of the CWA and Federal water quality standards regulations (40 CFR Part 131 [TN4814], “Water Quality Standards”).

Section 303(d) of the CWA requires States to identify all “impaired” waters for which effluent limitations and pollution control activities are not sufficient to attain water quality standards in such waters. Similarly, CWA Section 305(b) requires States to assess and report on the overall quality of waters in their State. States prepare a CWA Section 303(d) list that identifies the water quality limited stream segments that require the development of total maximum daily loads (TMDLs) to assure future compliance with water quality standards. The list also identifies the pollutant or stressor causing the impairment and establishes a priority for developing a control plan to address the impairment. The TMDLs specify the maximum amount of a pollutant that a water body can receive and still meet water quality standards. Once established, TMDLs are often implemented through watershed-based programs administered by the State, primarily through permits issued under the NPDES permit program, pursuant to Section 402 of the CWA, and associated point and nonpoint source water quality improvement plans and associated BMPs. States are required to update and resubmit their impaired waters list every 2 years, which ensures that impaired waters continue to be monitored and assessed by the State until applicable water quality standards are met. Under CWA Sections 305(b) and 303(d), Ohio compiles an integrated report of surface water quality every 2 years in even-numbered years. The 2022 assessment of surface water quality was completed in March 2022 (OEPA 2024-TN9894; EPA 2022-TN9895, EPA 2022-TN9896, EPA 2022-TN9897). The 2022 list of 303(d) impaired waters (Category 5) contains three listed impaired waters within the 6 mi (10 km) radius of the Perry Plant site (EH 2023-TN9534). The impaired waters include the McKinley Creek Frontal Lake Erie watershed, the Lake Erie Central Basin Shoreline, and the Grand River mainstem. The McKinley Creek Frontal Lake Erie watershed is the name for the small coastal watershed where the Perry Plant is located (12-digit USGS HUC: 041100030204). The McKinley Creek Frontal Lake Erie watershed was listed as impaired for recreational use due to the presence of *Escherichia coli*. The Lake Erie Central Basin Shoreline, a large region of Lake Erie that extends along the southern shoreline of Lake Erie from west of Cleveland to the Ohio-Pennsylvania State boundary, was listed as impaired for polychlorinated biphenyls. Grand River, located to the south of the Perry Plant site, was listed as impaired for recreational use due to the presence of *Escherichia coli* and polychlorinated biphenyls in fish tissue. Perry Plant has remained in compliance with its NPDES permit and is not a source for any of the listed nearby impairments (EH 2023-TN9534).

<u>Ohio Pollutant Discharge Eliminating System Permitting Status and Plant Effluents</u>

To operate a nuclear power plant, NRC licensees must comply with the CWA, including associated requirements imposed by the EPA or the State, as part of the NPDES permitting system under Section 402 of the CWA. The Federal NPDES permit program addresses water pollution by regulating point sources (i.e., pipes, ditches) that discharge pollutants to waters of the United States. NRC licensees must also meet State water quality certification requirements under Section 401 of the CWA. The EPA or the States, not the NRC, sets the limits for effluents and operational parameters in plant-specific NPDES permits. Nuclear power plants cannot operate without a valid NPDES permit and a current Section 401 Water Quality Certification.

As described in the ER, Perry Plant applied for CWA Section 401 Water Quality Certification on December 19, 2014 (FENOC 2014-TN10373). In a letter dated January 30, 2017, OEPA issued Section 401 Water Quality Certification to Perry Plant (FENOC 2014-TN10373). In its January 30, 2017, letter, OEPA confirmed that CWA Section 401 Water Quality Certification shall remain valid and in effect so long as the NRC operating license for Perry Plant is in effect. Based on the staff's review of this correspondence and applicable regulatory requirements in effect at the time the OEPA rendered its CWA Section 401 determination, the staff has determined that the certification remains valid, and no further action is required by the NRC as the responsible Federal licensing or permitting agency as related to the CWA Section 401 certification process.

Since August 1992, the Ohio EPA has the authority to administer the NPDES program (OEPA 2024-TN9944). OEPA regulates discharges of pollutants to Ohio surface waters. Perry Plant Unit 1 operates under OEPA Permit No. 3IB00016*MD (EH 2023-TN9746), which allows VistraOps to treat and discharge waste from three outfalls at Perry Plant Unit 1, one external to Lake Erie (004/094), and two internal (601 and 603) (Figure 3-4). In the permit issuance letter, OEPA confirmed that the Section 401 Water Quality Certification will remain valid and in effect for the duration of the NRC operating license (EH 2023-TN9534). The most recent NPDES permit (No. 3IB00016*MD) was issued on August 31, 2023, and is effective from October 1, 2023, to September 30, 2028 (EH 2023-TN9746).

Outfalls 094 and 004 are external and co-located. Outfall 004 corresponds to the final effluent discharge to Lake Erie. The other two, Outfalls 601 and 603, are internal outfalls. The Perry Plant NPDES permit also includes three surface impoundments that are used for stormwater management. The three impoundments are listed as the major stream impoundment, minor stream impoundment, and the northwest storm drainage impoundment (EH 2023-TN9534). Under OEPA Permit No. 3IB00016*MD (EH 2023-TN9746), process wastewaters from Unit 1 are monitored and discharged to Lake Erie using Outfall 004/094. There are two internal outfalls, Outfalls 601 and 603, whose discharges are also required to be monitored.

At Outfall 004, located offshore in Lake Erie, Perry Plant is permitted to discharge cooling water and effluent routed to 004 from internal Outfalls 601 and 603. There is no daily discharge and no temperature limit for discharge at Outfall 004, but both parameters are required to be monitored continuously. Loading limits for constituents are based on a flow of 88.23 MGD. The potential of hydrogen (pH) must remain between 6.5 and 9.0 with measurements taken once per day, residual chlorine cannot exceed 0.2 mg/L and must be measured when chlorination treatment is discharged, residual oxidants cannot exceed 0.025 mg/L and must be measured when bromination treatment is discharged, permissible maximum level of mercury is 1,700 nanograms per liter (ng/L) with a maximum monthly average of 6.4 ng/L and must be measured once per month, and chlorination/bromination must be limited to 120 minutes (min). Sampling for residual chlorine and oxidants is required when chlorination/bromination treatment waters are discharged.

Outfall 094 is co-located with Outfall 004 and is permitted to discharge effluent from bromination/chlorination treatment. There are no daily discharge or temperature limits, but both parameters need to be continuously monitored. Loading limits for constituents are based on a flow of 88.23 MGD. The pH must remain between 6.5 and 9.0 with measurements taken once per day, residual chlorine cannot exceed 0.038 mg/L and must be sampled when chlorination treatment waters are discharged, residual oxidants cannot exceed 0.0048 mg/L and must be sampled when bromination treatment waters are discharged, and mercury has a daily maximum of 1,700 ng/L and a maximum monthly average of 6.4 ng/L and must be measured once per month.

Figure 3-4 Perry Nuclear Power Plant Ohio Pollutant Discharge Elimination System Permitted Outfalls. Adapted from: EH 2023-TN9534.

Internal Outfall 601 has no limits on discharge, but flow rate needs to be continuously measured to record total 24 h daily flow. Outfall 601 discharges the regenerant neutralization pits and is routed to Outfall 004, which discharges into Lake Erie. Total suspended solids have 100 mg/L maximum and 30 mg/L monthly limits (measured every 2 weeks), and oil and grease have 20 mg/L maximum and 15 mg/L monthly limits (measured every 2 weeks). There are no pH limits, but pH is required to be sampled every 2 weeks.

Internal Outfall 603 has no limits on discharge, but flow rate needs to be continuously measured to record total 24 h daily flows. Discharge from Outfall 603 comprises wastewater from the reverse osmosis system and is ultimately discharged to Lake Erie via Outfall 004. Total suspended solids have 100 mg/L maximum and 30 mg/L monthly concentration limits (measured every 2 weeks), oil and grease 20 mg/L maximum and 15 mg/L monthly concentration limits (measured every 2 weeks). The are no pH limits, but pH is required to be sampled every 2 weeks. There is no concentration limit for total filterable residue, but it is required to be monitored quarterly.

Other Surface Water Resources Permits and Approvals

Stormwater discharges from the Perry Plant site are permitted under OEPA NPDES Permit No. 3IB00016*MD (EH 2023-TN9746). Perry Plant is required to implement and maintain an SWPPP. The SWPPP identifies pollutant sources and includes BMPs that help prevent or reduce contaminants in stormwater discharge.

Under CWA Section 311(j)(1)(C), Perry Plant is required to develop a spill prevention, control, and countermeasures (SPCC) plan. The Perry Plant SPCC plan identifies and describes the procedures, materials, equipment, and facilities to minimize the frequency and severity of any oil spills (EH 2023-TN9534). Nonradioactive spill response procedures are part of Perry Plant’s Oil and Chemical Release Contingency Plan (EH 2023-TN9534). These procedures identify site personnel responsibilities and response protocols.

Under 40 CFR Part 110 (TN8485), Perry Plant is required to report discharges of oil in quantities that may be harmful to public health, welfare, or the environment as described in Section 311(b)(4) of the Federal Water Pollution Control Act. Discharge of oil in quantities exceeding those identified in CWA Section 311(b)(4) must be reported to the EPA’s national response center. Perry Plant is also subject to ORC 3750.06, which requires reporting (1) releases of extremely hazardous substances defined by 40 CFR Part 355 Appendices A and B (TN5493), (2) Comprehensive Environmental Response, Compensation, and Liability Act of 1980 hazardous substances defined by Table 302.4 in 40 CFR Part 302 (TN5489), or (3) releases of oil in excess of 25 gallons (gal) to the environment or any quantity that creates visible film or sheen on navigable waters (EH 2023-TN9534). Releases must be reported to the local fire department, local emergency planning, and the OEPA within 30 min. If there is a release to navigable waters, the National Response Center must also be notified. The initial notification is required to be followed up by a written emergency notice that must be submitted within 30 days of the incident to the OEPA Emergency Response section, the local planning committee district, and the State Emergency Response Commission (EH 2023-TN9534). Following reporting, VistraOps is required to clean up and remediate any spills.

Currently, Perry Plant has no planned dredge and fill activities (EH 2023-TN9534). Therefore, Perry Plant does not have a CWA Section 404 permit.

As described in Section 3.5.2.1 and 3.5.2.5 of this SEIS, an underdrain system is used at Perry Plant to maintain groundwater elevations. Water collected in the underdrain system is removed using two systems—a pump system and a gravity drain system. The underdrain system discharges approximately 30 gpm (113.6 lpm) to the ESW forebay (Vistra 2024-TN9925). The ESW forebay is connected to the suction bay during normal operations, and both are hydraulically connected to Lake Erie. The combined volume of the ESW forebay and the suction bay is approximately 600,000 gal (2.7×10^6 L) (Vistra 2024-TN9925). The combined volume of the ESW forebay and the suction bay provides initial dilution of the underdrain system discharge, and Lake Erie’s large volume provides additional, much greater dilution.

3.5.2 Groundwater Resources

This SEIS section describes the groundwater flow systems (aquifers) and groundwater quality in and around Perry Plant. Aquifers are a geologic formation, or a group of formations, or part of a formation that contains sufficient saturated, permeable material to yield significant quantities of water to wells and springs.

3.5.2.1 Local and Regional Groundwater Resources

Sections 3.5.2 and 3.6.2 of the applicant’s ER describe the regional geology and groundwater resources, respectively, in the vicinity of Perry Plant (EH 2023-TN9534). NRC staff also evaluated information related to groundwater resources during the site audit, scoping process, and review of other available information as cited in this SEIS.

The Perry Plant is located in northeastern Ohio in Lake County within the Glaciated Central hydrogeologic region (Aller and Ballou 1991-TN9946). As described in Section 3.4.1 of this SEIS, the region was subject to repeated glaciation during the Pleistocene. As a result, glaciolacustrine sediments (i.e., deposits composed of suspended materials carried by glacial meltwater streams that flow into lakes bordering the glaciers) are regionally present overlying glacial till. The Painesville Lacustrine Aquifer of silt, sands, and gravels is the principal water bearing unit in the county; however, well yields are typically less than 3 gpm (11 lpm) (ODNR 2018-TN9608). Although the main bedrock aquifers in Ohio are consolidated sandstones and carbonate rocks, Devonian age shale bedrock is confined below the glacial till in Lake County. Well yields from the shale are typically only adequate for domestic use (less than 2 gpm [7.6 lpm]) (Aller and Ballou 1991-TN9946; Shmidt 1994-TN9947). Crystalline bedrock underlies the shale regionally at depths of approximately 5,000 ft below sea level (EH 2023-TN9534).

As described in Section 3.4.1 and depicted in Figure 3-1 of this SEIS, the Perry Plant site is underlaid by glaciolacustrine deposits of fine sand and clayey silt (EH 2023-TN9534). The glaciolacustrine deposits represent the main water bearing unit onsite and occur at depths from 0 to 20 ft bgs (6 m bgs). Hydraulic properties of the unit vary vertically and horizontally, resulting in a semi-perched groundwater condition. Prior to onsite construction activities, groundwater elevations in the glaciolacustrine deposits at Perry Plant generally ranged from 3–5 ft bgs (0.9–1.5 m bgs) (EH 2023-TN9534). The glaciolacustrine deposits terminate in an upper glacial till layer, which contributes little to no water to onsite aquifers. The lower permeability upper and lower till confine the underlying shale bedrock aquifer. The shale bedrock is the Chagrin unit of the Ohio Shale Formation. The unit is up to 1,200 ft (366 m) thick in northeastern Ohio (Hansen and Fakhari 2023-TN9948) and was excavated during construction to an elevation of 560 ft msl (171 m msl) (EH 2023-TN9534).

Within Lake County and the wider Lake Erie watershed, precipitation is the primary source of groundwater recharge. The annual net aquifer recharge to the glaciolacustrine deposits is estimated to be approximately 4 to 7 in. (10 to 18 cm) (ODNR 2018-TN9608). The shale bedrock aquifer is largely confined by a layer of low-permeability glacial till and locally receives minor amounts of rechange from the glaciolacustrine deposits (EH 2023-TN9534). In Lake County, groundwater flow within the bedrock aquifer is toward Lake Erie. At the Perry Plant site, prior to onsite construction activities, groundwater flow time from the radioactive waste building to Lake Erie was estimated to be 25 years using a gradient of 0.015, a hydraulic conductivity of 1.13 ft/day (4×10^{-4} cm/s), and an effective porosity of 0.2. VistraOps also used a conservative travel distance of 800 ft (240 m) from the radioactive waste building to the bluff of the lake to calculate groundwater flow time. This distance is based on the assumption that 200 ft (61 m) of bluff recession would occur during the life of the plant (EH 2023-TN9979).

Local, post-construction groundwater conditions have been altered by the presence of an underdrain system within the plant footprint. The underdrain system consists of 1 ft (0.3 m) diameter porous concrete pipe within a porous concrete blanket underlying the power block structures (EH 2023-TN9534). Groundwater collected in the concrete blanket is carried by the pipe to collection manholes, where it is either pumped or fed by gravity into the underdrain discharge system, intercepting flow within the glaciolacustrine deposits around the power block. The system is designed to reduce groundwater elevations below 568 ft msl (173.13 m msl) beneath the primary plant structures and to prevent groundwater levels from exceeding 590 ft msl (179.8 m msl) in the event of an accidental release (EH 2023-TN9979). Where the glaciolacustrine and glacial till deposits have been excavated to intercept the shale bedrock, the underdrain system likely captures some amount of groundwater from the shale.

VistraOps estimates the radius of influence of the underdrain system groundwater level drawdown to be less than 500 ft (152 m), or within the plant boundaries (EH 2023-TN9534). The system creates a local groundwater divide between groundwater captured by the underdrain system and groundwater that is not influenced by the underdrain system. The underdrain system is depicted in Figure 3-5.A map of groundwater contours derived from April 2020 groundwater elevations and the approximate boundary of the groundwater divide induced by the underdrain system is shown in Figure 3-6.

The horizontal hydraulic conductivity, or the amount of water than can flow through a cross-sectional area of the aquifer per unit time, of glaciolacustrine deposits was measured during construction. The values ranged from 4.2×10^{-7} to 1.2×10^{-4} cm/s (0.001 to 0.34 ft/day) (EH 2023-TN9534). VistraOps assumes the glaciolacustrine deposits exhibit the largest relative hydraulic conductivity, and therefore, contribute the most water to the underdrain system. The underdrain system has a design inflow rate of 80 gpm (303 lpm) and discharges approximately 30 gpm (113.6 lpm) to the ESW forebay (Vistra 2024-TN9925).

The Perry Plant is not situated within the boundary of an EPA-designated sole source aquifer, the nearest of which is approximately 89 mi (143 km) to the southwest of the site (EPA 2024-TN9950). Therefore, the Perry Plant poses negligible risk to any sole source aquifer.

3.5.2.2 Local and Regional Water Consumption

The majority of water supplied to Lake County is sourced from surface water, predominantly Lake Erie (LCO 2024-TN9964). Groundwater use in the county is limited due to low groundwater well yields from the glaciolacustrine deposits and the underlying Chagrin Shale. In 2015, domestic groundwater use was the primary consumer of groundwater in Lake County (EH 2023-TN9534). There are currently 4,301 registered supply wells in Lake Country, of which 3,287 are categorized as domestic use. Wells are predominantly completed in the bedrock aquifers. Table 3-10 displays current registered production wells in Lake County.

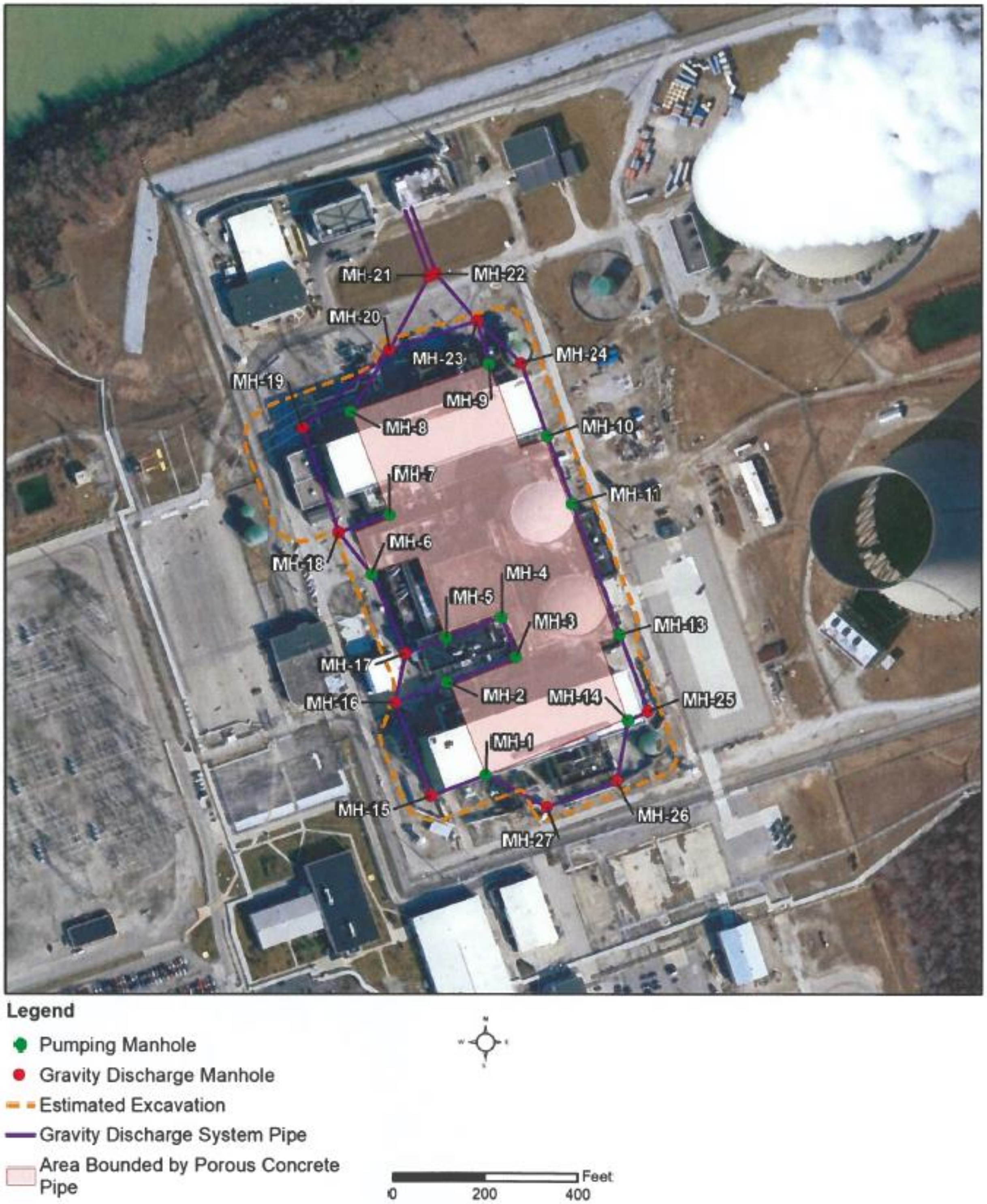


Figure 3-5 Underdrain System Map at Perry Nuclear Power Plant. Source: EH 2023-TN9534.

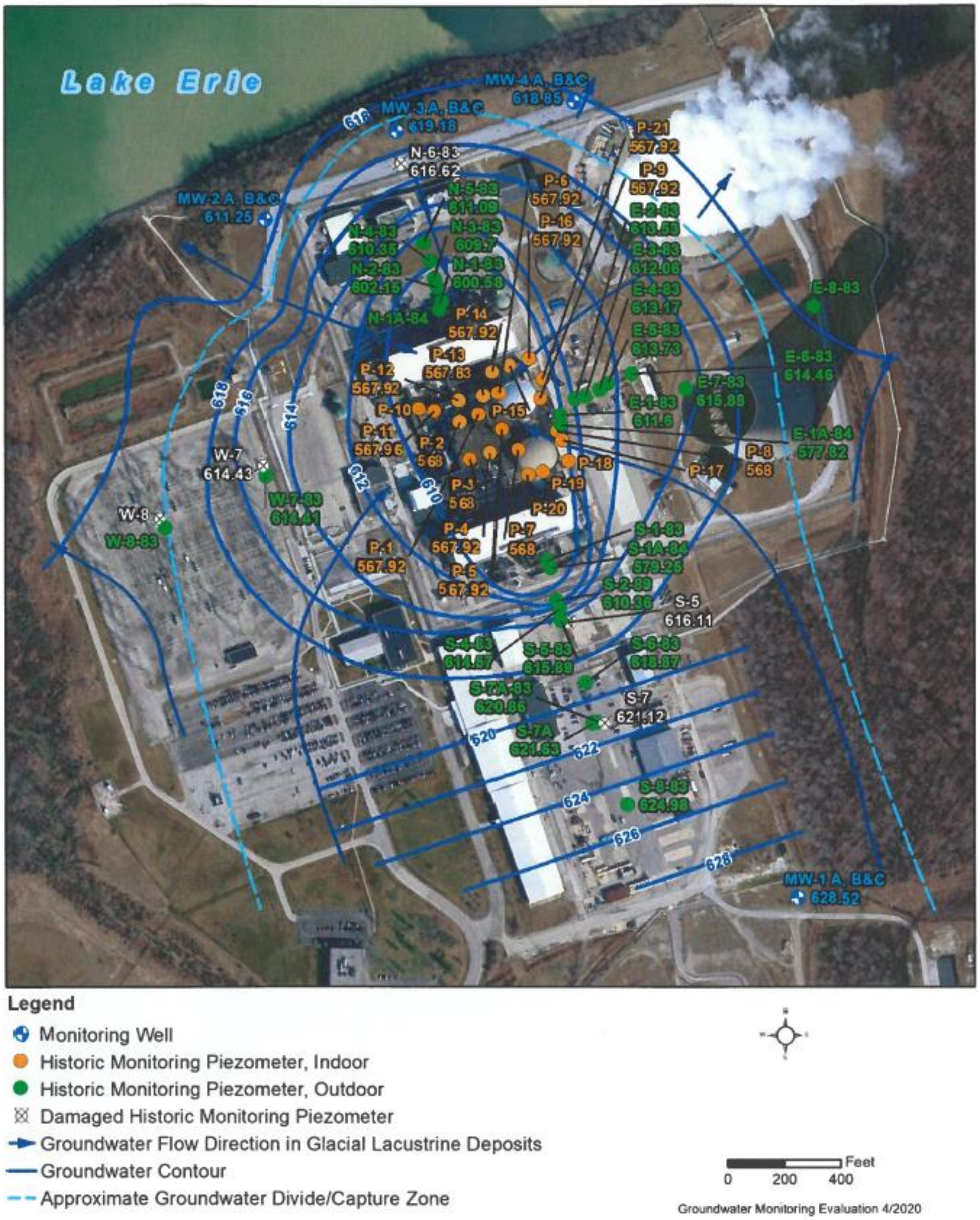


Figure 3-6 April 2020 Groundwater Contour Map of the Perry Nuclear Power Plant Site. Source: EH 2023-TN9534.

Table 3-10 Registered Water Production Wells in Lake County, April 2024. Source: ODNR 2024-TN10046.

Well Use Type	Aquifer Type: Unconsolidated (Sands, Gravels, Silts, Clays, Fill)	Aquifer Type: Bedrock (Sandstone, Shale, and/or Siltstone)	Aquifer Type: Unknown	Total
Agriculture/Irrigation	53	29	6	**88**
Commercial	7	4	0	**11**
Dewatering well	14	0	4	**18**
Domestic	885	2,364	38	**3287**
Heating/Cooling	14	48	0	**62**
Industrial	3	3	0	**6**
Municipal(b)	7	0	0	**7**
Other	1	6	0	**7**
Public/Semi-pub(c)	15	9	0	**24**
Recovery well	5	0	0	**5**
Unidentified	188	583	15	**786**
Total	**1,192**	**3,046**	**63**	**4,301**

(a) Includes wells completed in both bedrock and unconsolidated material. For example, “Clay and Shale.”
(b) Municipal: city, village, or town.
(c) Public/Semi-pub: schools, restaurants, gas stations, and rest areas.
Source: (ODNR 2024-TN10046).

In the vicinity of the Perry Plant site, there are 72 registered wells within a 2 mi (3.2 km) radius of the center of the site (i.e., centered on the reactor unit buildings) (ODNR 2024-TN10046). VistraOps states all water supply wells on the Perry Plant site have been abandoned (EH 2023-TN9534). The nearest recorded offsite well is a domestic well completed to a depth of 32 ft bgs (9.8 m bgs) within silt and clay. The well is approximately 0.7 mi (1.1 km) northeast of the site center.

The Perry Plant site does not use groundwater for any plant needs. Potable water and backup fire service water are provided by the Lake County Department of Utilities, which sources water from Lake Erie (LCO 2024-TN9964).

3.5.2.3 Groundwater Quality

Groundwater in Ohio is generally of good quality and managed at a State level by the Ohio Environmental Protection Agency. High priority sources of contamination for the State include fertilizer application, storage tanks, landfills, and septic systems. Elevated levels of naturally occurring arsenic, iron, and manganese are documented in sand and gravel aquifers (OEPA 2024-TN9894).

3.5.2.4 Nonradiological Spills

VistraOps controls the use and storage of chemicals associated with Perry Plant maintenance and operation in accordance with site-specific spill prevention plans. Site-specific programs to minimize the potential for a chemical release to the environmental are in place to ensure best management practices and structural controls are used by these programs. Nonradioactive waste is managed through a site-specific waste management procedure. No inadvertent releases or spills of nonradioactive contaminants that would trigger a notification requirement have occurred at the site between 2017 and January 2024 (EH 2023-TN9534; Vistra 2024-TN9925).

3.5.2.5 Historical Radiological Spills and Tritium in Groundwater

<u>Groundwater Protection Program</u>

Based on the Industry Groundwater Protection Initiative (NEI 2019-TN6775), a Groundwater Protection Program (GPP) was implemented at the Perry Plant site in 2006 to ensure timely and effective management of inadvertent releases of licensed material to groundwater (EH 2023-TN9534). As part of the GPP, Perry monitors groundwater via onsite piezometers, manholes, and groundwater wells for tritium, gamma-emitting isotopes, difficult to detect radionuclides, environmental conditions, and groundwater elevation in accordance with site-specific procedures. Table 3-11 summarizes the different monitoring location types at the Perry Plant site. Onsite monitoring wells and piezometers are shown in Figure 3-7. VistraOps has committed to voluntarily notify the State of Ohio for groundwater tritium concentrations measured greater than or equal to 2,000 picocuries per liter (pCi/L). In comparison, the EPA's maximum contaminant level (i.e., the highest contaminant level allowed in drinking water) for tritium is 20,000 pCi/L.

VistraOps conducts periodic reviews of plant SSCs to determine the relative risk of SSCs to contaminate groundwater. The most recent review was finalized in 2023 (Vistra 2024-TN9925). Other site-specific procedures relating to the monitoring and reporting of groundwater results and response to contaminated leaks/spills include REC-0104, NOP-OP-212, and NOP-OP-4705.

<u>Underdrain System Groundwater Discharge</u>

Potential releases from SSCs within the power block area will be captured by the underdrain system. Under normal operating conditions, individual pumps within 13 onsite manholes transport groundwater into the gravity discharge system, which drains to Lake Erie via the emergency service water pumphouse (EH 2023-TN9979). In the event of an accidental release of radioactive materials within the underdrain system, the manhole pumps can be shut off manually, preventing discharge to the pumphouse for a period of time (until groundwater rises to an approximate elevation of 588 ft msl (179.2 m msl).

Gravity discharge manholes MH-20 and MH-23, which represent composite groundwater from the underdrain flow catchment, are equipped with gamma radiation monitors. If elevated radioactivity (above background) is detected in these manholes, pumping in all manholes will cease. Water will back up within the underdrain system until the gravity discharge system is intercepted at approximately 588 ft msl (179.2 m msl) (EH 2023-TN9979). If no intervening measures are taken (e.g., manual pumping of contaminated groundwater to the radioactive waste treatment building or to holding tanks), all radionuclides would be discharged to Lake Erie via the gravity discharge system. If water is pumped in response to a leak/spill event, water is discharged to the radioactive waste treatment system and recycled back to the plant if water quality specifications are met. If water quality specifications are not met, the water is transferred to the ESW system through a radiation-monitored flow path to the Discharge Tunnel Entrance Structure (Vistra 2024-TN9925).

Water from the underdrain system enters the ESW pumphouse forebay, which is connected to the suction bay during normal operation. The forebay and the suction bay are hydraulically connected to Lake Erie. At a minimum average monthly lake water level of 565.26 ft (172.3 m) (USGS datum), the volume within the ESW pumphouse is approximately 600,000 gal (2.7×10^6 L). Under pumped conditions, water enters the EWS forebay at approximately 30 gpm (113.6 lpm) (Vistra 2024-TN9925).

Table 3-11 Groundwater Monitoring Location Summary for Perry Nuclear Power Plant

Monitoring Location Type	Count	Description	Purpose	Screened Unit	Monitoring Frequency
Historical Indoor Piezometers	21	Solid pipes with open ends located beneath the foundation slabs.	To monitor groundwater levels and hydrostatic pressures within the porous concrete of the underdrain system.	– Glaciolacustrine deposits	*Groundwater Elevation* – Weekly *Tritium and Gamma Emitters* – 5 sampled semiannually *Plume/Contamination Characterization* – As needed
Historical Outdoor Piezometers	30	Solid pipes with open ends located in four separate transects on site oriented in the north, south, east, and west directions.	To monitor the performance of the underdrain system.	– Glaciolacustrine deposits	*Groundwater Elevation* – Quarterly *Tritium and Gamma Emitters* – 4 (one from each transect) sampled semiannually
Groundwater Monitoring Wells	12	Installed in 4 triplicates to monitor groundwater at shallow (‘A,’ 25 ft bgs), medium (‘B,’ 50 ft bgs), and deep (‘C,’ 75 ft [23 m]) depths. Deep ‘C’ wells are progressed into the Chagrin Shale.	To provide adequate lateral and vertical groundwater monitoring coverage.	– Glaciolacustrine deposits – Glacial till – Shale	*Tritium and Gamma Emitters* – 2 sampled biennially – 10 sampled semiannually
Underdrain Manholes	24	Groundwater collection points and pump locations within the underdrain system.	To monitor effluent concentrations before the underdrain system water is discharged to Lake Erie. Sampling mainly occurs in MH-20 and MH-23, which represent composite samples of underdrain system water.	– Underdrain water from glaciolacustrine deposits and shale	*Tritium and Gamma Emitters* – 2 sampled quarterly Chemical Analysis – 2 sampled biennially *Plume/Contamination Characterization* – As needed

bgs = below ground surface; ft = foot (feet); m = meter(s); MH = manhole(s).
Source: (EH 2023-TN9534).

Figure 3-7 **Onsite Monitoring Wells and Piezometers at the Perry Nuclear Power Plant. Source: EH 2023-TN9534.**

Radiological Releases

Annual Radiological Effluent Release Reports are submitted to the NRC (per 10 CFR 50.36a [TN249]) to report the quantities of radionuclides released from liquid and gaseous effluents and the results of groundwater monitoring under the GPP (FENOC 2020-TN9953; EH 2021-TN9954, EH 2022-TN9955, EH 2023-TN9956, Vistra 2024-TN10193). The NRC staff reviewed 5 years of available radiological release reports (2019–2023 monitoring results), in addition to radiological monitoring results provided for select locations between January 2022 and January 2024 (Vistra 2024-TN9925). Table 3-12 summarizes release events from January 2020 to January 2024.

Table 3-12 Reported Liquid Releases from Perry Nuclear Power Plant, January 2020–January 2024

Event Date	Description	Impact(s)	Corrective Actions
January 31, 2020 (EH 2021-TN9954)	Leak from the reactor coolant system into the NCC system.	– Residual tritium activity detected in the NCC system in January, March, April, May, June, July, and December – Cobalt-60 detected in the February batch environmental counts and March composites ranging from 1.04×10^{-7} Ci to 1.82×10^{-6} Ci – Gross alpha activity detected in the November monthly composite sample	– Leak secured – Daily sampling
March 2020 (EH 2021-TN9954)	Auxiliary steam leaks bleeding into the auxiliary boiler deaerator, with excess water draining to the underdrain system.	– Tritium detections in MH-23 (5,310 pCi/L) and MH-9 (13,200 pCi/L) – Tritium continued to be detected in MH-23 in March, April, June, and November 2021 – Tritium released in 2021 totaled 2.52×10^{-2} Ci	– Drainage stopped once leak discovered – Monitoring and sampling plan developed – Auxiliary steam valves were investigated and repaired
December 14, 2021 (EH 2023-TN9534)	Failed thermal neck on a reactor water cleanup pump caused a release detection by the NCC process radiation monitor.	– 3.24×10^{-4} Ci tritium released	– Activity assessed in the monthly effluent surveillance
December 16, 2021 (EH 2023-TN9956 and EH 2023-TN9534)	Elevated tritium concentrations measured in MH-20. Although three potential sources of the release were suspected, no single source was identified.	– Tritium measured in MH-20 at 1,750 pCi/L and 2,050 pCi/L – Voluntary report made December 17, 2021 – Additional sampling indicated tritium detections were highest in samples collected from indoor piezometer PZ-3 – Tritium concentrations in PZ-3 ranged from 10,100 to 14,800 pCi/L in December 2021 and January 2022	– Investigation, chemistry action plan, and Tritium Action Plan implemented to identify the sources – The action plan included pumping groundwater from piezometer tubes and discharging to the radioactive waste treatment system – The piezometer pumping was set to underdrain recharge rates, between 5–50 gpd (18.9–189 lpd) – A sampling plan was implemented that specified sampling piezometers 2, 3, and 4 weekly, Manhole 18 every other week, and the ESW loops A/B/C each time the pump was started – After tritium activity in MH-20 decreased below 1,000 pCi/L for 2 weeks in March 2022, the final Tritium Action Plan action was completed on May 15, 2023, and the Tritium Action Plan was closed in June 2023

Table 3-12 Reported Liquid Releases from Perry Nuclear Power Plant, January 2020–January 2024 (Continued)

Event Date	Description	Impact(s)	Corrective Actions
June 23, 2023 (Updated Response Letter Vistra 2024-TN9925, NRC 2023-TN9961, and 2024 ARERR June 23, 2023 (Updated Response Letter Vistra 2024-TN9925, and NRC 2023-TN9961, and Vistra 2024-TN10193)	A voluntary notification was made on June 23, 2023, to report elevated tritium levels in the underdrain system. The source of the leak was under investigation as of April 2024, but no active leak identified.	– Maximum measured tritium concentration of 56,000 pCi/L recorded in PZ-21 on July 15 (see Figure 3-8)	– Low-volume pumping from PZ-21 began in July 2023 to reduce tritium concentrations to below 5,000 pCi/L – Pumped groundwater discharged to the radwaste treatment building – Eight shallow wells drilled on east side of plant to assess potential underground buried piping leaks. No underground leaks identified
January 5, 2024 (Updated Response Letter Vistra 2024-TN9925 and NRC 2024-TN9963)	A voluntary notification was made on January 5, 2024, to report elevated tritium levels in the underdrain system. The source of the leak was under investigation, and it was unconfirmed if the release was related to the June 2023 incident as of April 2024.	– Measured tritium concentration of 938,000 pCi/L recorded in PZ-6 on January 9, 2024 (see Figure 3-9) – Measured tritium concentration of 88,500 pCi/L recorded in PZ-21 on January 8, 2024 (see Figure 3-8)	– Higher-volume pumps installed in piezometers PZ-6, PZ-14, and PZ-21 to reduce the amount of contaminated water entering the underdrain system (total pumping rate fluctuates based hydraulic conditions but is less than 100 gpm [378.5 lpm]) – Pumped groundwater discharged to the radioactive waste treatment building

Ci = Curie; ESW = emergency service water; gpd = gallon(s) per day; gpm = gallon(s) per minute; lpm = liter(s) per minute; MH = manhole; NCC = Nuclear Closed Cooling; NRC = U.S. Nuclear Regulatory Commission; pCi/L = picocurie(s) per liter of air; PZ = piezometer(s).

As shown in Figure 3-8 and Figure 3-9, tritium concentrations measured in PZ-21 and PZ-6 exceed the historical maximum concentration of tritium in groundwater for the Perry Plant site of 59,900 pCi/L (NRC 2023-TN9980). However, sample results from MH-20 (representative of composite underdrain water) from January 2022 to January 9, 2024, as shown in Figure 3-10, indicate tritium concentrations are predominantly below 2,000 pCi/L (Vistra 2024-TN9925). Tritium concentrations discharged to the ESW from the underdrain system are therefore likely to be diluted below the lower limit of detection. Additionally, potential releases of radioactivity from the underdrain system are monitored and reported as part of the liquid effluent release data within the ARERRs. A review of the 2019–2023 ARERRs (FENOC 2020-TN9953; EH 2021-TN9954, EH 2022-TN9955, EH 2023-TN9956, Vistra 2024-TN10193) indicates the average diluted concentration of liquid effluent releases from plant operations have been within permitted values per 10 CFR Part 20-TN283, as described in Section 3.13 of this SEIS.

Onsite monitoring wells are outside the influence of the underdrain system and are therefore representative of potential groundwater contamination that would not be discharged to the ESW. Monitoring data representing tritium, gamma-emitting isotopes, and difficult-to-detect isotopic (beta emitter) analytical results collected from onsite monitoring wells from January 2019 to December 2023 were reviewed by NRC staff (FENOC 2020-TN9953; EH 2021-TN9954, EH 2022-TN9955, EH 2023-TN9956; Vistra 2024-TN10193, Vistra 2024-TN9925). Tritium was not detected above background levels of 500 pCi/L.

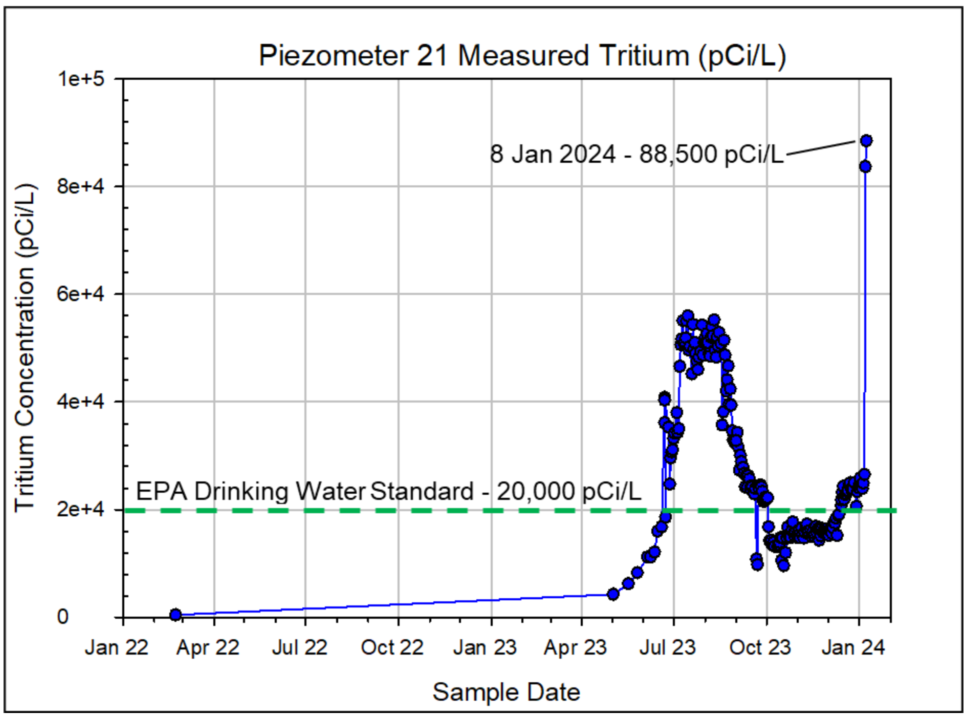


Figure 3-8 Measured Tritium in PZ-21, January 1, 2022–January 8, 2024. Data from: Vistra 2024-TN9925.

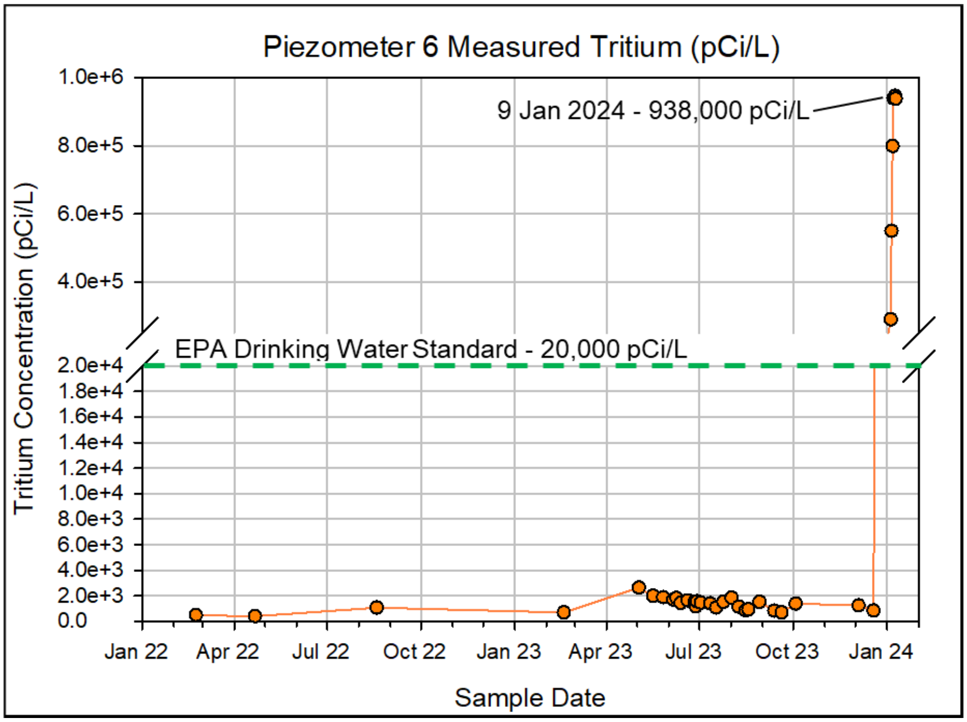


Figure 3-9 Measured Tritium in PZ-6, January 1, 2022–January 9, 2024. Data from: Vistra 2024-TN9925.

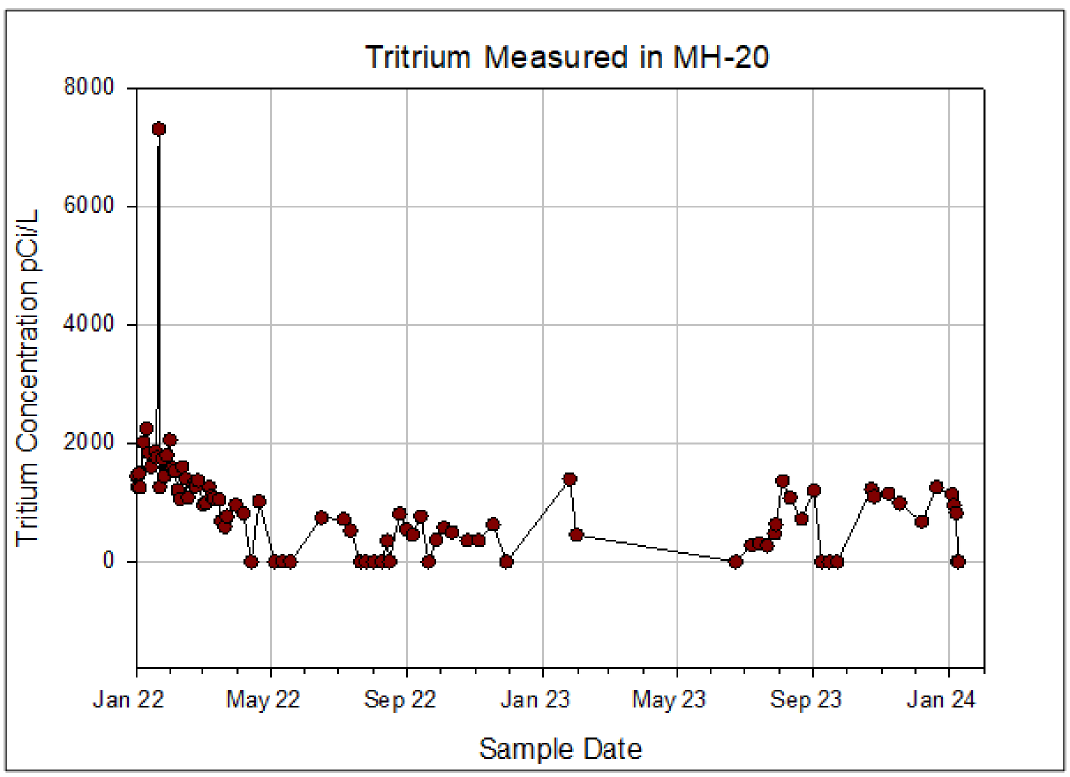


Figure 3-10 Measured Tritium in MH-20, January 1, 2022–January 9, 2024. Data from: Vistra 2024-TN9925.

No gamma or difficult to detect radionuclides were identified in piezometers, manholes, or groundwater monitoring wells at Perry Plant from January 2018 to October 2023 (EH 2023-TN9534 and Vistra 2024-TN9925). From October 2023 to January 2024, cobalt-60 has been detected in PZ-6 and PZ-21 only. Potential releases of radioactivity from the underdrain water discharged from PZ-6 and PZ-21 are monitored and reported as part of the liquid effluent release data within the ARERRs. Monitoring data reported from January 2023–December 2023 (Vistra 2024-TN10193) indicate dose to the general public from the plant's liquid effluent pathways were within permitted values per 10 CFR Part 20-TN283, as described in Section 3.13 of this SEIS. No other gamma or difficult to detect radionuclides have been identified in piezometers, manholes, or wells at the Perry Plant site (Vistra 2024-TN9925).

3.5.3 Proposed Action

3.5.3.1 Surface Water Resources

As documented in the LR GEIS (NRC 2013-TN2654) and cited in Table 3-1 for generic surface water resources issues, the impacts of nuclear power plant LR and continued operations would generally be SMALL for Category 1 issues applicable to Perry Plant. These issues include:

- surface water use and quality (non-cooling system impacts)
- altered current patterns at intake and discharge structures
- altered thermal stratification of lakes
- scouring caused by discharged cooling water
- discharge of metals in cooling system effluent
- discharge of biocides, sanitary wastes, and minor chemical spills
- temperature effects on sediment transport capacity

The NRC staff's review did not identify any new and significant information that would change the conclusion in the GEIS.

Three generic surface water resources issues listed in the LR GEIS (NRC 2013-TN2654) do not apply to the Perry Plant. These issues are described below.

- Surface water use conflicts (plants with once-through cooling systems): As stated in the LR GEIS, this issue is related to plants with once-through cooling systems. This issue does not apply because Perry Plant does not have a once-through cooling system.
- Altered salinity gradients: As stated in the LR GEIS, this issue is related to plants located on estuaries where cooling system water withdrawals and discharges may cause changes in salinity. Because Perry Plant is not located on an estuary, this issue does not apply.
- Effects of dredging on surface water quality: As stated in the LR GEIS, this issue is related to dredging in the vicinity of surface water intakes, canals, and discharge structures to remove deposited sediment and maintain cooling system functions. Dredging may also be needed to maintain barge shipping lanes. Perry Plant has not performed any dredging in the past and does not anticipate any future dredging (EH 2023-TN9534). Therefore, this issue does not apply.

The LR GEIS lists one Category 2 issue for surface water resources—surface water use conflicts (plants with cooling ponds or cooling towers using makeup water from a river) (NRC

2013-TN2654). Perry Plant has a closed-loop cooling system and a natural draft cooling tower with water that is sourced from Lake Erie (EH 2023-TN9534). Therefore, the Category 2 issue related to surface water resources does not apply to Perry Plant.

3.5.3.2 Groundwater Resources

As documented in the LR GEIS (NRC 2013-TN2654) and cited in Table 3-1 for generic groundwater resources issues, the impacts of nuclear plant LR and continued operations would be SMALL for the Category 1 issues applicable to Perry Plant. These issues are:

- groundwater contamination and use (non-cooling system impacts)
- groundwater use conflicts (plants that withdraw less than 100 gpm)

These applicable Category 1 issues were determined to result in a SMALL impact in 10 CFR Part 51 (TN250), Subpart A, Appendix B, Table B-1. No significant groundwater impacts with respect to Category 1 (generic) issues are anticipated during the LR term that would be different from those occurring during the current license term. As discussed in Section 3.5.2 of this SEIS, the NRC staff performed a review of groundwater use and quality. This review by NRC staff did not identify any new and significant information during the independent review of the ER, the scoping process, the audit, and the evaluation of available information that would change the conclusion reached in the LR GEIS. The NRC staff concluded the following:

- No discharges to groundwater requiring permits by regulatory agencies are expected during the renewal period. There are currently no regulated discharges to groundwater, and none were identified by the applicant to likely occur during the renewal period.
- There are no foreseeable conditions during the renewal term under which onsite groundwater withdrawals increase to near or above the 100 gpm limit included in the LR GEIS conclusion.

As a result, as concluded in the LR GEIS (NRC 2013-TN2654) for these Category 1 (generic) issues that are reported in Table 3-1, the impacts on groundwater resources of continued operation of Perry Plant would be SMALL.

As shown in Table 3-2, the NRC staff identified one site-specific Category 2 issue related to groundwater resources applicable to Perry Plant during the LR term. This Category 2 issue is analyzed below.

<u>Radionuclides Released to Groundwater</u>

This issue was added for consideration as part of the groundwater review for LR in the LR GEIS, Revision 1 (NRC 2013-TN2654), because of the accidental releases of liquids containing radioactive material into the groundwater at power reactor sites. The majority of these inadvertent releases involved leakage of water containing tritium or other radioactive isotopes from spent fuel pools, buried piping, or failed valves on effluent discharge lines. In 2006, the NRC released a report titled, "Liquid Radioactive Release Lessons Learned Task Force Report," documenting lessons learned from a review of these incidents that ultimately concluded that these instances had not adversely affected public health and safety (NRC 2006-TN1000). This report concluded, in general, that groundwater affected by radionuclide releases is expected to remain onsite, but instances of offsite migration have occurred. The LR GEIS (NRC 2013-TN2654) determined that impacts on groundwater quality from the release of radionuclides could be SMALL or MODERATE, depending on the magnitude of the leak, the radionuclides involved hydrogeologic factors, distance to receptors, and the response time of plant personnel to identify and stop the leak in a timely fashion. As a result, this is a Category 2 issue requiring a site-specific evaluation that is discussed below.

This issue was discussed and evaluated in Sections 3.6.4.2 and 4.5.5 of VistraOps' ER (EH 2023-TN9534). Perry Plant monitors groundwater for inadvertent release as part of its groundwater protection program, which was implemented in 2006 under Nuclear Energy Institute (NEI) 07-07 (NEI 2007-TN1913) to satisfy requirements of 10 CFR 20.1501 (TN283). New information regarding tritium releases to groundwater was identified during the audit, scoping, and review process and is described in Section 3.5.2.3 of this SEIS. From 2018–2021, onsite tritium detections were well below the historical maximum detection and the drinking water standard of 20,000 pCi/L. Releases in 2023 and 2024 to the underdrain system resulted in a reported peak tritium concentration of 938,000 pCi/L in PZ-6 and Co-60 detections in PZ-6 and PZ-21. Corrective actions have been implemented to control the amount of contaminated groundwater entering the underdrain system, including pumping from three onsite piezometers. Groundwater pumped from the underdrain system for contamination control is discharged to the radioactive waste treatment building, and underdrain system water is monitored prior to discharge as part of site radioactive liquid waste management systems. Tritium and gamma-emitting isotope measurements from monitoring wells outside of the influence of the underdrain system have not been above background levels.

While tritium continues to be detected in onsite groundwater at levels that exceed the EPA's maximum contaminant level for tritium, ongoing monitoring, contamination control pumping, the underdrain system groundwater catchment, and radiation control measures reduce the potential for offsite migration. The NRC staff expects that with VistraOps' continuation of remediation efforts, tritium levels within the underdrain system will be reduced below the EPA standard for drinking water. The NRC staff concludes that groundwater quality impacts due to the release of radionuclides would be SMALL during the LR term.

3.5.4 No-Action Alternative

3.5.4.1 Surface Water Resources

With the cessation of Perry Plant operations, there would be a large reduction in the amount of water withdrawn from Lake Erie. Wastewater discharges would also greatly decrease. Stormwater runoff would continue to be discharged from the Perry Plant site. As a result, Perry Plant shutdown would reduce the overall impacts on surface water use and quality. Therefore, the NRC staff concludes that the impact of the no-action alternative on surface water resources would be SMALL.

3.5.4.2 Groundwater Resources

With the cessation of operations, there would be little or no additional impact on groundwater quality. Contamination in onsite soil and groundwater, including tritium, would be assessed during decommissioning, whether the plant is decommissioned at the end of the current licensing period or at the end of the LR period. A license termination plan will describe actions needed for site remediation to meet NRC criteria for radiologic dose and site-specific clean up criteria to be met before release of the Perry Plant site. Therefore, pumping of the underdrain system for tritium control would likely continue at current rates or be reduced as tritium contamination is removed from the site groundwater. Consequently, the impact of the no-action alternative on groundwater resources would be SMALL.

3.5.5 Replacement Power Alternatives: Common Impacts

3.5.5.1 Surface Water Resources

<u>Construction</u>

Construction activities associated with replacement power alternatives may cause temporary impacts on surface water quality by increasing sediment loading to water bodies and waterways. Construction of intake and discharge structures, if needed, could result in within-water activities including dredge-and-fill, underwater construction, and tunneling. Construction activities might also affect surface water quality through pollutants in stormwater runoff from disturbed areas and excavations, spills and leaks from construction equipment, and sediment and other pollutants disturbed due to associated dredge-and-fill activities. These pollutants could be detrimental to downstream surface water quality, where applicable, and to ambient water quality in waterways near work sites.

Facility construction activities might alter surface water drainage features within the construction footprints of replacement power facilities, including any wetland areas. Impervious areas may increase, resulting in a potential for greater and quicker surface runoff. Potential hydrologic impacts would vary depending on the nature and acreage of the land area disturbed and the intensity of excavation work. Changes in stormwater runoff volume, timing, and quality are usually controlled and managed with applicable Federal, State, and local permits and implementation of BMPs.

The NRC staff assumes that construction contractors would implement BMPs for soil erosion and sediment control to minimize water quality impacts in accordance with applicable Federal, State, and local permitting requirements. These measures would include spill prevention and response procedures, such as measures to avoid and respond to spills and leaks of fuels and other materials from construction equipment and activities. Surface water use during construction is generally related to concrete preparation, dust suppression, and potable and sanitary water for the workforce and is limited to the construction duration. These water needs are usually small compared to cooling water needs during thermoelectric plant operation.

<u>Operation</u>

Thermoelectric generation may require varying amounts of surface water for the cooling of plant components depending on the selected cooling technology and, therefore, may require new water use permits from and agreements with State and local agencies. Potable and sanitary water use for the plant would depend on the workforce size and, therefore, may also require new potable water use permits from and sanitary water disposal agreements with local agencies or municipalities.

Discharge of wastewater including cooling system discharges would require permits from Federal, State, and local agencies, including a certification that the discharges are consistent with State water quality standards. Wastewater discharges would be subject to treatment, monitoring, and reporting requirements of relevant permitting agencies. The NRC staff assumes that plant operations would follow the requirements of any applicable Federal, State, and local permits.

3.5.5.2 Groundwater Resources

Construction

Excavation dewatering for foundations and substructures during construction of replacement power generation facilities, as applicable, may be required to stabilize slopes and permit placement of foundations and substructures below the water table or in areas of perched groundwater. Groundwater levels in the immediate area surrounding an excavation may be temporarily affected, depending on the duration of dewatering and the methods (e.g., cofferdams, sheet piling, sumps, and dewatering wells) used for dewatering. NRC staff expects that any impacts on groundwater flow and quality caused by dewatering would be highly localized, of short duration, and would not affect offsite groundwater users. Discharges resulting from dewatering operations would be released in accordance with applicable State and local permits, as described above.

Although foundations, substructures, and backfill may alter onsite groundwater flow patterns, local and regional trends would remain unaffected. Construction of replacement power generating facilities may contribute to onsite changes in groundwater infiltration and quality due to removal of vegetation and construction of buildings, parking lots, and other impervious surfaces. The potential impacts of increased runoff and subsurface pollutant infiltration or discharge to nearby water bodies would be prevented or mitigated through implementation of BMPs and an SWPPP.

In addition to construction dewatering, onsite groundwater could be used to support construction activities (e.g., dust abatement, soil compaction, and water for concrete batch plants). Groundwater withdrawal during construction could temporarily affect local water tables or groundwater flow, and these withdrawals and resulting discharges would be subject to applicable permitting requirements. The NRC staff concludes that the impacts on groundwater resources from construction and operation of a replacement power alternative would be SMALL.

Operation

Dewatering for building foundations and substructures may be required during the operational life of the replacement power facility. Operational dewatering rates, if required, would likely be lower than the rates required for construction and be managed subject to applicable permitting requirements. Dewatering discharges and treatment would be properly managed in accordance with applicable NPDES permitting requirements. The NRC staff expects that any impacts on groundwater flow and quality affected by dewatering would be highly localized, and that there would be no effects on offsite groundwater users due to the site location.

Effluent discharges (e.g., cooling water, sanitary wastewater, and stormwater) from a facility are subject to applicable Federal, State, and other permits specifying discharge standards and monitoring requirements. Adherence to proper procedures by replacement power facility operators during all material, chemical, and waste handling and conveyance activities would reduce the potential for any releases to the environment, including releases to the subsurface and groundwater.

For replacement power alternatives located at the Perry Plant site, groundwater use during operation is assumed to be similar to or less than current nuclear power plant use and tritium control withdrawals less than 100 gpm (380 lpm). Site groundwater use was determined to have a minimal impact on surrounding offsite groundwater use or quality. Therefore, NRC staff concludes that groundwater use during operation of a replacement power alternative would result in a SMALL impact. Onsite groundwater withdrawals would be subject to applicable State water appropriation, permitting, and registration requirements.

3.5.6 Natural Gas-Fired Combined-Cycle Alternative

3.5.6.1 Surface Water Resources

Surface water resource impacts common to all replacement power alternatives are described in Section 3.5.5.1. The workforce needed for the new NGCC plant would be approximately 1,200 workers during peak construction and 150 workers during operations (NRC 2019-TN6824). Perry Plant currently employs a permanent full-time non-outage workforce of approximately 645 workers, as stated in Section 3.10.1 of this SEIS.

Based on the workforce size, potable and sanitary water use during construction of an NGCC plant would be greater than the amount currently used to operate Perry Plant. This water use would be limited to the duration of plant construction. Construction-related impacts to surface water quality would be limited to the construction period and would be managed by applicable Federal, State, and local permits. The implementation of BMPs and adherence to Federal, State, and local permit requirements would minimize impacts to surface water resources. The NRC staff concludes that the impacts on surface water resources during construction of an NGCC plant at the Perry Plant site would be SMALL.

Cooling system requirements for a 1,350 MWe NGCC plant site are an order of magnitude smaller than the Perry Plant's recent annual average use of 87.4 MDG or 31,887 MGY, as reported in Section 3.5.1.2. Cooling water withdrawal for the NGCC plant is estimated to be approximately 7.8 MGD or 2,838 MGY, while consumptive use would be an estimated 6 MGD or 2,200 MGY (NETL 2022-TN8820). The new NGCC plant could either be located at the existing Perry Plant site or located at another brownfield site previously used for energy generation. If located at the Perry Plant site, the water to offset consumptive losses would come from Lake Erie. As stated in Section 3.5.1.2 of this SEIS, there are no annual limits on the amount of water Perry Plant can withdraw from Lake Erie. Because there are no limits on surface water use from Lake Erie and the estimated use of the NGCC alternative is an order of magnitude smaller than that of Perry Plant, the cooling-related surface water use impacts of the NGCC plant would be SMALL. If located at another brownfield site, the impacts to surface water use would likely be SMALL to MODERATE, depending on the water source and water availability at and near that site. Based on the estimated workforce size for the NGCC alternative, operational potable and sanitary water needs would be smaller than the current operational needs for Perry Plant. Some portion of this water may come from surface water resources, based on the sources used by providers of the potable and sanitary water. Discharges of stormwater, cooling system effluent, and wastewater during operations would be managed under applicable Federal, State, and local permits. These permits typically require implementation of BMPs, monitoring and reporting of effluent quantity and quality, and corrective actions to remedy the conditions leading to permit violations and effluent limit exceedances. The NRC staff concludes that the impacts on surface water resources during operations of an NGCC plant at the Perry Plant site would be SMALL and that at another brownfield site would be SMALL to MODERATE.

3.5.6.2 Groundwater Resources

The hydrologic and water quality assumptions and implications for construction and operations described in Section 3.5.5.2 as being common to all replacement power alternatives also apply to this alternative. However, given that the location of the potential NGCC plant could either be at the existing Perry Plant site or another brownfield site previously used for energy generation, the impacts of this alternative are uncertain prior to the selection of a site for the facility. Cooling water withdrawal for the NGCC plant is estimated be approximately 7.8 MGD or 2,838 MGY, while consumptive use would be an estimated 6 MGD or 2,200 MGY (NETL 2022-TN8820). If located at the Perry Plant site, it is unlikely groundwater use would occur due to the low yields of the onsite aquifers. The impacts to groundwater use would therefore likely be SMALL. If located at another brownfield site, groundwater yield and availability may be higher than at the Perry Plant site. Some portion of potable and sanitary water needed to support the NGCC plant workforce may be sourced from groundwater. Onsite groundwater withdrawals would be subject to applicable State water appropriation, permitting, and registration requirements. The impacts to groundwater use would therefore likely be SMALL to MODERATE, depending on the water source and water availability at and near that site.

3.5.7 Renewable and Natural Gas Combination Alternative

3.5.7.1 Surface Water Resources

Surface water resource impacts common to all replacement power alternatives are described in Section 3.5.5.1 of this SEIS. The workforce needed for the solar photovoltaic (PV) portion of the combination alternative would be approximately 500 workers during peak construction and 60 workers during operations (DOE 2011-TN8387; BLM 2019-TN8386). The workforce needed for the wind portion of the combination alternative would be approximately 330 workers during peak construction and 35 workers during operations (Tegen 2016-TN8826). The workforce needed for the NGCC portion of the combination alternative would be approximately 800 workers during peak construction and 100 workers during operations (NRC 2019-TN6824). Therefore, a total workforce of approximately 1,630 would be needed during peak construction and 195 workers during operation of the combination alternative, respectively. It is possible that peak construction for the three portions of the combination alternative may not coincide, leading to a total workforce somewhat smaller than 1,630 workers. As stated in Section 3.10.1 of this SEIS, Perry Plant currently employs a permanent full-time non-outage workforce of approximately 645 workers.

The NGCC portion of the combination alternative could be sited at the Perry Plant site or at another brownfield site previously used for energy production. The solar PV and onshore wind portions of the generating capacity would be located outside the Perry Plant site at multiple locations within Ohio. Therefore, construction-related impacts of the solar and wind portions would occur at the respective selected locations. Although these activities would occur at multiple sites, a combination of energy-generation technologies does not substantially change construction activities. Based on workforce size, potable and sanitary water use during construction would likely increase from that currently needed to operate the Perry Plant. However, this water use would be limited to the construction duration and would be distributed across multiple sites. Construction-related impacts on surface water quality would be limited to the construction duration and managed under applicable Federal, State, and local permits. Implementation of BMPs and adherence to Federal, State, and local permit requirements would minimize impacts on surface water resources. The NRC staff concludes that the impacts on surface water resources during construction of a combination alternative plant would be SMALL.

During operations, the solar PV and wind portions would not require condenser cooling. Therefore, for these portions of the combination alternative, consumptive water use for cooling and cooling system effluent discharges would be eliminated. The new 764 MW NGCC portion of the combination alternative would use a closed-cycle condenser cooling system with MDCTs. Cooling water withdrawal for the 764 MW NGCC portion of the combination alternative is estimated to be 4.8 MGD or 1,745 MGY, and consumptive water use would be 3.7 MGD or 1,352 MGY (NETL 2022-TN8820). If the NGCC plant is operated at the Perry Plant site, surface water would be obtained from Lake Erie. As stated in Section 3.5.1.2 of this SEIS, currently the Perry Plant has surface water use permits that allow unlimited withdrawal from Lake Erie. Because surface water use for the combination alternative is an order of magnitude less than the current Perry Plant surface water use, the cooling-related surface water use impacts would be negligible. If located at another brownfield site, the impacts to surface water use would likely be SMALL to MODERATE, depending on the water source and water availability at and near that site. Based on the estimated workforce size for operation of the combination alternative, potable and sanitary water needs would be smaller than the current operational needs of the Perry Plant. Some portion of this water may come from surface water resources, based on the sources used by providers of the potable and sanitary water. Discharges of stormwater, cooling system effluent, and wastewater during operations would be managed under applicable Federal, State, and local permits. These permits typically require implementation of BMPs, monitoring and reporting of effluent quantity and quality, and corrective actions to remedy the conditions leading to permit violations and effluent limit exceedances. The NRC staff concludes that the impacts on surface water resources during operations of the combination alternative would be SMALL if the NGCC portion were to be sited at the Perry Plant site and SMALL to MODERATE if the NGCC portion were to be sited at another brownfield site.

3.5.7.2 Groundwater Resources

The hydrologic and water quality assumptions and implications for construction and operations described in Section 3.5.5.2 as being common to all replacement power alternatives also apply to this alternative. NRC staff did not identify any impacts on groundwater resources for this alternative beyond those discussed above as being common to all replacement power alternatives or those discussed relating to the alterative siting of the potential NGCC plant in Section 3.5.6.2. Therefore, the NRC staff concludes that the impacts on groundwater resources from construction and operations under the renewable and NGCC alterative would be SMALL to MODERATE.

3.6 Terrestrial Resources

This section describes the terrestrial resources of the Perry Plant site and the surrounding landscape. Following the description, NRC staff analyzes the potential impacts on terrestrial resources from the proposed action of LR and alternatives to the proposed action. Information here is based on the initial Perry Plant license (NRC 1982-TN9606), the applicant’s ER (EH 2023-TN9534), and other publicly available information.

3.6.1 Ecoregion

The Perry Plant site lies within the Eastern Great Lakes Lowlands Ecoregion (EPA Level III Ecoregion 83, EPA 2013-TN9981). The terrain consists of broad, formerly glaciated, irregular plains bordered by hills. The parts of this ecoregion that are closest to the Great Lakes experience a longer growing season, more winter cloudiness, and more snowfall. Dairy operations, orchards, vineyards, and vegetable farming are important agricultural land uses in this ecoregion.

VistraOps' ER (EH 2023-TN9534: pp. 3-123 to 3-124) includes descriptions of several EPA Level IV ecoregions near the Perry Plant site. The descriptions characterize the terrain, soils, landform, and land uses and are incorporated here by reference for the following types:

- Mosquito Creek/Pymatuning Lowlands
- Low Lime Drift Plain
- Erie Gorges
- Summit Interlobate Area

The U.S. Army Corps of Engineers defines wetlands as areas either inundated or saturated by surface or groundwater at a frequency and duration sufficient to support (and that under normal circumstances do support) a prevalence of vegetation typically adapted for life in saturated soil conditions. In its ER, VistraOps (EH 2023-TN9534: Section 3.7.2.4) characterizes the National Wetlands Inventory features in the vicinity of the Perry Plant site as follows:

- freshwater emergent wetlands—53 ac (21 ha)
- freshwater forested/shrub wetlands—1,047 ac (424 ha)
- freshwater ponds—289 ac (117 ha)
- lakes—35,537 ac (35,537 ha)
- riverine waters—405 ac (164 ha)

3.6.2 Perry Plant Site

The Perry Plant site consists of 1,023 ac (414 ha) along the southeastern shore of Lake Erie in Lake County, Ohio. The Perry Plant site lies within the Erie/Ontario Lake Plain (Level IV Ecoregion 83a; EPA 2015-TN9982), a narrow lowland plain situated along Lake Erie, that has prominent beach ridges and high coastal bluffs (ODNR 2018-TN9608). Lake Erie has a strong influence on this ecoregion; the annual growing season in this ecoregion can be several weeks longer than more inland areas (Woods et al. 1998-TN9971). Industrial sites, ports, fruit and vegetable farms, and nurseries are common land uses on the plain.

About 25 percent of the Perry Plant site consists of developed land cover types, 1 percent is open water, and the remaining 74 percent of the site is vegetated (EH 2023-TN9534: Table 3.2-1). Forest is the dominant vegetation type, covering about 59 percent of the Perry Plant site. Deciduous forest cover is about 58 percent, and mixed forest is about 1 percent. All other vegetation types cover less than 10 percent of the site: grassland/herbaceous (9 percent), shrub/scrub (1 percent), hay/pasture (1.7 percent), woody wetlands (3 percent), and emergent herbaceous wetlands (<1 percent).

The descriptions in the ER (EH 2023-TN9534: Section 3.7.2.3) characterize the terrestrial habitats within the site boundary. Habitat descriptions of associated tree, shrub, and herbaceous strata are incorporated here by reference:

- sugar maple-red oak forest
- beech-maple forest
- mixed mesophytic forest
- hemlock-northern hardwood forest
- food plain forest

The Perry Plant site contains a total of 95.14 ac (38.51 ha) of wetlands, lakes, ponds, and riverine waters (EH 2023-TN9534: Section 3.7.2.4). Table 3-13 summarizes wetlands and surface water features on the Perry Plant site that are documented in the National Wetlands Inventory. Figure 3-11 shows the location of the National Wetlands Inventory wetlands on the Perry Plant site.

Table 3-13 Wetlands and Surface Water Features on the Perry Nuclear Power Plant Site as Mapped in the National Wetlands Inventory

Wetland or Water Feature	Area	Percent of Onsite Wetland Habitat
Freshwater Forested/Shrub Wetlands	72.77 ac (29.45 ha)	76.37
Riverine Waters	13.75 ac (5.56 ha)	14.43
Freshwater Emergent Wetlands	3.23 ac (1.31 ha)	3.39
Lakes	2.99 ac (1.21 ha)	3.30
Freshwater Ponds	2.40 ac (0.98 ha)	2.52
Total	95.14 ac (38.50 ha)	100.00

ac = acre(s); ha = hectare(s)
Source: EH 2023-TN9534: Section 3.7.2.4.

Figure 3-11 Wetlands Located within the Perry Plant Site, as Mapped in the National Wetlands Inventory. Source: EH 2023-TN9534: Figure 3.7.2.

Wildlife species occurring on the Perry Plant site consist of those species typically found around Lake Erie forests, developed areas, wetland and riparian areas, and agricultural areas (EH 2023-TN9534: Section 3.7.2.5). Table 3.7-3 in the ER presents a list of terrestrial species likely to occur in Lake County; this list includes 39 mammals, 346 birds, 22 amphibians, and 6 reptiles. Common mammals include white-tailed deer (*Odocoileus virginianus)*, Virginia opossum (*Odocoileus virginianus*), raccoon (*Procyon lotor*), eastern cottontail rabbit (*Sylvilagus floridanus*), striped skunks (*Mephitis nephitis*), and several small rodent species.

Birds on the Perry Plant site include a mix of resident bird species, seasonal residents, and birds stopping briefly during migration. The Perry Plant site is located within the Mississippi flyway, a major bird migration route that extends from the Gulf Coast to the Arctic Circle. Migrant birds often fly at night, landing to rest early in the morning. Suitable habitat that allows them to feed, rest, and avoid predators are called stopovers. Large natural barriers may create crowded stopover locations, because flights over the barriers mean long stretches without opportunities to rest or feed. Along the Mississippi flyway, Hudson Bay and the Great Lakes are major barriers. Many species of migratory birds likely use the project corridor during the spring and fall migrations.

3.6.3 Important Species and Habitats

3.6.3.1 Federally Listed Species

For a discussion of terrestrial species and habitats that are federally protected under the Endangered Species Act of 1973, as amended, see Section 3.8, “Special Status Species and Habitat,” of this report.

3.6.3.2 State-Listed Species

VistraOps provided a list of State-listed species known to occur or that have the potential to occur within Lake County (EH 2023-TN9534: Table 3.7.4). The ER also had seven additional terrestrial species that are State-listed and occur “at or within one mile of the project area” mentioned in the Ohio Department of Natural Resources letter in Attachment C (EH 2023-TN9534) from the Natural Heritage Database, and Ohio Division of Wildlife (DOW). All the species mentioned in the ER were incorporated into a master species list. VistraOps’ list was then compared to the most recent Lake County wildlife and plants list from 2023 (ODNR 2023-TN9983, ODNR 2023-TN9984), and species that were observed within the past 20 years were included in the final list. State-listed aquatic species are addressed in Section 3.7.1.2 of this document.

Of the 76 State-listed terrestrial species that have the potential to occur within Lake County, Ohio, 4 are birds, 14 are insects, 2 are mammals, 1 is a reptile, 52 are plants, and 3 are lichens. Species biology, habitat descriptions, and species trends for all 76 of these State-listed species are incorporated here by reference. Table 3-14 below summarizes the 76 State-listed species known to be in Lake County, Ohio, based on the ER (EH 2023-TN9534: Table 3.7.4), ER potential habitat analysis, the letter from Ohio Department of Natural Resources in Attachment C, and NRC staff’s independent review of the 2023 updated wildlife and plants that Ohio lists as endangered or threatened (ODNR 2023-TN9983, ODNR 2023-TN9984).

Table 3-14 State-Listed Species in Perry Nuclear Power Plant That Are Not Federally Listed

Group	Common	Scientific Name	State Status
Birds	Black-crowned night-heron[b]	*Nycticorax nycticorax*	Threatened
Birds	Least bittern	*Ixobrychus exilis*	Threatened
Birds	Northern harrier[b]	*Circus hudsonius*	Endangered
Birds	Upland sandpiper[b]	*Bartramia longicauda*	Endangered
Insects	Beaverpond Baskettail	Epitheca canis	Threatened
Insects	Boreal bluet	*Enallagma boreale*	Threatened
Insects	Four-spotted Skimmer	*Libellula quadrimaculata*	Endangered
Insects	Green-faced clubtail	*Gomphus viridifrons*	Threatened
Insects	Lilypad forktail	*Ischnura kellicotti*	Endangered
Insects	Marsh bluet	*Enallagma ebrium*	Threatened
Insects	None	*Chimarra socia*	Endangered
Insects	None	*Psilotreta indecisa*	Threatened
Insects	None	*Rheopelopia acra*	Endangered
Insects	Northern bluet	*Enallagma cyathigerum*	Threatened
Insects	Ocellated Darner[b]	Boyeria grafiana	Threatened
Insects	Racket-tailed emerald	*Dorocordulia libera*	Endangered
Insects	Riffle snaketail[b]	*Ophiogomphus carolus*	Threatened
Insects	Uhler’s sundragon	*Helocordulia uhleri*	Endangered
Mammal	Black bear[b]	*Ursus americanus*	Endangered
Mammal	Little Brown Bat[b]	*Myotis lucifugus*	Endangered
Reptiles	Spotted turtle[a,b,c]	*Clemmys guttata*	Threatened
Plants	Alpine rush	*Juncus alpinoarticulatus*	Threatened
Plants	American beach grass[a,b,c]	*Ammophila breviligulata*	Threatened
Plants	Bailey’s Sedge[b]	*Carex baileyi*	Endangered
Plants	Bristly sarsaparilla[b]	*Aralia hispida*	Endangered
Plants	Bushy cinquefoil[b]	*Potentilla paradoxa*	Threatened
Plants	Canada Buffalo-berry[b]	Shepherdia canadensis	Threatened
Plants	Canada hawkweed[b]	*Hieracium umbellatum*	Threatened
Plants	Canada St. John’s-wort	*Hypericum canadense*	Endangered
Plants	Clinton's Wood Fern[b]	*Dryopteris clintoniana*	Endangered
Plants	Coarse Smartweed	*Persicaria robustior*	Threatened
Plants	Coastal little bluestem[b]	*Schizachyrium littorale*	Endangered
Plants	Cooper’s milk-vetch[b]	*Astragalus neglectus*	Threatened
Plants	Cow-wheat	*Melampyrum lineare*	Endangered
Plants	Dwarf bulrush[b]	*Lipocarpha micrantha*	Threatened
Plants	Early buttercup	*Ranunculus fascicularis*	Threatened
Plants	Few-flowered St. John’s-wort	*Hypericum ellipticum*	Threatened
Plants	Forked Rush[b]	*Juncus dichotomus*	Endangered
Plants	Great St. John’s-wort[b]	*Hypericum Ascyron ssp. pyramidatum*	Threatened
Plants	Hobblebush	*Viburnum lantanoides*	Threatened
Plants	Inland beach pea[b,c]	*Lathyrus japonicus*	Threatened

Table 3-14 State-Listed Species in Perry Nuclear Power Plant That Are Not Federally Listed (Continued)

Group	Common	Scientific Name	State Status
Plants	Keeled bur-reed	*Sparganium androcladum*	Threatened
Plants	Large-leaved mountain-rice[(b)]	*Oryzopsis asperifolia*	Endangered
Plants	Leafy goldenrod[(b)]	*Solidago squarrosa*	Threatened
Plants	Leafy tussock sedge[(b)]	*Carex aquatilis*	Threatened
Plants	Least spike-rush	*Eleocharis parvula*	Endangered
Plants	Log fern	*Dryopteris celsa*	Endangered
Plants	Lyre-leaved rock cress	*Arabidopsis lyrata*	Endangered
Plants	Marsh Bedstraw	*Galium palustre*	Threatened
Plants	Mountain bindweed	*Fallopia cilinodis*	Endangered
Plants	Necklace sedge[(b)]	*Carex projecta*	Threatened
Plants	Nodding sedge[(b)]	*Carex gynandra*	Endangered
Plants	Northern Bog Club-moss[(b)]	*Lycopodiella inundata*	Threatened
Plants	Northern poison-ivy	*Toxicodendron rydbergii*	Endangered
Plants	Pennsylvania Hawthorn [(b)]	*Crataegus pennsylvanica*	Endangered
Plants	Rock serviceberry	*Amelanchier sanguinea*	Threatened
Plants	Rock-harlequin[(b)]	*Corydalis sempervirens*	Threatened
Plants	Round-leaved Dogwood[(b)]	*Cornus rugosa*	Threatened
Plants	Short-fringed sedge[(b)]	*Carex crinita var. brevicrinis*	Threatened
Plants	Showy Shadbush	*Amelanchier amabilis*	Endangered
Plants	Spotted Coral-root	*Corallorhiza maculata*	Endangered
Plants	Smooth Blackberry[(b)]	*Rubus canadensis*	Endangered
Plants	Small Fringed Gentian	*Gentianopsis procera*	Threatened
Plants	Sweet-fern	*Comptonia peregrina*	Endangered
Plants	Thread-like naiad[(b)]	*Najas gracillima*	Endangered
Plants	White wood-sorrel[(b)]	*Oxalis montana*	Endangered
Plants	Vernal Water-starwort[(b)]	*Callitriche palustris*	Endangered
Plants	Variegated Scouring-rush[(b)]	*Equisetum variegatum*	Endangered
Plants	Yellow vetchling	*Lathyrus ochroleucus*	Threatened
Plants	Golden-fruited sedge[(b,c)]	*Carex aurea*	Potentially Threatened
Plants	Seaside spurge[(b,c)]	*Europhorbia polygonifolia*	Potentially Threatened
Plants	Oakes' Evening-primrose[(b,c)]	*Oenothera oakesiana*	Potentially Threatened
Lichen	Bachman's Jelly Lichen[(b,c)]	*Enchylium bachmanianum*	Threatened
Lichen	Bug-on-a-stick[(b)]	*Buxbaumia aphylla*	Threatened
Lichen	Awned Dichelyma Moss	*Dichelyma capillaceum*	Threatened

(a) Species known to occur on the Perry Plant site
(b) Species with potential habitat on the Perry Plant Site
(c) Species known within 6 mi (1.8 km) of the Perry Plant site (EH 2023-TN9534: Appendix C)

The Ohio Department of Natural Resources letter in Attachment C of the ER (EH 2023-TN9534) incorporated comments from the Natural Heritage Database, Ohio DOW, and the Division of Water Resources. According to the Natural Heritage Database, seven species (spotted turtle [*Clemmys guttata*], American beach grass [*Calamogrostis breviligulata*], golden-fruited sedge [*Carex aurea*], seaside spurge [*Euphorbia polygonifolia*], fringed gentian [*Gentianopsis crinite*], Oakes' evening-primrose [*Oenothera oakesiana*], and Bachman's jelly lichen [*Enchylium bachmanianum*]) are located within 1 mi (1.6 km) of the project area. In addition, the Ohio DOW mentioned the spotted turtle and northern harrier (*Circus cyaneus*) as known to occur near the Perry Plant site. Furthermore, the Ohio DOW recommends conducting a habitat assessment for the Indiana bat, northern long-eared bat (*Myotis septentrionalis*), little brown bat (*Myotis lucifugus*), and tricolored bat. Section 3.8 discusses the federally listed Indiana bat, northern long-eared bat, and tricolored bat in detail. State-listed species known to occur or that have potential to occur on the Perry Plant site are discussed in detail below.

Of these species, only one, the spotted turtle, was reported to occur on the Perry Plant site in the Final Environmental Statement related to the initial operating license for Perry Plant (NRC 1982-TN9606: Sections 4.3.7 and 5.6.2), which matches the Ohio DOW and Natural Heritage records. This species prefers fens, bogs, and marshes, but likely inhabits pond edges and wet woods on site. The Ohio DOW concluded that impacts to this species were unlikely given that no land or habitat disturbance is planned.

Six State-listed plants including American beachgrass and inland beach pea (*Lathyrus japonicus*) are known to occur within 1 mi (1.6 km) of the Perry Plant site (EH 2023-TN9534: Section 3.7.8.2 and Attachment C) and are described in more detail below:

- American beachgrass is a State-listed threatened grass species that thrives in shifting sand on beaches and foredunes (iNaturalist 2024-TN9968). The beach grass has been observed at the Perry Plant site along the shoreline of Lake Erie, on the northern edges of the site.
- Inland Bea-Pea is a State-listed threatened perennial that prefers beaches or stony seashores (iNaturalist 2024-TN9967). Within Ohio, it is known on the sandy beaches of Lake Erie (ODNR 2020-TN9978) and within 1 mi (1.6 km) of the Perry Plant site.
- Golden-fruited sedge is a potentially threatened sedge that thrives in wet and open environments (ODNR 2020-TN9978). Potential habit near the Perry Plant site include interdunal swales near Lake Erie.
- Seaside spurge is a rare annual that prefers sand dunes and sandy beaches of the Great Lakes (ODNR 2020-TN9978). Potential habit near the Perry Plant site include interdunal swales near Lake Erie.
- Fringed gentian is a potentially threatened perennial that can be found in low wood and meadows (ODNR 2020-TN9978).
- Oakes' evening-primrose is a potentially threatened biennial herb that prefers sand dunes and beaches (ODNR 2020-TN9978). Potential habit near the Perry Plant site include interdunal swales near Lake Erie.
- Bachman's jelly lichen is a State-listed threatened lichen that thrives in limestone-based soil in exposed areas (ODNR 2020-TN9986).

Four State-listed wildlife species are known to occur within 1 mi (1.6 km) of the Perry Plant site (EH 2023-TN9534: Section 3.7.8.2 and Attachment C) and are described in more detail below. In addition, migratory fly overs of the Perry Plant site may occur by three species (black-crowned night heron [*Nycticorax nycticorax*], lark sparrow [*Chondestes grammacus*], and upland sandpiper [*Bartramia longicauda*]).

- Northern harrier is a State-listed endangered bird species that nests within dense vegetation and hunts over grasslands, marshes, and fields. There is potential nesting habitat within the forests of the Perry Plant site and foraging habitat within the maintained transmission corridor.
- Little Brown Bat is a State-listed endangered bat species that utilizes a wide range of habitats ranging from man-made structures to caves and trees for resting and maternity sites and tend to overwinter in caves and tunnels (FWS Undated-TN9987). Foraging typically occurs over streams, along margins of lakes or forested wetlands. The Perry Plant site has potential foraging and maternity habitat; however, the nearest cave is approximately 34 mi (55 km) southeast of the site, so the species is unlikely to overwinter onsite.
- Ocellated darner (*Boyeria grafiana*) and Riffle snaketail (*Ophiogomphus carolus*) are State-listed threatened insects that prefer shaded moderately flowing rivers with rocky bottoms (Wisconsin Odonata Survey Undated-TN9988). There is potential habitat with the rivers on the Perry Plant site.

In addition, 23 species could have potential habitat on site, based on habitat assessment and recorded observations within the past 20 years.

- Forested wetlands on site could be potential habitat for Bailey's sedge, Clinton's wood fern, and white wood-sorrel (iNaturalist Undated-TN9989; ODNR 2020-TN9990).
- Emergent wetlands and stream floodplains can contain great St. John's-wort, leafy tussock sedge, necklace sedge, and nodding sedge (ODNR 2020-TN9978).
- Sandy streambanks or the shores of Lake Erie could be potential habitat for bushy cinquefoil, dwarf bulrush, forked rush, Cooper's milk-vetch, and variegated scouring-rush (iNaturalist Undated-TN9991; ODNR 2020-TN9992). Similarly, coastal little bluestem and northern bog club-moss can occur on the sand dunes along Lake Erie (Mid-Atlantic Herbaria Consortium Undated-TN9993).
- Thread-like naiad prefers the shallow waters of lakes and may be found along Lake Erie.
- Forested portions of the site can contain Canada buffalo-berry, large-leaved mountain-rice, and leafy goldenrod (ODNR 2020-TN9978). In addition, the forests are potential habitat for black bears, but it is unlikely that the bears are on site (EH 2023-TN9534: Section 4.6.6.4).
- Disturbed areas such as the maintained transmission line corridor, openings within the forest, and roadsides can provide habitat for Canada hawkweed, Pennsylvania hawthorn, rock-harlequin, round-leaved dogwood, smooth blackberry, and bug-on-a-stick (Dodds 2022-TN9994; NC State Extension Undated-TN9995; NatureServe Explorer 2024-TN9996).

3.6.3.3 Species Protected Under the Bald and Golden Eagle Protection Act

The Bald and Golden Eagle Protection Act (TN1447) extends regulatory protections to the bald eagle and golden eagle. The Act prohibits anyone without a permit from the Secretary of the Interior from "taking" bald eagles or golden eagles, including their parts, nests, or eggs.

Bald and golden eagles are known to occur within Lake County, Ohio (EH 2023-TN9534; Table 3.7.3), but golden eagles are not known to nest within Ohio (ODNR 2018-TN9893). Seven bald eagle nests have been identified in Lake County (ODNR 2020-TN9892). Bald eagles have been observed within the Perry Plant site but are not known to nest onsite (EH 2023-TN9534: p. 4-25).

3.6.3.4 Species Protected Under the Migratory Bird Treaty Act

The Migratory Bird Treaty Act (MBTA) makes it illegal for anyone to take, possess, import, export, transport, sell, purchase, barter, or offer for sale any migratory bird or the parts, nests, or eggs of such a bird except under the terms of a valid permit issued under Federal regulations.

VistraOps lists 345 birds likely to be observed in Lake County, Ohio (EH 2023-TN9534: Table 3.7-3). Of these, 339 are protected by the MBTA. Sixteen are either eagles or are listed as a Birds of Conservation Concern (FWS 2021-TN8740): bald eagle, black-billed cuckoo (*Coccyzus erythropthalmus*), blue-winged warbler (*Vermivora pinus*), bobolink (*Dolichonyx oryzivorus*), Canada warbler (*Cardellina canadensis*), Cerulean warbler (*Dendroica cerulea*), evening grosbeak (*Coccothraustes* vespertinus), golden eagle (*Aquila chrysaetos*), golden-winged warbler (*Vermivora chrysoptera*), lesser yellowlegs (*Tringa flavipes*), long-eared owl (*Asio otus*), prairie warbler (*Dendroica discolor*), red-headed woodpecker (*Melanerpes erythrocephalus*), ruddy turnstone (*Arenaria interpres morinella*), short-billed dowitcher (*Limnodromus griseus*), and wood thrush (*Hylocichla mustelina*).

VistraOps has procedures and policies relating to the handling and management of migratory birds (Vistra 2024-TN9925: Attachment 43). Between 2013–2023, there were a total of 20 documented bird incidents at the Perry Plant site (Vistra 2024-TN9925: Attachment 42). These 20 incidents included one injured peregrine falcon and at least 85 dead birds. The largest bird mortality incident consisted of 60 skeletonized birds impinged on a circulating water basin screen in 2021. VistraOps staff had vacuumed the screens the week before the impingement and has not been able to identify the cause of the incident (EH 2023-TN9534: Section 3.7.7.2). None of the subsequent incidents were impingements on this screen.

3.6.3.5 *Invasive Species*

Invasive species are identified as nonnative organisms whose introduction causes or is likely to cause economic or environmental harm or harm to human, animal, or plant health (EO 13751, 81 FR 88609-TN8375). Executive Order (EO) 13112 (64 FR 6183-TN4477) directs Federal agencies to not authorize, fund, or carry out actions likely to cause or promote the introduction or spread of invasive species unless the Federal agency determines that the benefits of the action clearly outweigh the harm from invasive species and that all feasible and prudent measures to minimize risk of harm are taken (64 FR 6183-TN4477: Section 2).

Based on the information provided by VistraOps (EH 2023-TN9534: Sections 3.7.5), species biology, habitat descriptions, and invasion effects are incorporated by reference here for 25 species that NRC staff consider to be terrestrial. These are all the aquatic invasive plants (EH 2023-TN9534: Section 3.7.5.2) except for the deeper water brittle naiad (*Najus major*) and European millefoil (*Myriophyllum spicatum*), all the terrestrial invasive plants (EH 2023-TN9534: Section 3.7.5.3), and all the terrestrial invasive animals (EH 2023-TN9534: Section 3.7.5.4). Descriptions of the above-listed invasive species are incorporated here by reference.

All 25 of these species have the potential to occur onsite. VistraOps does not have procedures for controlling or monitoring terrestrial invasive species (EH 2023-TN9534: Section 3.7.5). However, Perry Plant controls invasive species growth on the eastern side of the facility at the stream diversion to comply with Ohio EPA and U.S. Army Corps of Engineers (USACE) requirements.

3.6.3.6 Important Habitats

Important habitats include any wildlife sanctuaries, refuges, preserves, or habitats identified by State or Federal agencies as unique, rare, or of priority for protection; wetlands and floodplains; and land areas identified as critical habitat for species listed by the U.S. Fish and Wildlife Service (FWS) as threatened or endangered. The Ohio Department of Natural Resources classified the eastern part of the Perry Plant site as a conservation site (EH 2023-TN9534: Section 3.7.4.3) and recognizes the hemlock-hardwood forest and mixed mesophytic plant communities that occur on the Perry Plant site as having significant ecological value (EH 2023-TN9534: Attachment C letter).

Other important habitats on and off the Perry Plant site include the shoreline of Lake Erie and other wetlands on site and in the vicinity (discussed above in Sections 3.6.1 and 3.6.2). Important offsite habitats include Headlands Dune State Natural Preserve (EH 2023-TN9534: Section 3.7.4.1) and the Lakeshore Reservation (EH 2023-TN9534: Section 3.7.4.2). There are no designated or proposed critical habitats onsite (Section 3.8.1) or within the vicinity of the Perry Plant site.

3.6.4 Proposed Action

Table 3-1 and Table 3-2 in this SEIS list the generic (Category 1) and site-specific (Category 2) issues that apply to terrestrial resources at the Perry Plant site during the proposed LR period. The NRC staff did not identify any new and significant information associated with the Category 1 terrestrial resource issues identified in Table 3-1 during the review of the applicant's ER and available scientific literature, the site audit, and the Federal and State agency and public comments received during the scoping process. As a result, no information or impacts related to these issues were identified that would change the conclusions presented in the LR GEIS (NRC 2013-TN2654). For these issues, the LR GEIS concludes that the impacts are SMALL. Table 3-2 identifies only one site-specific (Category 2) issue related to terrestrial resources during the Perry Plant term: effects on terrestrial resources from non-cooling system impacts. This issue is analyzed below. Perry Plant withdraws makeup water from Lake Erie, which is not a river. Therefore, the site-specific (Category 2) issue related to water use conflicts with terrestrial resources (plants with cooling ponds or colling towers using makeup water from a river) does not apply.

3.6.4.1 Effects on Terrestrial Resources (Non-cooling System Impacts)

According to the LR GEIS, non-cooling system impacts on terrestrial resources can include impacts that result from site and landscape maintenance activities, stormwater management, elevated noise levels, and other ongoing operations and maintenance activities that would occur during the LR period on and near a nuclear power plant site. The NRC staff based its analysis in this section on information derived from VistraOps' ER (EH 2023-TN9534), unless otherwise cited. VistraOps has not identified any refurbishment activities during the proposed relicensing term (EH 2023-TN9534). No further analysis of potential impacts from refurbishment activities is therefore necessary.

In its ER, VistraOps (EH 2023-TN9534) states that it would conduct ongoing operational and maintenance activities at Perry Plant throughout the LR term, including landscape maintenance activities, stormwater management, piping installation, and fencing. The NRC staff expects that physical disturbance would be limited to paved or disturbed areas or to areas of mowed grass or early successional vegetation and would not encroach into wetlands or into the remaining areas of mixed forest. The NRC staff concurs with VistraOps that the anticipated activities would have only minimal effects on terrestrial resources.

VistraOps (EH 2023-TN9534) states that it has administrative controls in place at Perry Plant to ensure that it reviews operational changes or construction activities and minimizes environmental impacts through BMPs, permit modifications, or new permits, as needed. VistraOps (EH 2023-TN9534) further states that regulatory programs for issues like stormwater management, spill prevention, dredging, and herbicides further minimize impacts on terrestrial resources. The NRC staff concurs that continued adherence to environmental management practices and BMPs already established for Perry Plant would continue to protect terrestrial resources during the LR period.

The NRC staff presumes that VistraOps would continue to comply with applicable requirements of Federal and State regulatory programs. VistraOps has procedures and policies relating to the handling and management of migratory birds (Vistra 2024-TN9925: Attachment 43). Furthermore, the staff presumes that if appropriate, VistraOps would obtain required incidental take permits from FWS for impacts on bald eagles, peregrine falcons, or other protected migratory bird species.

Operational noise from the Perry Plant facilities extends into the remaining natural areas on the site. However, Perry Plant has exposed these habitats to similar operational noise levels since it began construction approximately 55 years ago. The NRC staff therefore expects that wildlife in the affected habitats has long ago acclimated to the noise and human activity of Perry Plant operations and adjusted behavior patterns accordingly. Extending the same level of operational noise levels during the 20-year LR period is therefore unlikely to noticeably change the patterns of wildlife movement and habitat use.

VistraOps describes a potential shoreline protection project within the site boundary (EH 2023-TN9534: Section 3.1.4). The project area is adjacent to shoreline protection features north of the cooling tower and would extend east approximately 1,200 ft (370 m). In order for this shoreline protection project to be implemented, VistraOps would have to obtain permits from USACE and State agencies. Because USACE is a Federal agency that would authorize the activity, effects of this shoreline activity would be analyzed under ESA Section 7(a).

Based on its independent review, the NRC staff concludes that the landscape maintenance activities, stormwater management, elevated noise levels, and other ongoing operations and maintenance activities that VistraOps might undertake during the renewal term would primarily be confined to already disturbed areas of the Perry Plant site. These activities would neither have noticeable effects on terrestrial resources nor would they destabilize any important attribute of the terrestrial resources on or in the vicinity of the site. Accordingly, the NRC staff concludes that non-cooling system impacts on terrestrial resources from non-cooling system activities during the relicensing term would be SMALL.

3.6.5 No-Action Alternative

Under the no-action alternative, the NRC would not issue a renewed license, and Perry Plant would shut down on or before the expiration of the current facility operating license. Much of the operational noise and human activity at Perry Plant would cease, thereby reducing disturbance to wildlife in forest cover, grasslands, wetlands, and other natural vegetation on and near the site. However, some continued maintenance of Perry Plant would still be necessary; thus, at least some human activity, noise, and herbicide application would continue at the site with possible impacts resembling, but perhaps of a lower magnitude than, those described for the proposed action. Shutdown itself is unlikely to noticeably alter terrestrial resources. Reduced human activity and frequency of operational noise may constitute minor beneficial effects on wildlife inhabiting nearby natural habitats. The NRC staff therefore concludes that the impacts of the no-action alternative on terrestrial resources during the proposed LR term would be SMALL.

3.6.6 Replacement Power Alternatives: Common Impacts

Additional land would likely be temporarily disturbed for construction and laydown areas. If not already previously disturbed, the licensee could later revegetate temporarily disturbed land. The renewable and natural gas combination alternative would also involve construction on developed or undeveloped lands outside the vicinity of the Perry Plant site with indeterminate loss of offsite forest, grasslands, or wetlands.

Loss of habitat and increased noise generation during construction and operation of the new facilities could cause terrestrial wildlife to move into other habitats in the surrounding landscape, increasing demands on those habitats and competing with other wildlife. Erosion and sedimentation from clearing, leveling, and excavating land could affect adjacent riparian and wetland habitats. However, implementation of appropriate BMPs and revegetation of temporarily disturbed lands would minimize impacts.

The NRC assumes that the applicant would conduct required ecological surveys and develop any needed mitigation plans for any protected terrestrial species. The applicant would also have to conduct wetland delineations of affected lands and apply for permits for any wetland fill from USACE and the Ohio Department of Natural Resources. The NRC staff expects that any Federal or State permits authorizing wetland impacts would require mitigation. Wetland losses of this magnitude can typically be mitigated through various forms of compensatory wetland mitigation, such as mitigation banks.

3.6.7 Natural Gas-Fired Combined-Cycle Alternative

The types of impacts that the terrestrial environment would experience from the NGCC alternative are characterized in the previous section (Section 3.6.6), which discusses impacts common to all replacement power alternatives.

The NRC assumes that an NGCC alternative would involve construction of a 1,350 MWe NGCC plant on 60 ac (24 ha) of land either within the existing footprint of the Perry Plant site or at another site previously used for energy generation. This would mean little to no additional land would be needed for construction. If the NGCC plant were constructed within Perry Plant boundaries, minimal new pipeline infrastructure would be needed because a natural gas pipeline already crosses the Perry Plant site. If another site previously used for energy generation is chosen, construction of a natural gas pipeline infrastructure may be needed. While future upgrades may be required, it is assumed that the existing transportation and transmission line infrastructure at either the Perry Plant site or the other site would be adequate to support the alternative.

The LR GEIS (NRC 2013-TN2654: p. 4119) concludes that many of the impacts on terrestrial resources from the operation of fossil-fuel energy alternatives would be essentially similar to those from the continued operation of a nuclear power plant. These similar impacts include cooling tower salt drift, noise, bird collisions with plant structures and transmission lines, the impacts connected with herbicide application and landscape management, and the potential water use conflicts connected with cooling water withdrawals. However, some impacts particular to an NGCC plant would be from air emissions of GHGs such as nitrogen oxide, carbon dioxide, and methane. Such GHGs can lead to consequences like climate change. Section 3.15.3.7 in this report discusses the effects of climate change on terrestrial resources. Despite these emissions, operating the NGCC alternative power plant would not likely destabilize any important attribute of the terrestrial environment.

With respect to operation, Federal and State permits would control and mitigate many of the potential effects on the terrestrial environment, such that the associated effects would be unlikely to noticeably alter or destabilize any important attribute of the terrestrial environment.

Based on the above, the NRC staff assumes that the new plant would use some of the site infrastructure and buildings onsite or offsite. The NRC staff concludes that the impacts on terrestrial resources from construction of an NGCC alternative would be SMALL to MODERATE, depending on whether the NGCC plant is built onsite at Perry or offsite at another site that might require construction of a natural gas pipeline or other infrastructure. For operations, the NRC staff concludes that impacts on terrestrial resources would be SMALL, because the sites are already highly developed and the plant operation would obtain required Federal and State permits that would include best management practices and mitigation strategies to minimize effects on terrestrial resources.

3.6.8 Renewable and Natural Gas Combination Alternative

The second replacement power alternative combines renewable energy (solar and wind) and natural gas to replace the generating power of Perry Plant. This alternative proposes to construct and operate a 764-MWe NGCC plant, six 125-MW solar installations with battery storage, and three wind installations totaling 540 MW. All facilities and transmission lines associated with this project would be in the State of Ohio. The natural gas plant would be constructed in the same location as the NGCC alternative described in Section 3.6.7 (i.e., either within Perry Plant site boundaries or at an alternate site already used for energy generation). The solar and wind portions of this alternative would be located offsite from Perry Plant. Total Ohio land requirement for this alternative is about 56,151 ac (22,724 ha). Power generation facilities would require about 52,060 ac (21,068 ha). About 4,090 ac (1,655 ha) would be needed for the new 225 mi (362 km) of required transmission line corridors. Each of the nine corridors would be 25 mi (40 km) long and 150 ft (40.2 m) wide.

Natural Gas Component

Effects of this portion of the alternative would be similar to those of the NGCC alternative described in Section 3.6.7. The NRC staff concludes that the impacts on terrestrial resources from construction of the NGCC portion of the alternative would be SMALL to MODERATE, depending on location chosen.

However, because the proposed facility is 764 MWe, rather than 1,350 MWe, many of the operational impacts related to natural gas combustion would be less than the NGCC alternative. The NRC staff concludes that operational impacts on terrestrial resources would be SMALL.

Solar Component

About 8,727 ac (3,532 ha) of land would be required to construct and operate six, 125 MW solar installations. DOE estimates that solar installations require 8 ac (3 ha) per MW, so total area required for power generation is 6,000 ac (2,428 ha). An additional 2,726 ac (1,103 ha) would be needed for the six new 345 kV transmission line corridors. A small amount of additional land would be needed to support the battery storage system at each site.

Impacts on terrestrial habitats and biota from the construction and operation of solar PV plants would depend largely on the amount of land required and its location. The NRC assumes that one of the solar plants would be located on the Perry Plant site, and the other two would be located offsite. If the lands chosen for the plants offsite were previously cleared and used for industrial activity, the impacts on terrestrial resources would be less significant than if the lands were forest, grasslands, wetlands, or desert containing important species and habitats. Vegetation clearing and tree removal would displace wildlife to nearby habitats, but some species would return at the end of construction when temporarily disturbed land is restored. Once in operation, solar plants pose special hazards to birds through collisions with PV equipment and transmission lines, electrocution by substation and distribution lines, and predation by other animals when birds are injured and stunned on the ground after collision (Hathcock 2019-TN8470). Another less understood cause of bird collisions is known as the lake effect theory. Birds, especially migrating waterfowl and shorebirds, perceive the horizontally polarized light of PV solar panels as bodies of water and are injured or killed when they attempt to land on the panels as if they were water (Horvath et al. 2009-TN897). Water-seeking insects can also collide with the panels for the same reasons. In large enough numbers, such insect deaths may affect food webs. The Multiagency Avian-Solar Collaborative Working Group is a collection of Federal and State agencies identifying information needs and best practices for reducing the avian impacts of solar energy. Collaboration with government agencies on best practices in the construction and siting of the solar installations can mitigate their impacts on birds.

The NRC staff concludes that the impacts on terrestrial resources from the solar portion of this alternative would be MODERATE to LARGE based on the land requirement for solar generation facilities and transmission corridors, resulting in the significant loss of wildlife, habitats, and vegetation and the increased mortality risk to birds from collisions with solar PVs and new transmission lines.

Wind Component

About 47,364 ac (19,277 ha) of land would be needed for the wind portion of this alternative. This includes approximately 46,000 ac (18,600 ha) for three wind installations (about 15,300 ac [6,200 ha] per installation) and an additional 1,364 ac (552 ha) for three new 345 kV transmission lines.

Impacts on terrestrial habitats and biota from the construction and operation of wind farms as part of the combination alternative would depend largely on the amount of land required, location of the land, and whether the facility is onshore or offshore. The NRC staff assumes that the onshore wind portion of the alternative would be in the VistraOps region of influence. If the lands chosen for the plants were previously cleared and used for industrial activity, the impacts on terrestrial resources would be less significant than if the lands were forests or grasslands containing important species and habitats. Vegetation clearing and tree removal would displace wildlife to nearby habitats, though some species would return at the end of construction when temporarily disturbed land is restored.

Operation of wind farms would likely cause the injury and/or death of bats and birds that collide with wind turbines (Allison et al. 2019-TN8847). Species composition of deaths varies regionally. Bat collision mortality appears to be largest for migratory tree-roosting species and lowest in areas with the greatest grassland cover around the onshore wind farm (Thompson et al. 2017-TN8746). Most of the observed bird deaths at onshore wind farms are small songbirds (57 percent of deaths) or diurnal raptors (9 percent).

The MBTA makes it illegal to take any migratory bird (or parts, nests, or eggs), except under a valid permit issued under Federal regulations. The utility would likely need to commission avian impact studies and obtain a permit for take of MBTA-protected bird species.

Based on the preceding analysis, the NRC staff concludes that impacts on terrestrial resources from construction and operation of the wind portion of this alternative would be MODERATE to LARGE. Construction of the wind farms would result in the significant loss of vegetation and wildlife habitat, and operational impacts would negatively impact bird and bat populations.

Alternative Conclusion

Based on the above discussion of natural gas, solar, and wind, the NRC staff concludes that the overall impacts on terrestrial resources from the combination alternative could range from MODERATE to LARGE, mainly because of the large area of land and the types of land that could be used for the renewable portions of the alternative, and the operational impacts of the solar and wind on birds and bats.

3.7 Aquatic Resources

This section describes the aquatic resources of the affected environment (i.e., Lake Erie). The NRC staff previously characterized these resources in Sections 4.3.3 and 4.3.6 of the 1982 Perry Final Environmental Statement (NRC 1982-TN9606). Section 3.7 of the VistraOps' ER (EH 2023-TN9534) also describes the aquatic environment. Key, new, and updated information are summarized in the sections below. Following the description of each aquatic environment, the NRC staff analyzes the potential impacts of the proposed action (LR) and alternatives on these resources.

3.7.1 Lake Erie

Perry Plant lies along the southern shore in the central basin of Lake Erie, which is the second smallest of the Great Lakes by surface area (9,910 mi^2; 25,557 km^2) (ODNR 2018-TN9608). Lake Erie is also the shallowest, southernmost, and warmest of the Great Lakes. The volume of Lake Erie is 119 mi^3 (496 km^3) or 127.7 trillion gal (483 trillion liters), and the lake is approximately 241 mi (388 km) long and 57 mi (92 km) wide. The average depth is 58 ft (17.6 m), and the maximum depth is 210 ft (64 m). Surface temperatures range from 34°F (1.1°C) during winter to 74°F (23.3°C) during summer (NOAA 2024-TN9726). The surface water currents along the southern shore of Lake Erie by Perry Plant flow eastward, following the prevailing winds (ODNR 2018-TN9608).

Lake Erie is considered eutrophic, which means that it is a high productivity aquatic ecosystem due to an abundance of nutrients and large yields of primary production (namely phytoplankton)

(ODNR 2018-TN9608). Photosynthesis occurs in the euphotic zone, which is the upper portion of the water column that is penetrated by sunlight. In Lake Erie, this zone is within the first 10 ft (3 m) of the water column. The lake has historically suffered from pollution due to agriculture, industry, and urbanization; however, the health of the Lake Erie aquatic ecosystem has been generally improving over the last 30 years based on the 5-year running averages for various indicators from the 2022 Lake Erie Quality Index Report (Figure 3-12; OLEC 2022-TN9707). Four aquatic metrics are listed as "FAIR," although two of those, which include (1) harmful algae blooms and (2) shore and tributary biology, are showing improvement. Aquatic habitats have remained the same, while the plankton index is declining. The Plankton Index of Biotic Integrity, which is measured using the phytoplankton and zooplankton present from June to August, has declined in the western basin, while fluctuating but remaining fair in the central basin where Perry Plant is located. The plankton index was affected by an increase in the number of toxin-producing blue-green algae and a shift in the amount of various zooplankton (see Section 3.7.1.1).

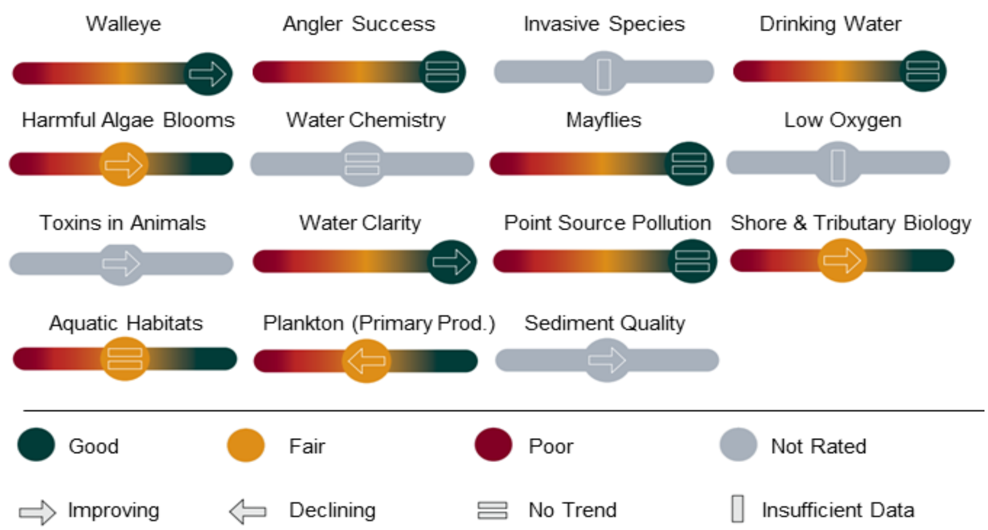


Figure 3-12 Lake Erie Water Quality and Aquatic Ecosystem Health Indicator Trends, 1992–2022. Adapted from: OLEC 2022-TN9707.

3.7.1.1 Biological Communities of Lake Erie

The trophic structure of Lake Erie includes primary producers (plankton, macrophytes, and periphyton), primary consumers (zooplankton and benthic macroinvertebrates), and bottom-feeding, planktivorous, and piscivorous fish that serve as secondary and tertiary consumers. Primary producers are organisms that capture solar energy and synthesize organic compounds from inorganic chemicals. They form the trophic structure's foundation by producing the organic nutrients and energy used by consumers. Primary producers in lake systems include phytoplankton, aquatic macrophytes, and periphyton. Of the three, phytoplankton are the major producers in all but very shallow lakes. Figure 3-13 illustrates the trophic structure of Lake Erie.

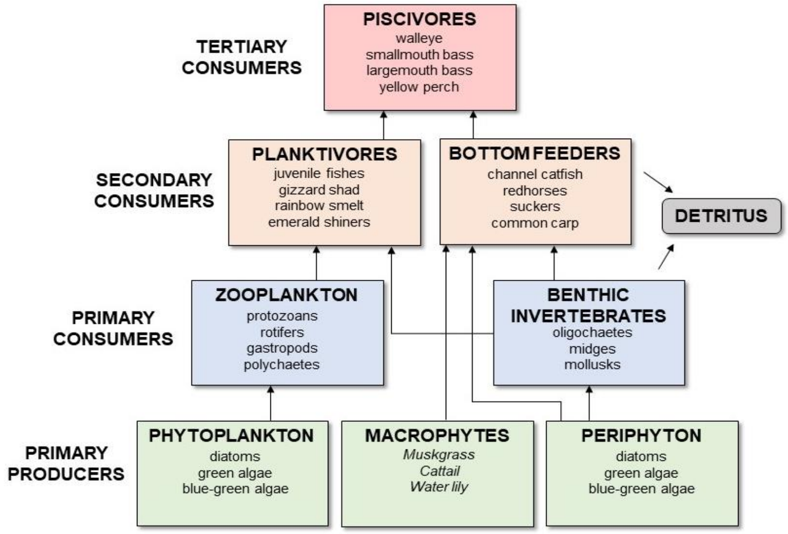


Figure 3-13 Trophic Structure of Lake Erie's Aquatic Ecosystem

Plankton

Plankton are small and often microscopic organisms that drift or float in the water column. Phytoplankton are single-celled plant plankton and include diatoms (single-celled, yellow algae) and dinoflagellates (a single-celled organism with two flagella). Phytoplankton live suspended in the water column and occur in the limnetic (open water) zone of a lake. In 1971 and 1972, Cleveland Electric Illuminating Company, the original owner and operator of the Perry Plant, conducted preoperational surveys that included plankton sampling. Survey results indicate that approximately 120 phytoplankton taxa occur in Lake Erie near the site (EH 2023-TN9534: Table 3.7-2). Prevalent taxa included the diatoms *Melosira binderana*, *M. varians*, *Cyclotella kuetzingiana*, *Fragilaria capucina*, and *Stephanodiscus niagarae* and the green algae *Coelastrum cambricum*, *C. microporum*, and *Mougeotia viridis*.

A team from the Ohio State University conducted the Lake Erie Plankton Abundance Study from 2000 through 2015 and sampled plankton every 2 weeks from May through September at eight sites in the central basin of Lake Erie off Fairport Harbor, Ohio, approximately 7 mi (11 km) west of Perry Plant (O'Donnell et al. 2023-TN9758). The Lake Erie Plankton Abundance Study data indicate that phytoplankton abundances varied by season with diatoms, cryptophytes, and green algae being most common in the spring and large increases in blue-green algae as the dominant phytoplankton by late summer. Over the 15-year sampling period the study reported, there has been an overall shift toward a more dominant blue-green algae phytoplankton community consisting of *Microcystis* ssp.*, Aphanothece, Dolichospermum*, etc. Blue-green algae, also known as cyanobacteria, are responsible for the seasonal algal blooms in Lake Erie, which typically occur from July to October when warmer water creates favorable bloom conditions. These blooms can rapidly decrease dissolved oxygen and increase phosphorus concentrations, which can result in fish kills, discolored or foul-smelling water, and other negative effects on the aquatic and human environment (OSU 2024-TN9727, Francy et al. 2020-TN9729).

Zooplankton are animals that either spend their entire lives as plankton (holoplankton) or exist as plankton for a short time during development (meroplankton). Zooplankton include rotifers, isopods, protozoans, marine gastropods, polychaetes, small crustaceans, and the eggs and larval stages of insects and other aquatic animals.

Cleveland Electric Illuminating Company's preoperational surveys in 1971 and 1972 indicate that approximately 50 taxa of zooplankton occur in Lake Erie near the site. These include protozoans, rotifers, copepods, and some microcrustaceans, such as Cladocerans (water fleas) (EH 2023-TN9534: Table 3.7-2). In 2014, USGS conducted a zooplankton survey in Lake Erie off Fairport Harbor, Ohio (USGS 2018-TN9720)[2]. Researchers collected samples between April and October. Water fleas and other microcrustaceans and copepods in the orders Calanoida and Cyclopoida were the most prevalent zooplankton. Rotifers were not included in this dataset. Table 3-15 shows seasonal abundance (counts of individuals per liter) of zooplankton from this survey.

Table 3-15 Seasonal Zooplankton Abundance in Lake Erie off Fairport Harbor, Ohio, 2014

Class (common name)	Spring	Summer	Fall	Total (number/liter)	Percent
Cladocera (Water fleas)	230.7	198.05	5.51	434.26	26.6%
Eucopepoda (Copepods)	714.4	472.56	11.11	1,198.06	73.4%
Calanoid Copepods	219.34	123.78	5.51	(348.62)	-
Cyclopoid Copepods	495	348.78	5.51	(849.28)	-
Harpacticoid Copepods	0.07	-	0.09	(0.16)	-

"-" denotes no entry in table cell.
Source: USGS 2018-TN9720.

Macrophytes and Periphyton

Aquatic macrophytes are large plants, both emergent and submerged, that inhabit shallow water areas. Periphyton consists of single-celled or filamentous species of algae that attach to benthic or macrophytic surfaces. Macrophytes and periphyton occur in the littoral (nearshore and shallow) zone. They tend to be highly productive because they have more access to nutrients through their roots than do phytoplankton.

Macrophytes within Lake Erie include cattails and rushes. The EPA Coastal Wetland Monitoring Program considers the coastal wetland vegetation in Lake Erie to be highly degraded compared to plant communities in Lakes Superior, Michigan, and Huron (EPA 2023-TN9721). EPA attributes this to greater amounts of human disturbance, nutrient runoff, and invasive species as compared to the other lakes.

Benthic Invertebrates

Benthic invertebrates inhabit the bottom of the water column and its substrates. They include macroinvertebrates (clams, crabs, oysters, and other shellfish) as well as certain zooplankton. Cleveland Electric Illuminating Company's preoperational survey data (1971–1972) identified 54 taxa of benthic macroinvertebrates comprising the following groups: oligochaete worms (33 percent), Chironomid larvae (e.g., midges) (22 percent), other types of insect larvae (15 percent), mollusks (9 percent), and crustaceans (7 percent) (EH 2023-TN9534). The remainder were a mixture of planarians, nematodes, leeches, water mites, and other colony-forming stationary invertebrates.

[2] See dataset: CSMI_2014_Zooplankton.csv in USGS 2018-TN9720.

One big change to the benthic invertebrate community since Perry Plant first started operating is the invasion of zebra and quagga mussels (Dreissenids) in 1989 and 1990s. In the central basin of Lake Erie where Perry Plant is located, the distribution of Dreissenid mussels is limited by bottom hypoxia, which occurs when dissolved oxygen on the lake floor (deeper than 20 m) is too low to sustain life (Karatayev et al. 2018-TN9755; Benson et al. 2023-TN9754). This shift in the benthos community structure can be seen in the 2014 USGS benthos data from off Fairport Harbor, Ohio at depths from 34 ft to 83 ft (10 m to 25 m). In these samples, taken from April to October, the dominant taxa are Dreissena mussels (33 percent) followed by oligochaete worms (19.5 percent), Sphaeriidae (17 percent), Chironomid larvae (11 percent), nematodes (8 percent), and gastropods (7.5 percent) (USGS 2018-TN9720).[3]

Ichthyoplankton

Ichthyoplankton are the eggs and larvae of fish. Preoperational ichthyoplankton surveys were conducted near Perry Plant in 1974 (NRC 1982-TN9606). Eggs collected within 3.2 mi (5 km) of Perry Plant included freshwater drum (*Aplodinotus grunniens*) (24 percent), yellow perch (*Perca flavescens*) (9 percent), trout-perch (*Percopsis omiscomaycus*) (9 percent), rainbow smelt (*Osmerus mordax*) (3 percent), and minnows (*Cyprinidae*) (2 percent). Larvae collections comprised minnows (76 percent), rainbow smelt (8 percent), freshwater drum (1 percent), and invasive alewife (*Alosa pseudoharengus*) (1 percent). VistraOps has not conducted any recent ichthyoplankton surveys, and the NRC staff identified no recent surveys by other organizations near the Perry Plant.

Juvenile and Adult Fish

Many surveys have been conducted to characterize the fish community in Lake Erie. In 1971 and 1972, Cleveland Electric Illuminating Company conducted gillnet surveys, and in 1974, they conducted additional sampling using gillnets, bottom trawls, and shore seines (NRC 1982-TN9606, EH 2023-TN9534). From 2010 through 2022, the Great Lakes Fishery Commission (GLFC) conducted trawl tows for prey fishes in the Central Basin of Lake Erie (Slagle et al. 2023-TN9747). The Ohio Department of Natural Resources (ODNR) has also conducted long-term fish surveys in Lake Erie using trawl, gillnet, electrofishing, hydroacoustic gear, and creel surveys (ODNR 2024-TN9737). This section briefly summarizes these surveys, and Table 3-16 lists species commonly collected in these surveys.

The 1971–1972 and 1974 plant preoperational fish surveys caught 16 different species using gill netting, with the most abundant fish being yellow perch (53 percent), freshwater drum (23.5 percent), and walleye (unknown, *Sander vitreus*) (NRC 1982-TN9606; EH 2023-TN9534). In 1974, shore seining near the Perry Plant found that emerald shiners (*Notropis atherinoides*) and young alewives (invasive) were the most abundant in the shallow, nearshore areas. Additional trawl and gillnet surveys in the offshore areas near the intake and discharge structures resulted in collecting freshwater drum, yellow perch, emerald shiner, spottail shiner (*Notropis hudsonius*), invasive rainbow smelt, white sucker (*Catostomus commersonii*), invasive common carp (*Cyprinus carpio*), and gizzard shad (*Dorosoma cepedianum*). The 1974 surveys also recorded young-of-the-year and juvenile fishes with alewives, gizzard shads, and shiners being the most numerous species. Young yellow perch, white bass (*Morone chrysops)*, freshwater drum (*Aplodinotus grunniens)*, channel catfish (*Ictalurus punctatus*), and suckers (*Catostomus* spp.) were present in lower numbers (see Table 3-16 for full list).

[3] See dataset: CSMI_2014_Benthos.csv in USGS 2018-TN9720.

1 **Table 3-16 Common Fish Species in Lake Erie near Perry Nuclear Power Plant**

Common Name	Species	Special Status[(a)]
Alewife	*Alosa pseudoharengus*	invasive
American eel	*Anguilla rostrata*	ST
American gizzard shad	*Dorosoma cepedianum*	-
black bullhead	*Ameiurus melas*	-
Bluegill	*Lepomis macrochirus*	-
brook silverside	*Labidesthes sicculus*	-
brown bullhead	*Ameiurus nebulosus*	-
Buffalo	*Ictiobus cyprinellus*	-
channel catfish	*Ictalurus punctatus*	-
channel darter	*Percina copelandi*	-
cisco	*Coregonus artedi*	SE
common carp	*Cyprinid* spp.	invasive
emerald shiner	*Notropis atherinoides*	-
freshwater drum	*Aplodinotus grunniens*	-
gizzard shad	*Dorosoma cepedianum*	-
golden redhorse	*Moxostoma erythrurum*	-
Goldfish	*Carassius* spp.	invasive
grass carp	*Ctenopharangydon idella*	invasive
Iowa darter	*Etheostoma exile*	SE
Johnny darter	*Etheostoma nigrum*	-
lake sturgeon	*Acipenser fulvescens*	SE
lake whitefish	*Coregonus clupeaformi*	-
largemouth bass	*Micropterus salmoides*	-
Logperch	*Percina caprodes*	-
longnose dace	*Rhinichthys cataractae*	SSC
mimic shiner	*Notropis volucellus*	-
northern brook lamprey	*Ichthyomyzon fossor*	SE
pugnose minnow	*Opsopoeodus emiliae*	SE
pumpkinseed	*Lepomis gibbosus*	-
Quillback	*Carpiodes cyprinus*	-
rainbow smelt	*Osmerus mordax*	invasive
rock bass	*Ambloplites rupestris*	-
round goby	*Neogobius melanostomus*	invasive
Rudd	*Scardinius erythrophthalmus*	invasive
sea lamprey	*Petromyzon marinus*	invasive
shortnose gar	*Lepisosteus platostomus*	SE
silver chub	*Macrhybopsis storeriana*	-
silver redhorse	*Moxostoma anisurum*	-
shorthead redhorse	*Moxostoma macrolepidotum*	-
smallmouth bass	*Micropterus dolomieu*	-
spottail shiner	*Notropis hudsonius*	-
silver lamprey	*Ichthyomyzon unicuspis*	-

Table 3-16 Common Fish Species in Lake Erie near Perry Nuclear Power Plant (Continued)

Common Name	Species	Special Status(a)
steelhead trout	*Oncorhynchus mykiss*	introduced
Suckers	*Catostomus* spp.	-
trout perch	*Percopsis omiscomaycus*	-
Walleye	*Sander vitreus*	-
white bass	*Morone chrysops*	-
white perch	*Morone americana*	invasive
white sucker	*Catostomus commersonii*	-
yellow perch	*Perca flavescens*	-

(a) - = no special status; introduced = not native to a specific location; invasive = not native and causes damage to the environment or humans; SE = State-endangered; ST = State-threatened; SSC = State species of special concern.

Sources: EH 2023-TN9534; Slagle et al. 2023-TN9747; ODNR 2024-TN9737, ODNR 2024-TN9914.

More recently, the GLFC survey conducted in 2022 showed an averaged density of 1,401 prey (bait) fish per hectare in Ohio waters of the central basin (Slagle et al. 2023-TN9747). This is similar to densities reported in 2021, which were up from 2020 survey numbers with rainbow smelt and spiny-rayed species (e.g., yellow perch, walleye) dominating the catch. Despite the increases in prey fish abundance during between 2020 and 2022, overall density remained below the long-term average, with the exception of rainbow smelt and walleye, which had abundances above the long-term average.

ODNR's Management Unit 3, encompassing two transects off Perry and Ashtabula, Ohio, annually conducts surveys and analyzes the relative abundance and growth of major predator (walleye, yellow perch, white bass, smallmouth bass) and prey (invasive white perch, gizzard shad, emerald shiner, rainbow smelt, invasive round goby) fish (ODNR 2024-TN9737). In 2022, only walleye and age-0 gizzard shad exhibited a population density above their 30+ year mean. Over the last 30 years, including the most recent samples in 2022, young-of-the-year rainbow smelt have consistently dominated sample abundances followed by white and emerald shiners, with lower numbers of walleye, yellow perch, white bass, round goby, alewife, trout perch, and freshwater drum (Table 3-17). In 2022, for age-1+, while rainbow smelt (29 percent) remained most abundant, there is a shift is the composition of other fish to freshwater drum (14 percent), round goby (12 percent), walleye (9 percent), trout perch (7 percent), white perch (6 percent), and yellow perch (2 percent).

Examining data from both the GLFC and ODNR surveys, the abundance of walleye is estimated to be at relatively high levels in recent years compared to historical averages. Recruitment of prey was up for most species in 2022, although recruitment has been highly variable over the last 5 years. The fluctuation in prey fish abundances over time is natural, reflecting the inherent variability of these species, which are characterized by short lifespans and high reproductive rates.

Table 3-17 Age-0 Fish Abundance During Ohio Department of Natural Resources' Yearly Sampling in Management Unit 3

Species	30-Year Average Abundance (%)	2022 Abundance (%)
rainbow smelt	51	76
white perch	18	1
emerald shiners	16	2
round goby	4.5	3.5
yellow perch	2.5	<1
white bass	2.5	<1
Walleye	<1	1.5
Alewife	<1	<1
trout perch	<1	<1
freshwater drum	<1	<1

Source: ODNR 2024-TN9737.

Impingement and entrainment of some aquatic organisms is an unavoidable consequence of the cooling water intake system. Based on the selected technologies and operational measures used at Perry Plant, the Ohio EPA has determined the cooling water intake structure represents the best technology available to minimize adverse environmental impacts under Section 316(b) of the Clean Water Act (EH 2023-TN9746). Cleveland Electric Illuminating Company conducted intake monitoring at five of their power plants within a 50 mi (80 km) radius of Perry Plant on Lake Erie from 1977 to 1978 (NRC 1982-TN9606). Perry Plant was not included in this monitoring effort. Ashtabula C, the plant most similar to Perry Plant, showed that commercially and recreationally important species made up only 5 percent of the impingement losses, with the other 95 percent primarily comprising forage fishes (e.g., smelt, shad, shiners). From information gathered during the environmental site audit, the NRC staff understands that Perry Plant staff inspect the fish baskets while checking the traveling screens on the intake system. Fish are rarely found and when present, occur in low numbers (1 to 2 fish) (Vistra 2024-TN9925: Response AQ-1).

3.7.1.2 Important Species and Habitats of Lake Erie

This section summarizes important Lake Erie fisheries and State-protected and other special status species.

Commercially Important Fisheries

The ODNR manages commercial fisheries in Lake Erie (ODNR 2024-TN9737). Since 2008, ODNR has required commercial fishermen to track their harvest, effort, and ex-vessel revenue. Total annual harvests have ranged from 3.7 to 4.6 million lb (1.68–2.09 million kg) of fish during that period. The primary species caught have been yellow perch (27 percent), freshwater drum (15 percent), white bass (11 percent), channel catfish (11 percent), and buffalo (*Ictiobus cyprinellus*) (5 percent).

The ODNR manages the commercial fisheries, including yellow perch, with total allowable catch limits that include separate allocations for commercial and recreational fisheries (ODNR 2024-TN9737, ODNR 2023-TN9730). Total allowable catch is based on the results of stock assessments that produce sustainable harvest limits. The ODNR evaluates other fisheries based on indicators from fishery-dependent and fishery-independent surveys, such as catch rates and length compositions by year, and manages these fisheries through bag limits, size limits, and other routine management measures.

Recreationally Important Fisheries

Recreational and charter fishing are popular in Lake Erie, and anglers spend about $2 billion annually on fishing-related expenses (ODNR 2018-TN9608, ODNR 2024-TN9737). The Lake Erie charter boat industry is the largest in North America and accounts for 40 percent of all Great Lakes charter boats. Walleye is the most popular sport fishery. This species is targeted by 49 percent of anglers and accounts for 64 percent of annual harvest. Yellow perch is another popular sport fishery that is targeted by 31 percent of anglers and accounts for 33 percent of annual harvest. Other popular recreational fisheries include steelhead trout (*Oncorhynchus mykiss)*, smallmouth bass (*Micropterus dolomieu*), and channel catfish. The GLFC maintains management plans for walleye and yellow perch (Kayle et al. 2015-TN9731 and GLFC 2020-TN9732).

State-Protected and Other Special Status Aquatic Species

The ODNR has regulatory authority for fish and wildlife in Ohio per Title 15, Conservation of Natural Resources, of the Ohio Laws and Administrative Rules since 1974 (OAC Title 15-TN9748). The ODNR also has the authority to implement rules to restrict the take of species that it deems as endangered at the State level (OAC Title 15-TN9736). Under these rules, "endangered" means the species may be extirpated from Ohio, "threatened" means the species is not in immediate jeopardy but could become endangered, and "species of concern" includes species that could become threatened or lack enough information for the ODNR to make an adequate evaluation on the status of the species (ODNR 2024-TN9738).

Table 3-18 shows the State-listed species that may occur near Perry Plant, which the NRC staff compiled based on information in the ER[4] (EH 2023-TN9534), from ODNR (ODNR 2024-TN9738), and the results of aquatic surveys described previously in Section 3.7.1.1 of this SEIS. While the three mussels listed could occur near Perry Plant, no federally or State-listed mussel species have been identified during periodic surveys conducted to monitor mussel settlement on plant systems during spawning season in Lake Erie (Vistra 2024-TN9925: Response AQ-6).

3.7.1.3 Invasive and Nuisance Species of Lake Erie

Nonnative species are those species that are present only because of introduction and that would not naturally occur either currently or historically in an ecosystem. Invasive species are nonnative organisms whose introduction causes or is likely to cause economic or environmental harm or harm to human, animal, or plant health (81 FR 88609-TN8375). For purposes of this discussion, nuisance species are nonnative species that alter the environment but that do not rise to the level of invasive.

[4] Ohio Department of Natural Resources. 2022. Letter from Pettegrew, M. Environmental Services Administrator to Grimm, J. Energy Harbor, dated September 9, 2022, regarding "Re: 22-0801; Perry Nuclear Power Plant License Renewal." Accession No. ML23184A08, in Appendix E, Attachment C of EH 2023-TN9534).

Table 3-18 State-Listed Species That May Occur in Lake Erie within 1.0 mi (1.6 km) of the Perry Nuclear Power Plant

Common Name	Scientific Name	State Status[(a)]	Habitat & Spawning
American eel	*Anguilla rostrata*	ST	Bottom of muddy, silt bottomed lakes, spawn only in the Sargasso Sea. (Fuller et al. 2024-TN9749)
Cisco	*Coregonus artedi*	SE	Rare in Lake Erie, aggregate spawners in nearshore, gravel areas particularly the mouth of the Detroit River, when temperatures drop 2–5°C (3.6–9°F) in late fall. (GLFC 2017-TN9756)
Iowa darter	*Etheostoma exile*	SE	Dependent on cool, clear, vegetated aquatic habitat, spawning occurs in spring in sandy, vegetated areas or beneath stream banks. (Bland and Willink 2018-TN9750)
lake sturgeon	*Acipenser fulvescens*	SE	Opportunistic bottom feeders that forage over gravel, sand, and/or mud substrates; occur in rivers and shallow areas of lakes and spawn in gravelly tributary streams of rivers and lakes. (EH 2023-TN9534)
longnose dace	*Rhinichthys cataractae*	SSC	Rocky shores of lakes, spawn during spring in very fast riffles over shallow gravel. (IDNR 2024-TN9759)
northern brook lamprey	*Ichthyomyzon fossor*	SE	Adults are typically found over coarse substrate, sand, or gravel; in swifter waters, riffles, or runs. Ammocoetes are found burrowed in fine sediment or organic debris, inside channels or other quiet water in areas with embedded woody debris. Spawning occurs in crevices beneath rocks and boulders. (EH 2023-TN9534)
pugnose minnow	*Opsopoeodus emiliae*	SE	Prefers slow, clear, vegetated water with sandy or organic bottom, spawning occurs in spring. (MSU 2024-TN9809)
shortnose gar	*Lepisosteus platostomus*	SE	Wave-washed shoals of large lakes, spawns in spring at temperatures between 16 and 20°C (61 to 68°F) in quiet shallow water with submerged structure. (Fuller et al. 2019-TN9765)
Deertoe	*Truncilla truncata*	SSC	Found in muddy sand or cobble, rely on freshwater drum for a larval host. (ODNR 2022-TN9757)
Fawnsfoot	*Truncilla donaciformis*	ST	Found in muddy sand or cobble, rely on freshwater drum for a larval host. (ODNR 2022-TN9757)
threehorn wartyback	*Obliquaria reflexa*	ST	Found in sand or cobble, rely on shiners, dace, and minnows as larval hosts. (ODNR 2022-TN9757)

(a) SE = State-endangered; ST = State-threatened; SSC = State species of special concern.
Sources: EH 2023-TN9534; Slagle et al. 2023-TN9747; ODNR 2022-TN9766; NRC 1982-TN9606.

There are nearly 200 invasive species that affect the Lake Erie aquatic ecosystem (ODNR 2018-TN9608; ODNR 2024-TN9760). Many were unintentionally introduced from ballast water discharges of ships and through shipping canals, while some have been intentionally introduced from illegal stocking. For a list of invasive fishes that may occur near Perry Plant see Table 3-16. The ODNR's main aquatic species of concern include sea lamprey *(Petromyzon marinus),* curlyleaf pondweed (*Potamogeton crispus*), hydrilla (*Hydrilla verticillata*), round goby (*Apollonia melanostomus*), ruffe (*Gymnocephalus cernuus*), red swamp crayfish (*Procambarus clarkia*), white perch (*Morone americana*), and zebra mussel (ODNR 2024-TN9760). The ODNR and NOAA are also concerned that multiple species of Asian carp could migrate from the Mississippi River and into the Great Lakes; NOAA predicts that if introduced to

Lake Erie, Asian carp could comprise up to 34 percent of total fish by weight and could negatively impact native species in many ways (ODNR 2021-TN9753; NOAA 2023-TN9752).

The primary invasive species concern related to Perry Plant operations is biofouling of the cooling water intake system by invasive bivalves, such as Asian clams (*Corbicula fluminea)*, zebra mussels, and quagga mussels. VistraOps regularly monitors potentially affected cooling system components and treats water in the system, as needed, to prevent biofouling. Perry Plant's NPDES permit also allows VistraOps to remove bivalves via mechanical means (e.g., scraping) and to use molluscicides in accordance with EPA regulations and NPDES permit conditions (USACE 2012-TN9751 and EH 2023-TN9746).

3.7.2 Proposed Action

As described in the LR GEIS (NRC 2013-TN2654) and cited in Table 3-1 of this SEIS, the impacts of all generic (Category 1) aquatic resource issues would be SMALL. There are no site-specific (Category 2) issues that apply to aquatic resources for the proposed Perry Plant LR and no associated new and significant information was identified. As indicated in Section 3.1 of this SEIS, there are no impacts related to the issues beyond those discussed in the LR GEIS.

3.7.3 No-Action Alternative

If Perry Plant were to cease operations, impacts on the aquatic environment would decrease or stop following reactor shutdown. Some water withdrawal would continue during the shutdown period to provide cooling to the reactor core and spent fuel in the spent fuel pool until that fuel could be transferred to dry storage. The amount of water withdrawn for these purposes would be a small fraction of water withdrawals during operations, would decrease over time, and would likely end within the first several years following shutdown. The reduced demand for cooling water would substantially decrease the effects of impingement, entrainment, and thermal effluent on aquatic organisms, and these effects would wholly cease following the transfer of spent fuel to dry storage. Effects from cold shock would be unlikely, given the small area of lake affected by thermal effluent under normal operating conditions, combined with the phased reductions in withdrawal and discharge of lake water that would occur following shutdown. The NRC staff concludes that the impacts of the no-action alternative on aquatic resources would be SMALL.

3.7.4 Replacement Power Alternatives: Common Impacts

Construction impacts for many components of either replacement power alternative would be qualitatively and quantitatively similar. Construction could result in aquatic habitat loss, alteration, or fragmentation; disturbance and displacement of aquatic organisms; mortality of aquatic organisms; and increase in human access. For instance, construction-related chemical spills, runoff, and soil erosion could degrade water quality in Lake Erie by introducing pollutants and increasing sedimentation and turbidity. Dredging and other in-water work could directly remove or alter the aquatic environment and disturb or kill aquatic organisms. Because construction effects would be short term, associated habitat degradation would be relatively localized and temporary. Effects could be minimized by the use of existing infrastructure such as the natural gas line and powerlines that are onsite at the Perry Plant, and the utilization of existing transmission lines, roads, parking areas, and certain buildings. Aquatic habitat alteration and loss could be minimized by siting components of the alternatives farther from water bodies and away from drainages and other aquatic features.

Water quality permits required through Federal and State regulations would control, reduce, or mitigate potential effects on the aquatic environment. Through such permits, the permitting agencies could include conditions requiring VistraOps to follow BMPs or to take certain mitigation measures if adverse impacts are anticipated. Notably, the EPA final rule under Phase I of the CWA Section 316(b) regulations applies to new facilities and sets standards to limit intake capacity and velocity to minimize impacts on fish and other aquatic organisms in the source water (40 CFR 125.84 [TN254]). Any new replacement power alternative subject to this rule would be required to comply with the associated technology standards.

With respect to operation of a new replacement power alternative, operational impacts for either alternative would be qualitatively similar but would vary in intensity, based on each alternative's water use and consumption. Both alternatives would involve NGCC plants that would be built at the Perry Plant site. Similar to nuclear power plants, NGCC plants heat the water to produce steam that generates electricity in steam turbines. These NGCC plants would use cooling towers that minimize water withdrawals and reduce impacts to aquatic ecosystems as compared to other systems, such as once-through cooling systems. Water use conflicts are unlikely given the large volume of available water in Lake Erie and the small consumptive use rates that would likely during cooling tower operation.

3.7.5 Natural Gas-Fired Combined-Cycle Alternative

The types of impacts that the aquatic environment would experience from this alternative are characterized in the previous section that discusses impacts common to all replacement power alternatives.

This alternative would involve construction of an NGCC plant within the existing footprint of the Perry Plant site or at another site previously used for energy generation, which would require no additional land for construction. It would also require construction of some short onsite natural gas pipelines to connect to the existing natural gas pipeline that crosses the Perry Plant site. Although some infrastructure upgrades may be required, it is assumed that the existing transportation and transmission line infrastructure at Perry Plant would be adequate to support the alternative.

The NRC staff finds that the impacts of construction on aquatic resources would be SMALL because construction effects would be of limited duration, the new plant would use some of the existing site infrastructure and buildings, and required Federal and State water quality permits would likely include conditions requiring BMPs and mitigation strategies to minimize environmental effects.

With respect to operations, Federal and State water quality permits would control and mitigate many of the potential effects on the aquatic environment, including water withdrawal and discharge, such that the associated effects would be unlikely to destabilize or noticeably alter any important attribute of the aquatic environment. Therefore, the NRC staff finds that the impacts of operation on aquatic resources would be SMALL.

Based on the above, the NRC staff concludes that the impacts on aquatic resources from construction and operation of an NGCC alternative would be SMALL.

3.7.6 Renewable and Natural Gas Combination Alternative

This alternative would involve the construction and installation of an NGCC plant at the Perry Plant site plus solar and wind installations that would be located elsewhere in Ohio.

Construction of utility-scale solar fields and onshore wind farms requires relatively large amounts of offsite land disturbance associated with the footprints of the wind turbines, access roads, and transmission lines. The roads and transmission lines would likely cross aquatic water bodies (e.g., creeks) depending on where they are placed. During operation of the solar fields and onshore wind farms, accidental releases of contaminants from lubricant, fuel, and chemical spills would pose a hazard to the aquatic environment. As explained under the discussion of impacts common to all alternatives, water quality permits required through State and Federal regulations would control, reduce, or mitigate the effects on the aquatic environment for replacement power sources such as onshore wind. Through such permits, the permitting agencies can include conditions requiring VistraOps to follow BMPs or take certain mitigation measures if adverse impacts are anticipated. These water quality permits apply to both the construction and operational phases.

For construction, the renewables component of this alternative would likely have SMALL to MODERATE impacts on aquatic resources, depending on the where the solar fields and wind turbines would be placed and the types of aquatic habitats that are in the vicinity The impacts of wind operations would be SMALL to MODERATE depending on the effectiveness of measures designed to control accidental releases of contaminants and to clean up such releases if they occur. Operation of the solar photovoltaic component would have no discernible effects on the aquatic environment. As discussed in Sections 3.7.4 and 3.7.5, the NGCC portion of this alternative would have SMALL impacts for construction and operation.

The NRC staff concludes that the impacts on aquatic resources from construction and operation of a combination alternative would be SMALL to MODERATE during construction and SMALL to MODERATE during operation. The higher magnitude of potential impacts experienced by the aquatic environment is primarily attributable to the onshore wind component of the alternative due to the relatively high amount of land disturbance.

3.8 <u>Special Status Species and Habitats</u>

The NRC must consider the effects of its actions on ecological resources protected under several Federal statutes and must consult with the FWS or the NOAA prior to acting in cases where an agency action may affect those resources. These statutes include the following:

- ESA (16 U.S.C. § 1531 et seq.) (TN1010)
- MSA, as amended by the Sustainable Fisheries Act of 1996 (16 U.S.C. § 1801 et seq.) (TN9966, TN1061)
- National Marine Sanctuaries Act (NMSA) (16 U.S.C. § 1431 et seq.) (TN4482).

This section describes the species and habitats that are federally protected under these statutes and analyzes how the proposed LR and alternatives may affect these resources.

3.8.1 Endangered Species Act

Congress enacted the ESA in 1973 to protect and recover imperiled species and the ecosystems upon which they depend. The ESA provides a program for the conservation of endangered and threatened plants and animals (collectively, “listed species”) and the habitats in which they are found. The FWS and National Marine Fisheries Service (NMFS) are the lead Federal agencies for implementing the ESA, and these agencies determine species that warrant listing. The following sections describe the Perry Plant action area and the species and habitats that may occur in the action area under each of the Services’ jurisdictions.

3.8.1.1 Endangered Species Act: Action Area

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 Part 402-TN4312). The action area effectively bounds the analysis of federally listed species and critical habitats because only species and habitats that occur within the action area may be affected by the Federal action.

For the purposes of assessing the potential impacts of continued operation of Perry Plant during the LR term, the NRC staff considers the action area to consist of the following:

<u>Perry Plant Site</u>: The terrestrial region of the action area consists of the Perry Plant site in Lake County, Ohio, which is 1,023 ac (414 ha) (EH 2023-TN9534: Table 3.2-1). The site is situated on the southern shore of Lake Erie. It includes developed land to support nuclear power plant operations (253 ac [103 ha]), deciduous forest (595 ac [241 ha]), mixed forest (8 ac [3 ha]), grassland/herbaceous (93 ac [38 ha]), shrub/scrub (10 ac [4 ha]), woody wetlands (31 ac [12 ha]), emergent herbaceous wetlands (3 ac [1 ha]), and hay/pasture lands (18 ac [7 ha]). Section 3.6 of this draft SEIS describes the developed and natural features of the site and the characteristic vegetation and habitats.

<u>Lake Erie</u>: The aquatic region of the action area encompasses the area of Lake Erie influenced by the intake and discharge systems (described in Section 2.1.3 and 3.5.1) and the area of Lake Erie that experiences increased temperatures from discharge of heated effluent.

The NRC staff recognizes that, although the described action area is stationary, federally listed species can move in and out of the action area. For instance, a migratory bird could occur in the action area seasonally as it forages or breeds within the action area. Thus, in its analysis, the NRC staff considers not only those species known to occur directly within the action area but also those species that may passively or actively move into the action area. The NRC staff then considers whether the life history and habitat requirements of each species make it likely to occur in the action area where it could be affected by the proposed LR. The following sections first discuss listed species and critical habitats under FWS jurisdiction, followed by those under NMFS jurisdiction.

3.8.1.2 Endangered Species Act: Federally Listed Species and Critical Habitats Under FWS Jurisdiction

This section evaluates six species. Three are federally listed as endangered, one is federally listed as threatened, one is proposed for listing under the ESA, and one is a candidate for listing. Table 3-19 identifies each of these species and its Federal status. The NRC staff determined these species to be relevant to this review based on desktop analysis of the Perry Plant action area, available scientific literature and studies, and the results of past ESA Section 7 consultations related to the Perry Plant site. No designated or proposed critical habitat occurs within the action area.

Table 3-19 Federally Listed Species Under U.S. Fish and Wildlife Jurisdiction Evaluated for Perry Nuclear Power Plant License Renewal

Common Name	Species	Federal Status[a]
northern long-eared bat	*Myotis septentrionalis*	FE
Indiana bat	*Myotis sodalis*	FE
tricolored bat	*Perimyotis subflavus*	FPE
piping plover (Great Lakes DPS)[b]	*Charadrius melodus*	FE
red knot	*Calidris canutus rufa*	FT
monarch butterfly	*Danaus plexippus*	FC

(a) Indicates protection status under the Endangered Species Act. FC = candidate for Federal listing; FE = federally endangered; FPE = proposed for Federal listing as endangered; and FT = federally threatened.
(b) DPS = Distinct Population Segment.

During the NRC staff's environmental review for the 1982 original operating license (NRC 1982-TN9606), the staff evaluated the effects of Perry Plant operation on three federally listed species: longjaw cisco (*Coregonus alpenae*), blue pike (*Stizostedion vitreum glaucum*), and Indiana bat (*Myotis sodalis*). Neither the longjaw cisco nor the blue pike were captured in preoperational surveys near the site, and the NRC staff did not evaluate these species in detail in the Final Environmental Statement for operation of Perry (FES-O). In 1983, the FWS delisted both species due to extinction (48 FR 39911-TN9811). During the NRC staff's preparation of the FES-O, staff from the ODNR visited the Perry Plant site in 1981 and determined that the site contains potentially suitable roosting and foraging habitat for the Indiana bat. However, because neither construction nor operation of Perry would disturb this habitat, the NRC staff concludes that operation of the Perry Plant would have no effect on the Indiana bat. The NRC staff consider this species in detail in this draft SEIS because suitable habitat remains present on the site and because the FWS identified the Indiana bat as potentially present in the LR action area.

In addition to the Indiana bat, the NRC staff evaluates five other species, all of which the FWS listed, proposed for listing, or added to its candidate list after the NRC issued the 1982 FES-O. These species are northern long-eared bat, piping plover (*Charadrius melodus*), red knot (*Calidris canutus rufa*), tricolored bat (*Perimyotis subflavus*), and monarch butterfly (*Danaus plexippus*). The sections below describe the habitat requirements, life history, and regional occurrences of these species.

3.8.1.3 Northern Long-Eared Bat

The FWS listed the northern long-eared bat as threatened throughout its range in 2015 (80 FR 17974-TN4216). In 2016, the FWS determined that designating critical habitat for the species was not prudent because such a designation would increase threats to the species resulting from vandalism and disturbances and could potentially increase the spread of white-nose syndrome (81 FR 24707-TN8388). In 2022, the FWS reclassified this species as endangered with an effective date of January 30, 2023 (87 FR 73488-TN8545). Information in this section is from the description of the species in the FWS *Federal Register* notice associated with the final rule to list the species (80 FR 17974-TN4216) and draws from this source unless otherwise indicated.

The northern long-eared bat is a medium-sized bat that is distinguished from other *Myotis* species by its long ears, which average 0.7 in. (17 mm) in length. Adults weigh 5 to 8 g (0.2 to 0.3 oz), and females tend to be slightly larger than males. Individuals are medium to dark brown on the back, dark brown on the ears and wing membranes, and tawny to pale brown on the ventral side.

The northern long-eared bat inhabits much of the eastern and north-central United States and all Canadian provinces from the Atlantic coast west to the southern Northwest Territories and eastern British Columbia. Its range includes 37 U.S. States.

Northern long-eared bats predominantly overwinter in hibernacula of various sizes that include underground caves and abandoned mines. Preferred hibernacula have relatively constant, cool temperatures with very high humidity and no air currents. Individuals most often roost in small crevices or cracks in cave or mine walls or ceilings but are also infrequently observed hanging in the open. Less commonly, northern long-eared bats overwinter in abandoned railroad tunnels, storm sewers, aqueducts, attics, and other noncave or nonmine hibernacula with temperature, humidity, and air flow conditions resembling suitable caves and mines.

In summer, northern long-eared bats typically roost individually or in colonies underneath bark or in cavities or crevices of both live trees and snags. Males and nonreproductive females may also roost in cooler locations including caves and mines. Individuals have also been observed roosting in colonies in barns and other buildings, on utility poles, and in other human-made structures. The species has been documented to roost in many species of trees, including black oak (*Quercus velutina*), northern red oak (*Q. rubra*), silver maple (*Acer saccharinum*), black locust (*Robinia pseudoacacia*), American beech (*Fagus grandifolia*), sugar maple (*A. saccharum*), sourwood (*Oxydendrum arboreum*), and shortleaf pine (*Pinus echinata*). Foster and Kurta (1999-TN8499) found that, rather than being dependent on particular tree species, northern long-eared bats are likely to use a variety of trees as long as they form suitable cavities or retain bark. Owen et al. (TN8500) found that tree-roosting maternal colonies chose roosting sites in larger trees that were taller than the surrounding stand and in areas with abundant snags. Carter and Feldhamer (TN8501) indicate that resource availability drives roost tree selection more than the actual tree species. However, several studies have shown that the species more often roosts in shade-tolerant deciduous trees than in conifers. Additionally, the FWS concludes in its final listing that the tendency for northern long-eared bats to use healthy live trees for roosting is low.

Northern long-eared bats actively form colonies in the summer, but such colonies are often in flux because members will frequently depart to be solitary or to form smaller groups and later return to the main unit. This behavior is described as “fission–fusion,” and it also results in individuals often switching tree roosts (typically every 2 to 3 days). Roost trees are often near each other within the species’ summer range, with various studies documenting distances between roost trees ranging from 20 ft (6.1 m) to 2.4 mi (3.9 km).

Spring staging is the period between winter hibernation and spring migration to summer habitat when bats begin to gradually emerge from hibernation. Individuals will exit the hibernacula to feed but reenter the same or alternative hibernacula to resume periods of physical inactivity. The spring staging period is believed to be short for the northern long-eared bat and may last from mid-March through early May, with variations in timing and duration based on latitude and weather.

Fall swarming is the period between the summer and winter seasons and includes behaviors such as copulation, introduction of juveniles to hibernacula, and stopovers at sites between summer and winter regions. Both males and females are present together at swarming sites, and other bat species are often present as well. For northern long-eared bats, the swarming period may occur between July and early October, depending on the latitude within the species' range. Northern long-eared bats may use caves and mines during swarming. Little is known about roost tree selection during this period, but some studies suggest that a wider variation in tree selection may occur during swarming than during the summer.

Northern long-eared bats roost in cavities, crevices, and hollows or under the bark of live and dead trees and snags greater than 3 in. (8 cm) in diameter at breast height. Isolated trees may be considered suitable habitats when they exhibit these characteristics and are less than 1,000 ft (300 m) from the next nearest suitable roost tree within a wooded area. Northern long-eared bats appear to choose roost trees based on structural suitability rather than exhibiting a preference for specific species of trees.

Northern long-eared bats hibernate during winter months. Individuals arrive at hibernacula in August or September, enter hibernation in October and November, and emerge from hibernacula in March or April. Northern long-eared bats migrate relatively short distances (between 35 and 55 mi [56 and 89 km]) from summer roosts and winter hibernacula. The spring migration period typically occurs from mid-March to mid-May, and fall migration typically occurs between mid-August and mid-October. Northern long-eared bats mate from late July in northern regions to early October in southern regions. Females raise their young in maternity colonies, and roost tree selection changes depending on the reproductive stage, with lactating females roosting higher in tall trees with less canopy cover.

Northern long-eared bats are nocturnal foragers that use hawking and gleaning in conjunction with passive acoustic cues to collect prey. The species' diet includes moths, flies, leafhoppers, caddisflies, beetles, and arachnids. Individuals forage 1 to 3 m (3 to 10 ft) above the ground between the understory and canopy of forested hillsides and ridges, with peak foraging activity occurring within 5 hrs after sunset.

Factors Affecting the Species

The FWS identifies white-nose syndrome, a disease caused by the fungus *Pseudogymnoascus destructans*, to be the predominant threat to the northern long-eared bat's continued existence. Other factors include human disturbance of hibernacula and loss of summer habitat due to forest conversion and forest management.

Occurrence within the Action Area

The FWS (FWS 2023-TN9767) identified the northern long-eared bat as potentially occurring in the action area in the Information for Planning and Consultation (IPaC) report for the proposed action. Within Ohio, the species is found throughout the State in the summer months. In preoperational surveys of the site, ODNR staff identified the Perry Plant site as containing suitable roosting and foraging habitat for bats (NRC 1982-TN9606); these areas remain intact and have not appreciably changed since that time (EH 2023-TN9534). VistraOps reports no occurrences of northern long-eared bats on the Perry Plant site. However, VistraOps has conducted no ecological surveys to specifically assess the species' presence or the suitability of onsite habitat.

Based on the above information, the NRC staff conservatively assumes that deciduous forest habitat within the action area could support foraging, mating, and sheltering in the spring, summer, and fall. Accordingly, the staff assesses the potential impacts of the proposed action on this species in Section 3.8.4.2 of this draft SEIS.

3.8.1.4 Indiana Bat

The FWS originally listed the Indiana bat as being in danger of extinction under the Endangered Species Preservation Act of 1966 (32 FR 4001-TN2750), and the species is currently listed as endangered under the ESA wherever found. The FWS designated critical habitat in 1976, consisting of 11 caves and two mines in six States (41 FR 41914, as corrected by 42 FR 47840-TN5355). No designated critical habitat occurs in Ohio. Information in this section is from the 2007 recovery plan (FWS 2007-TN934) unless otherwise indicated.

The Indiana bat is a medium-sized, insectivorous bat that resembles the northern long-eared bat and the little brown bat (*Myotis lucifugus*). Distinguishing characteristics of the Indiana bat include a distinctly keeled calcar (the bony spur that extends from the ankle bone and helps spread the membrane between the tail and the hind legs); a light-colored nose; small, delicate hind feet; and a skull with a small sagittal crest. The species occurs across 23 States in the eastern and central United States. During the winter, Indiana bats cluster together to hibernate in caves and abandoned mines, with populations in some winter hibernacula exceeding 30,000 individuals. The FWS's 2019 winter census estimate was 537,297 bats in 223 hibernacula in 16 States (FWS 2024-TN9810). Mating typically occurs from late August to October, before hibernation. Hibernation lasts from October to April. Females typically give birth to a single pup between mid-June to early July in their maternity colonies.

Indiana bats disperse from winter hibernacula to summer roosting habitat in the spring. Tracking studies have recorded migration paths that span from 10 mi (16 km) to 357 mi (575 km). During the spring, summer, and fall, Indiana bats roost in trees, bridges, caves, mines, and bat houses. Minimum roost tree diameter is 2.5 in. (6.4 cm) for males and 4.3 in. (11 cm) for females.

Average maternity colony size consists of about 80 adult females. Females typically roost under exfoliating bark or narrow cracks of trees, but tree selection appears related to local availability of trees with suitable structure. Of the 33 tree species documented as maternity colonies roost tree, most are deciduous.

Evidence suggests that Indiana bats are selective, nocturnal predators, with diets consisting mostly of flying insects from four orders: beetles (Coleoptera), flies (Diptera), moths (Lepidoptera), and caddisflies (Trichoptera). Presence of sporadically available prey such as winged ants (Hymenopterans) and spiders (presumably ballooning individuals) in diets suggests that Indiana bats can opportunistically feed on other aerial prey when present in large enough numbers.

Factors Affecting the Species

White-nose syndrome is present across 93 percent of the Indiana bat's species range (Cheng et al. 2021-TN9903). Researchers estimate that that WNS has caused an overall 84 percent decline in Indiana bat's wintering population counts. Other factors affecting this species include disruptions to roosting areas, availability of hibernation habitat, and connectivity and conservation of roosting-foraging and migration corridors.

Occurrence within the Action Area

The FWS (FWS 2023-TN9767) identified the Indiana bat as potentially occurring in the action area in the IPaC report for the proposed action. Within Ohio, the species is found throughout the State in the summer months. In preoperational surveys of the site, ODNR staff identified the Perry Plant site as containing suitable roosting and foraging habitat for Indiana bat (NRC 1982-TN9606). Although VistraOps reports the continued presence of this habitat, it reports no occurrences of Indiana bats on the Perry Plant site (EH 2023-TN9534). However, VistraOps has conducted no ecological surveys to specifically assess the species' presence or the suitability of onsite habitat.

Based on the above information, the NRC staff conservatively assumes that deciduous forest habitat within the action area could support foraging, mating, and sheltering in the spring, summer, and fall. Accordingly, the NRC staff assesses the potential impacts of the proposed action on this species in Section 3.8.4.2 of this draft SEIS.

3.8.1.5 Tricolored Bat

The FWS issued a proposed rule to list the tricolored bat as endangered in 2022 (87 FR 56381-TN8546-TN8546). The FWS proposed no critical habitat with the rule because it found that such a designation could increase the degree of threat to the species. Information in this section is drawn from the FWS's species status assessment (FWS 2021-TN8589) unless otherwise cited.

The tricolored bat is a small insectivorous bat that can be distinguished by its unique tricolored fur, which often appears yellowish to orange. The species occurs across 39 States in the eastern and central United States and in portions of southern Canada, Mexico, and Central America. During the winter, tricolored bats often inhabit caves and abandoned mines. In the southern United States, where caves are sparse, tricolored bats also roost in road culverts where they exhibit shorter hibernation bouts and may leave hibernacula to forage during warm nights. Tricolored bats hibernate singly, but sometimes in pairs or in small clusters of both sexes away from other bats. Between mid-August and mid-October, males and females converge at cave and mine entrances to swarm and mate, and females typically give birth to two young between May and July.

Tricolored bats disperse from winter hibernacula to summer roosting habitat in the spring. Tracking studies have recorded migration paths that span from 27 mi (44 km) to 151 mi (243 km). During the spring, summer, and fall, tricolored bats occupy forested habitats. Individuals roost among leaves of live or recently dead deciduous hardwood trees, but individuals may also roost in pines (*Pinus* spp.), eastern red cedar (*Juniperus virginiana*), Spanish moss (*Tillandsia usneoides*), *Usnea trichodea* lichen, and occasionally human structures. Tricolored bats are opportunistic feeders and consume small insects including caddisflies (Trichoptera), flying moths (Lepidoptera), small beetles (Coleoptera), small wasps and flying ants (Hymenoptera), true bugs (Homoptera), and flies (Diptera).

Factors Affecting the Species

Tricolored bats face extinction due primarily to the rangewide impacts of white-nose syndrome. The FWS estimates that white-nose syndrome has caused population declines of 90 percent or more in affected tricolored bat colonies across most of the species' range.

Occurrence within the Action Area

The FWS (FWS 2023-TN9767) identified the tricolored bat as potentially occurring in the action area in the IPaC report for the proposed action. Within Ohio, the species is found throughout the State in the summer months. During a preoperational survey In 1981, ODNR determined that the site contains potentially suitable roosting and foraging habitat for bats (NRC 1982-TN9606). VistraOps reports no occurrences of tricolored bats on the Perry Plant site. However, VistraOps has conducted no ecological surveys to specifically assess the species' presence or the suitability of onsite habitat.

Based on the above information, the NRC staff conservatively assumes that deciduous forest habitat within the action area could support foraging, mating, and sheltering in the spring, summer, and fall. Accordingly, the staff assesses the potential impacts of the proposed action on this species in Section 3.8.4.2 of this draft SEIS.

3.8.1.6 Piping Plover

The FWS listed the Great Lakes populations of the piping plover as threatened in 1985 (50 FR 50726-TN5502). In 2001, FWS designated 35 units of Great Lakes critical habitat (66 FR 22938-TN9904) in eight States. The two Ohio units are in Headlands Dunes State Park (Lake County) and Sheldon Marsh (Erie County). No critical habitat occurs within the action area. Information in this section is drawn from the FWS's 2016 draft revised recovery plan for the species (FWS 2003-TN8841) unless otherwise cited.

The piping plover is small, plump, pale gray-brown plover. Two subspecies are recognized: one occurs along the Atlantic coast and one occurs within the interior of the continent. Within the interior subspecies, the FWS recognizes two distinct population segments: Northern Great Plains and Great Lakes Watershed. The FWS recognizes three breeding populations and treats them separately in the final rule listing the species. The other two populations are federally listed as threatened.

In the Great Lakes region, piping plovers breed and raise young mainly on sparsely vegetated beaches, cobble pans, and sand spits of glacial sand dune ecosystems along the Great Lakes shoreline. Low-lying vegetation and cobble provide important nest selection characteristics, probably for predator protection. Courtship behavior includes aerial displays, digging nests, and stone-tossing. Nests are in shallow depressions lined with light-colored pebbles and small shell fragments. Both adults defend the nest and share incubation duties.

At Great Lakes nesting sites, adults begin arriving in early April, and nesting begins by mid to late May. Eggs typically hatch late May to late July. Chicks are able to feed themselves within a few hours. Chicks fledge about 21 to 30 days after hatching. Adults leave nesting grounds between mid-July and August. Juveniles usually leave after adults, by late August.

Piping plovers forage on exposed beach substrates by pecking for invertebrates near the surface of the sand. Forage area selection depends on habitat types, food abundance, stage of breeding cycle, and human disturbance. Diets consist of various invertebrates, including insects, crustaceans, and mollusks. Foraging habitat and food availability affect chick survival, with mudflats and ephemeral pools providing higher chick survival in some locations, possibly due to greater insect prey availability.

Factors Affecting the Species

The FWS believes that hunting in the late 19th and early 20th centuries led to the piping plover's initial decline. Habitat loss and alteration, predation, and surface water contamination have contributed to further population declines. Shoreline development, specifically, has reduced available breeding grounds along the Great Lakes and wintering grounds along the Atlantic coast.

Occurrence within the Action Area

The FWS identified the piping plover as potentially occurring in the action area in the IPaC report (FWS 2023-TN9767) for the proposed action. VistraOps reports no occurrences of piping plover within the action area (EH 2023-TN9534: Section 3.7.8.1.3, 4.6.6.4). The NRC staff's review of publicly available information (iNaturalist 2024-TN10048) indicates that piping plovers use beach habitats to the west (6 mi [10 km]) and east (17 mi [27 km]) of the action area. However, the sparsely vegetated, sandy, or cobbly beach areas that piping plovers use for nesting and foraging do not occur within the action area (Section 3.6).

The NRC staff concludes that individuals could occasionally pass through on their way to or from nearby breeding and foraging habitat. Accordingly, the NRC staff assesses the potential impacts of the proposed action on this species in Section 3.8.4.3 of this draft SEIS.

3.8.1.7 Red Knot

The FWS listed the red knot as threatened wherever found, effective in 2015 (79 FR 73706-TN4267). The FWS listed critical habitat for the species in 2023 (88 FR 22530-TN10376). None of the critical habitat units for red knot are in Ohio. Information in this section is drawn from the FWS's species status assessment (FWS 2020-TN8850) unless otherwise cited.

The red knot is a medium-sized shorebird that migrates annually between breeding grounds in the Canadian Arctic and several wintering regions, including the southeastern United States, northeastern Gulf of Mexico, northern Brazil, and Tierra del Fuego in southern part of South America. During both spring and fall migrations, red knots use key staging and stopover areas to rest and feed. While most individuals travel along the Atlantic coast during migration, Texas and Louisiana wintering red knots migrate through Northern Plains region of the Central Flyway twice annually during migration (Newstead 2024-TN9974).

During migration, red knots use coastal marine and estuarine habitats with large areas of exposed intertidal sediments; ocean- or bay-front areas; and tidal flats in more sheltered bays and lagoons (FWS 2014-TN8851). Along the Atlantic coast, dynamic and ephemeral features are important red knot habitats and include sand spits, islets, shoals, and sandbars (Harrington 2008-TN8852). Inland stopovers include saline lakes within the Northern Great Plains (Newstead et al. 2013-TN8853). The FWS (FWS 2014-TN8851) has found that although little information exists indicating whether red knots may use inland freshwater habitats during migration, current data suggest that certain freshwater areas may warrant further study as potential stopover habitat. The FWS (FWS 2014-TN8851) also concluded that the best available data show that small numbers of red knots may use impoundments and other manufactured freshwater habitats during inland migrations.

Red knots migrate long distances over a relatively brief period of time. According to a geolocator study of midcontinent red knot migrations (Newstead et al. 2013-TN8853), individuals left Texas between May 16 and 21 and flew two days directly to a stopover site in the Northern Great

Plains or flew three days to a stopover site at the southern edge of Hudson Bay in Manitoba or Ontario. Birds spent 15 to 21 days at the selected stopover site before leaving for breeding grounds between June 1 and 13. Red knots overwintering in the southeastern U.S. used one of two northward migration routes to reach the boreal and Arctic breeding grounds: 1) along the mid-Atlantic to Delaware Bay or 2) through the eastern Great Lake Basin (Smith et al. 2023-TN9975). Red knots stopping in Delaware Bay left around May 10, while the others left about one week later. Most of the red knots in this study relied on tailwinds from their South Carolina departure and traveled north through the eastern Great Lakes Basin without stopping.

Factors Affecting the Species

In its final listing rule (79 FR 73706-TN4267), the FWS determined that the red knot warranted threatened status under the ESA due to the following primary threats: loss of breeding and nonbreeding habitat (including sea level rise, coastal engineering, coastal development, and Arctic ecosystem change); effects related to disruption of natural predator cycles on the breeding grounds; reduced prey availability throughout the nonbreeding range; and increasing frequency and severity of asynchronies (mismatches) in the timing of the birds' annual migratory cycle relative to favorable food and weather conditions.

Occurrence within the Action Area

The FWS identified the red knot as potentially occurring in the action area in the IPaC report (FWS 2023-TN9767) for the proposed action. VistraOps reports no occurrences of red knot on the Perry Plant site (EH 2023-TN9534: Section 3.7.8.1.4, 4.6.6.4). However, VistraOps has conducted no ecological surveys to specifically assess the species' presence or the suitability of onsite habitat. The NRC staff's review of publicly available information indicates that suitable foraging habitat lies within 6 mi (10 km) of the action area (Section 3.8.1.1). Because this habitat is not present in the action area, the NRC staff concludes that the species is unlikely to forage in the action area. Moreover, red knots migrating through the eastern Great Lakes Basin on their way to their Arctic breeding grounds tend to pass through without stopping (Smith et al. 2023-TN9975). However, because the FWS IPaC report (FWS 2023-TN9767) includes the red knot as potentially occurring within the action area, the NRC staff assesses the potential impacts of the proposed action on this species in Section 3.8.4.3 of this SEIS.

3.8.1.8 Monarch Butterfly

The monarch butterfly is a candidate for Federal listing. In 2020, the FWS issued a 12-month finding announcing its intent to prepare a proposed rule to list the monarch as threatened (85 FR 81813-TN8590). In 2022, the FWS identified the monarch listing action as a priority because the magnitude of threats is moderate to low; however, those threats are imminent for the eastern and western North American populations. Although the ESA does not require consultation for candidates, the NRC considers this species here at the recommendation of the FWS (FWS 2023-TN9767) for the proposed action. Information in this section is drawn from the FWS's candidate review unless otherwise cited (87 FR 26152-TN8591).

The monarch is a large butterfly with bright orange wings and black veining and borders. During the breeding season, females lay eggs on milkweed (primarily *Asclepias* spp.). Developing larvae feed on milkweed, which allows them to sequester toxic chemicals as a defense against predators, before pupating into a chrysalis to transform into the adult butterfly form. Monarchs produce multiple generations each breeding season, and most adult butterflies live two to five weeks. Overwintering adults, however, enter reproductive diapause and live six to nine months.

Monarch butterflies occur in 90 countries, islands, or island groups. Monarch butterflies have become naturalized at most of these locations outside of North America since 1840. The populations outside of eastern and western North America (including southern Florida) do not exhibit long-distance migratory behavior. In many regions, monarchs breed year-round. In temperate climates, such as eastern and western North America, monarchs migrate long distances and live for an extended period. In the fall, in both eastern and western North America, monarchs begin migrating to their respective overwintering sites in the forests of California and Mexico. These overwintering sites provide protection from the elements and moderate temperatures, as well as nectar and clean water sources located nearby. Migrations can be of distances of over 1,900 mi (3,000 km) and span a 2-month period. In early spring (February–March), surviving monarchs break diapause and mate at overwintering sites before dispersing. The same individuals that undertook the initial southward migration begin flying back through the breeding grounds, and their offspring restart the cycle of generational migration. Adult monarchs feed on nectar from milkweeds and from a variety of plant species (Waterbury et al. 2019-TN9972, James et al. 2021-TN9973).

Factors Affecting the Species

The primary threats to the monarch's biological status include loss and degradation of habitat from conversion of grasslands to agriculture, widespread use of herbicides, logging/thinning at overwintering sites in Mexico, senescence and incompatible management of overwintering sites in California, urban development, drought, exposure to insecticides, and effects of climate change.

Occurrence within the Action Area

The FWS identified the monarch butterfly as potentially occurring in the action area in the IPaC report (FWS 2023-TN9767) for the proposed action. VistraOps reports no occurrences of monarch butterfly on the Perry Plant site (EH 2023-TN9534: Section 3.7.8.1.7). However, VistraOps has conducted no ecological surveys to specifically assess the species' presence or the suitability of onsite habitat but states that suitable habitat may be present in grassland areas of the action area. Monarchs and milkweed are known to occur within 1 mi (1.6 km) of the site boundary from late April to mid-October (iNaturalist 2023-TN9913). Monarchs and milkweed are associated with prairie, meadow, and grassland habitats. The action area includes approximately 93 ac (38 ha) of grassland. The NRC staff assumes that juvenile and adult monarchs could occur in the action area if milkweeds are present on site. Otherwise, adults may be present, nectaring and moving between areas of more suitable habitat. Accordingly, the NRC staff assesses the potential impacts of the proposed action on this species in Section 3.8.4.4 of this SEIS.

3.8.1.9 Summary of Potential Species Occurrences in the Action Area

Table 3-20 summarizes the potential for each species discussed in this section to occur in the action area. No proposed or designated critical habitat occurs within the action area.

Table 3-20 Occurrences of Federally Listed, Proposed, and Candidate Species in the Action Area under U.S. Fish and Wildlife Service Jurisdiction

Common Name	Type of and Likelihood of Occurrence in the Action Area
northern long-eared bat	Seasonal presence in spring, summer, and fall possible in low numbers in action area forests of sufficient size to support foraging, mating, and sheltering.
Indiana bat	Same as northern long-eared bat.
tricolored bat	Same as northern long-eared bat.
piping plover	Adults may pass through when moving to areas of more suitable nesting and foraging habitat along Lake Erie.
red knot	Adults may pass through when moving to areas of more suitable foraging habitat along Lake Erie.
monarch butterfly	Eggs and larvae may be present if milkweed is present in grasslands on site. Adults may pass through the action area from April through October when moving to areas of more suitable habitat.

3.8.1.10 Endangered Species Act: Federally Listed Species and Critical Habitats Under NMFS Jurisdiction

No federally listed species or designated critical habitats under NMFS jurisdiction occur in the action area. Therefore, this section does not contain a discussion of any such species or habitats.

3.8.2 Magnuson-Stevens Fishery Conservation and Management Act: Essential Fish Habitat

Congress enacted the MSA in 1976 to foster long-term biological and economic sustainability of the Nation's marine fisheries. The MSA directs the fishery management councils, in conjunction with NMFS, to designate areas of essential fish habitat (EFH) and to manage marine resources within those areas. EFH is the coastal and marine waters and substrate necessary for fish to spawn, breed, feed, or grow to maturity (50 CFR 600.10) (TN1342). For each federally managed species, the fishery management councils and NMFS designate and describe the EFH by life stage (i.e., egg, larva, juvenile, and adult). No coastal or marine waters occur near the Perry Plant site. Therefore, this draft SEIS does not discuss EFH.

3.8.3 National Marine Sanctuaries Act: Sanctuary Resources

Congress enacted the NMSA in 1972 to protect areas of the marine environment that have special national significance. The NMSA authorizes the Secretary of Commerce to establish the National Marine Sanctuary System and designate sanctuaries within that system, which includes 15 sanctuaries and 2 marine national monuments, encompassing more than 600,000 mi^2 (1,550,000 km^2) of marine and Great Lakes waters from Washington State to the Florida Keys, and from Lake Huron to American Samoa. Within these areas, sanctuary resources include any living or nonliving resource of a national marine sanctuary that contributes to the conservation, recreational, ecological, historical, educational, cultural, archaeological, scientific, or aesthetic value of the sanctuary. No marine waters occur near Perry Plant.

The NMSA (16 U.S.C. 1431 et seq. [TN4482]) authorizes the Secretary of Commerce to designate and protect areas of the marine environment with special national significance due to their conservation, recreational, ecological, historical, scientific, cultural, archaeological, educational, or aesthetic qualities as national marine sanctuaries. The NMSA protects nationally significant aquatic and marine resources and delegates authority to the NOAA to designate and administer marine sanctuaries. The NMSA defines "sanctuary resources" as any living or nonliving resource of a national marine sanctuary that contributes to the conservation, recreational, ecological, historical, educational, cultural, archaeological, scientific, or aesthetic value of the sanctuary (16 U.S.C. 1432(8) [TN4482]).

In February 2016, NOAA added the proposed Lake Erie Quadrangle to its inventory of potential new national marine sanctuaries (NOAA 2016-TN9905). The area being considered for designation as a national marine sanctuary in Lake Erie is located approximately 35 mi (91 km^2) east of the Perry Plant and includes approximately 740 mi^2 (1,917 square kilometers) of lake waters and bottomlands. The area would be adjacent to approximately 75 mi (120 km) of coastline bordering Erie County, Pennsylvania, that extends westward to the Ohio State line, northward to the international border with Ontario, Canada, and eastward to the New York State line (88 FR 32198-TN10017). The sanctuary would protect 35 known shipwrecks and an estimated 161 undiscovered wrecks that possess exceptional historic, archaeological, and recreational value. If designated, NOAA's activities would complement the Commonwealth of Pennsylvania's efforts to preserve and interpret the area's importance, including its collection of nationally significant historic shipwrecks and other underwater cultural resources.

The area supports a diverse assemblage of aquatic life. Lake Erie contains a variety of important sport and commercial fish species, including the walleye, smallmouth bass, and steelhead (Dahlkemper 2015-TN9906). Section 3.7.1 of this draft SEIS describes the aquatic community in detail.

For the purposes of considering national marine sanctuaries, the affected area of the proposed Perry Plant LR is identical to the ESA action area described in Section 3.8.1. Therefore, the proposed Lake Erie Quadrangle sanctuary is not within the affected area.

3.8.4 Proposed Action

The following sections address the site-specific environmental impacts of Perry Plant LR on the environmental issues identified in Table 3-1 that relate to federally protected ecological resources.

3.8.4.1 Endangered Species Act: Federally Listed Species and Critical Habitats under U.S. Fish and Wildlife Service Jurisdiction

In Section 3.8.1.2, the NRC staff determined that four listed species may occur in the action area: northern long-eared bat, Indiana bat, piping plover, and red knot. Additionally, the tricolored bat, which the FWS has proposed for Federal listing as endangered, and the monarch butterfly, which is a candidate for Federal listing, may also occur in the action area. Section 3.8.1.2 includes relevant information about the habitat requirements, life history, and regional occurrence of these species. In the sections below, the NRC staff analyzes the potential impacts of the proposed Perry Plant LR on these species. Table 3-21 below summarizes the NRC staff's ESA effect determination that resulted from the staff's analysis.

Table 3-21 Effect Determinations for Federally Listed Species in Perry Nuclear Power Plant Under U.S. Fish and Wildlife Service Jurisdiction

Species	Federal Status[(a)]	Potentially Present in the Action Area?	Effect Determination[(b)]
northern long-eared bat	FE	Yes	NLAA
Indiana bat	FE	Yes	NLAA
tricolored bat	FPE	Yes	NLAA
piping plover (Great Lakes DPS)[(c)]	FE	Yes	NLAA
red knot	FT	Yes	NLAA
monarch butterfly	FC	Yes	NLAA

(a) Indicates protection status under the Endangered Species Act. FC = candidate for Federal listing; FE = federally endangered; FPE = proposed for Federal listing as endangered; and FT = federally threatened.
(b) The NRC staff makes its effect determinations for federally listed species in accordance with the language and definitions specified in the FWS and NMFS Endangered Species Consultation Handbook (FWS and NMFS 1998-TN1031). NLAA = may affect but is not likely to adversely affect.
(c) DPS = Distinct Population Segment.

3.8.4.2 Northern Long-eared Bat, Indiana Bat, and Tricolored Bat

In Section 3.8.1 of this draft SEIS, the NRC staff concludes that northern long-eared, Indiana, and tricolored bats may occur in the action area's forests in spring, summer, and fall. If present, these bats would occur rarely and in low numbers.

The potential stressors that bats could experience from operation of a nuclear power plant (generically) are as follows:

- mortality or injury from collisions with nuclear power plant structures and vehicles
- habitat loss, degradation, disturbance, or fragmentation, and associated effects
- behavioral changes resulting from refurbishment or other site activities

This section addresses each of these stressors below.

Mortality or Injury from Collisions with Nuclear Power Plant Structures and Vehicles

Several studies have documented bat mortality or injury resulting from collisions with human-made structures. Saunders (1930-TN8504) reported that five bats of three species—eastern red bat (*Lasiurus borealis*), hoary bat (*Lasiurus cinereus*), and silver-haired bat (*Lasionycteris noctivagans*)—were killed when they collided with a lighthouse in Ontario, Canada. In Kansas, Van Gelder (1956-TN8505) documented five eastern red bats that collided with a television tower. In Florida, Crawford and Baker (1981-TN8506) collected 54 bats of seven species that collided with a television tower over a 25-year period, Zinn and Baker (1979-TN8507) reported 12 dead hoary bats at another television tower over an 18-year period, and Taylor and Anderson (1973-TN8508) reported one dead yellow bat (*Lasiurus intermedius*) at a third Florida television tower. Bat collisions with communications towers have been reported in North Dakota, Tennessee, and Saskatchewan, Canada; with convention center windows in Chicago, Illinois; and with power lines, barbed wire fences, and vehicles in numerous locations (Johnson and Strickland 2003-TN8509).

More recently, bat collisions with wind turbines have been of concern in North America. Bat fatalities have been documented at most wind facilities throughout the United States and Canada (USGS 2016-TN8510). For instance, during a 1996–1999 study at the Buffalo Ridge wind power development project in Minnesota, Johnson et al. (TN8511) reported 183 bat fatalities, most of which were hoary bats and eastern red bats. The U.S. Geological Survey estimates that tens to hundreds of thousands of bats die at wind turbines in North America each year (USGS 2016-TN8510).

Bat collisions with human-made structures at nuclear power plants are not well documented but are likely rare based on available information. In an assessment of the potential effects of the operation of Davis-Besse, the NRC staff (NRC 2014-TN7385) noted that four dead bats were collected at the nuclear power plant during bird mortality studies conducted from 1972 through 1979. Two red bats (*Lasiurus borealis*) were collected at the cooling tower, and one big brown bat and one tricolored bat were collected near other nuclear power plant structures. The NRC staff (NRC 2014-TN7385) found that future collisions of bats would be extremely unlikely and, therefore, discountable, given the small number of bats collected during the study and the marginal suitable habitat that the nuclear power plant site provides. The FWS (FWS 2014-TN7605) concurred with this determination. In a 2015 assessment associated with Indian Point Nuclear Generating Units 2 and 3 in New York, the NRC staff (NRC 2015-TN7382) determined that bat collisions were less likely to occur at Indian Point than at Davis-Besse because Indian Point does not have cooling towers or similarly large obstructions. The tallest structures on the Indian Point site are the 134 ft (40.8 m) tall turbine buildings and 250 ft (76.2 m) tall reactor containment structures. The NRC staff (NRC 2015-TN7382) concluded that the likelihood of bats colliding with these and other nuclear power plant structures on the Indian Point site during the LR period was extremely unlikely to occur and, therefore, discountable. FWS concurred with this determination (FWS 2015-TN7612). In 2018, the NRC staff (NRC 2018-TN7381) determined that the likelihood of bats colliding with site buildings or structures on the Seabrook Station, Unit 1, site in New Hampshire would be extremely unlikely. The tallest structures on that site are the 199 ft (61 m)-tall containment structure and the 103 ft (31 m)-tall turbine and heater bay building. The FWS (FWS 2018-TN7610) concurred with the NRC staff's determination. Since that time, the FWS has concurred with similar findings for initial and subsequent license renewals at multiple other nuclear power plant sites, including Surry Power Station, Units 1 and 2, in Surry, Virginia (FWS 2019-TN7609); Peach Bottom Atomic Power Station, Units 2 and 3, in Delta, Pennsylvania (FWS 2019-TN9742); Point Beach Nuclear Plant, Units 1 and 2, in Two Rivers, Wisconsin (FWS 2021-TN9740); North Anna Power Station, Units 1 and 2, in Louisa, Virginia (FWS 2023-TN9093).

On the Perry Plant site, the tallest site structures are the cooling towers, each of which is 516 ft (158 m) high (EH 2023-TN9534: Section 3.2.3). The turbine buildings, meteorological tower, reactor domes, and transmission lines are also prominent features on the Perry Plant site. To date, VistraOps has reported no incidents of collision injury or mortality of any species of bat on the Perry Plant site associated with site buildings or structures. Accordingly, the NRC staff finds the likelihood of future bat collisions with site buildings or structures to be extremely unlikely and, therefore, discountable.

Vehicle collision risk for bats varies depending on factors including time of year, location of roads and travel pathways in relation to roosting and foraging areas, the characteristics of individuals' flight, traffic volume, and whether young bats are dispersing. Although collision has been documented for several species of bats, the Indiana Bat Draft Recovery Plan (FWS 2007-TN934) indicates that bat species do not seem to be particularly susceptible to vehicle collisions. However, the FWS also finds it difficult to determine whether roads pose a greater risk for bats colliding with vehicles or a greater likelihood of decreasing risk of collision by deterring bat activity (FWS 2016-TN7400). In most cases, the FWS expects that roads of increasing size decrease the likelihood of bats crossing the roads and, therefore, reduce collision risk (FWS 2016-TN7400).

During the proposed Perry Plant LR term, vehicular traffic from truck deliveries, site maintenance activities, and personnel commuting to and from the site would continue throughout the LR period as they have during the current licensing period. Vehicle use would occur primarily in areas that bats would be less likely to frequent, such as along established county and State roads or within industrial-use areas of the Perry Plant site. Additionally, most vehicle activity would occur during daylight hours when bats are less active. To date, VistraOps has reported no incidents of injury or mortality of any species of bat on the Perry Plant site associated with vehicle collisions. Accordingly, the NRC staff finds the likelihood of future northern long-eared, Indiana, or tricolored bat collisions with vehicles to be extremely unlikely and, therefore, is not considered further.

Habitat Loss, Degradation, Disturbance, or Fragmentation, and Associated Effects

As previously discussed in this draft SEIS, the Perry Plant action area includes forested habitat that northern long-eared, Indiana, and tricolored bats may rarely to very occasionally inhabit in spring, summer, and fall. In its final rule listing the northern long-eared bat (80 FR 17974-TN4216), the FWS stated that forest conversion and forest modification from management are two of the most common causes of habitat loss, degradation, disturbance, or fragmentation affecting this species. These effects also affect the Indiana and tricolored bat. Forest conversion is the loss of forest to another land use type, such as cropland, residential, or industrial. This can lead to loss of a suitable habitat, fragmentation of remaining habitat patches, and elimination of travel corridors (80 FR 17974-TN4216). Forest management practices maintain forest habitat at the landscape level, but they involve practices that can have direct and indirect effects on bats. Impacts from forest management are typically temporary in nature and can include positive, neutral, and negative impacts.

The proposed action would not involve forest conversion or management and would generally not disturb the existing forested habitat on the site. VistraOps states that it would continue to perform vegetation maintenance on the Perry Plant site over the course of the proposed LR term. Most maintenance would be of grassy, mowed areas between buildings and along walkways within the industrial portion of the Perry Plant site or on adjacent hillsides. VistraOps would continue to maintain onsite transmission line right-of-ways in accordance with North American Electric Reliability Corporation standards. Less-developed areas and forested areas would be largely unaffected. VistraOps does not intend to undertake tree removal or conduct any other activities that would disturb habitat suitable for bat roosting or maternity (Vistra 2024-TN9925: Attachment 9).

Site personnel may occasionally remove select trees around the margins of existing forested areas if those trees are deemed hazardous to buildings, infrastructure, or other site facilities or to existing overhead clearances. Negative impacts on bats could result if such trees are potential roost trees. Bats could also be directly injured during tree clearing. However, tree removal would be infrequent, and VistraOps personnel would follow company guidance to minimize potential impacts on federally listed bat species (Vistra 2024-TN9925: Attachment 12). This guidance requires that if suitable trees must be cut, then cutting must occur between September 30 and April 1. If suitable trees must be cut during the summer (April 2 to September 9), then a net survey must be conducted in May or June before cutting.

The NRC staff finds that infrequent to rare hazardous tree removal in forested areas during the proposed LR term would not measurably affect any potential bat habitat in the action area. Direct injury or mortality to bats during tree removal is also unlikely because VistraOps company guidance would ensure that personnel take the appropriate measures to avoid this potential impact. Additionally, the continued preservation of the existing forested areas on the site during the Perry Plant LR term would result in positive impacts on northern long-eared, Indiana, or tricolored bats if they are present within or near the action area.

Behavioral Changes Resulting from Refurbishment or Other Site Activities

Construction or refurbishment and other site activities, including site maintenance and infrastructure repairs, could prompt behavioral changes in bats. Noise and vibration and general human disturbance are stressors that may disrupt normal feeding, sheltering, and breeding activities (FWS 2016-TN7400). At low noise levels or farther distances, bats initially may be startled but would likely habituate to the low background noise levels. At closer range and louder noise levels, particularly if accompanied by physical vibrations from heavy machinery, many bats would likely be startled to the point of fleeing from their daytime roosts. Fleeing individuals could experience increased susceptibility to predation and would expend increased levels of energy, which could result in decreased reproductive fitness (FWS 2016-TN7400, Table 4-1). Increased noise may also affect foraging success. Schaub et al. (2008) [TN8867] found that the foraging success of the greater mouse-eared bat (*Myotis myotis*) diminished in areas with noise mimicking the traffic sounds that would be experienced within 15 m (49 ft) of a highway.

Within the Perry Plant action area, noise, vibration, and other human disturbances could dissuade bats from using the action area’s forested habitat during migration, which could also reduce the fitness of migrating bats. However, bats that use the action area have likely become habituated to such disturbance because Perry Plant has been consistently operating for several decades. According to the FWS, bats that are repeatedly exposed to predictable, loud noises may habituate to such stimuli over time (FWS 2010-TN8537). For instance, Indiana bats have been documented as roosting within approximately 1,000 ft (300 m) of a busy State route adjacent to Fort Drum Military Installation and immediately adjacent to housing areas and construction activities on the installation (U.S. Army 2014-TN8512). Northern long-eared, Indiana, and tricolored bats would likely respond similarly.

Continued operation of Perry Plant during the LR term would not include major construction or refurbishment and would involve no other maintenance or infrastructure repair activities besides routine activities already performed on the site. Levels and intensity of noise, lighting, and human activity associated with continued day-to-day activities and site maintenance during the LR term would be similar to ongoing conditions since Perry Plant began operating, and such activity would only occur on the developed, industrial-use portions of the site. While these disturbances could cause behavioral changes in migrating or summer roosting bats, such as the expenditure of additional energy to find alternative suitable roosts, the NRC staff assumes that federally listed bats, if present in the action area, have already acclimated to regular site disturbances. Thus, continued disturbances during the LR term would not cause behavioral changes in bats to a degree that would be able to be meaningfully measured, detected, or evaluated or that would reach the scale where a take might occur.

Summary of Effects

The potential stressors evaluated in this section are unlikely to result in effects on the northern long-eared bat, Indiana bat, and tricolored bat that could be meaningfully measured, detected, or evaluated, and such stressors are otherwise unlikely to occur for the following reasons:

- Bat collisions with nuclear power plant structures in the United States are rare, and none have been reported to date at Perry Plant. Vehicle collisions attributable to the proposed action are also unlikely, and none have been reported at Perry Plant.
- The proposed action would not involve any construction, land clearing, or other ground-disturbing activities.
- Continued preservation of the existing forested areas on the site would result in positive impacts on bats.
- Bats, if present in the action area, have likely already acclimated to the noise, vibration, and general human disturbances associated with site maintenance, infrastructure repairs, and other site activities. During the LR term, such disturbances and activities would continue at current rates and would be limited to the industrial-use portions of the site.

Conclusion for the Northern Long-eared Bat

All potential effects on the northern long-eared bat resulting from the proposed action would be insignificant or discountable. Therefore, the NRC staff concludes that the proposed action *may affect but is not likely to adversely affect* the northern long-eared bat.

In a letter dated October 19, 2023 (FWS 2023-TN9741), the FWS concurred with this determination based on a standing analysis completed by the Service in its development of the IPaC Northern Long-eared Bat Rangewide Determination Key. The FWS's October 19, 2023, letter documents that the NRC staff has fulfilled its ESA Section 7(a)(2) obligations with respect to the proposed Perry Plant LR. The NRC staff notes that ESA regulations at 50 CFR 402.16 (TN4312) prescribe certain circumstances that require Federal agencies to reinitiate consultation. As of the date of issuance of this draft SEIS, the NRC staff has identified no information that would warrant re-initiation of consultation (TN4312).

Conclusion for the Indiana Bat

All potential effects on the Indiana bat resulting from the proposed action would be insignificant or discountable. Therefore, the NRC staff concludes that the proposed action *may affect but is not likely to adversely affect* the Indiana bat. Following the issuance of this draft SEIS, the NRC staff will seek the FWS's concurrence regarding this finding.

Conclusion for the Tricolored Bat

All potential effects on the tricolored bat resulting from the proposed action would be insignificant or discountable. Therefore, the NRC staff concludes that the proposed action *may affect but is not likely to adversely affect* the tricolored bat.

The ESA regulations in 50 CFR 402.10(a) require Federal agencies to confer with the Services on any agency action that is likely to jeopardize the continued existence of any proposed species or result in the destruction or adverse modification of proposed critical habitat.

Therefore, based on its “not likely to adversely affect” determination, the NRC is not required to confer with the FWS on the tricolored bat.

3.8.4.3 Piping Plover and Red Knot

In Section 3.8.1.1 of this draft SEIS, the NRC staff concludes that piping plover and red knot may occur in the action area during the migration period from late April through late August when individuals are moving between areas of more suitable habitat. If present, piping plovers would occur in the action area occasionally and for short periods of time.

The potential stressors that piping plover could experience from operation of a nuclear power plant (generically) are as follows:

- mortality or injury from collisions with nuclear power plant structures and vehicles
- habitat loss, degradation, disturbance, or fragmentation, and associated effects
- behavioral changes resulting from refurbishment or other site activities.

Mortality or Injury from Collisions with Plant Structures and Vehicles

In the GEIS, the NRC generically determined that the impacts of bird collisions with plant structures and transmission lines would be SMALL at all nuclear power plants (NRC 2013-TN2654). However, because the piping plover and red knot are federally endangered, this issue requires species-specific evaluation.

On the Perry Plant site, the tallest site structures are the cooling towers, each of which is 516 ft (158 m) high (EH 2023-TN9534: Section 3.2.3). The turbine buildings, meteorological tower, reactor domes, and transmission lines are also prominent features on the Perry Plant site. However, because of species behavior, summarized in the next two paragraphs, neither species is unlikely to interact with plant infrastructure or site vehicles.

Piping plovers generally fly close to the ground within breeding areas. Therefore, tall structures are unlikely to represent a unique collision hazard. For instance, in a study of flight behaviors of piping plovers, Stantial and Cohen (2015) [TN7348] assessed flight heights of piping plovers in New Jersey and Massachusetts during the 2012 and 2013 breeding seasons. The researchers found that flight heights ranged from 2.3 to 34.4 ft (0.7 to 10.5 m) with a mean of 8.5 ft (2.6 m). Visually estimated flight heights ranged from 0.8 to 131 ft (0.25 to 40 m). Because piping plovers fly relatively low to the ground, they are acclimated to navigating various natural and manmade flight hazards, and tall structures on the Perry Plant site are unlikely to create an additional risk. Even in the case of wind turbines, which have moving components, researchers found that collision hazards at five wind facilities in New England during the piping plover breeding season were low, assuming that constant turbine operation ranged from 0.06 to 2.27 collisions per year for a single large turbine (radius 134.5 ft [41 m]), 0.03 to 0.99 for a single medium turbine (radius 74 ft [22.5 m]), and 0.01 to 0.29 for a single small turbine (radius 31.5 ft [9.6 m]) (Stantial 2014-TN7614). With respect to vehicle collision hazards, Stantial and Cohen (2015) determined average calculated flight speed of piping plovers to be 30.5 feet per second (fps; 9.3 m/s). The high speed at which piping plovers can fly make them unlikely to collide with site vehicles.

Red knots rapidly migrate long distances to and from their boreal and Arctic breeding ranges (FWS 2020-TN8850). Red knots migrating northward from the southeastern U.S. to their breeding grounds had average flight speeds of 65.6 fps (20 m/s) and a median travel distance of 301 mi (485 km) (Smith et al. 2023-TN9975). Most red knots migrating through the eastern Great Lakes in the spring had no stopovers; they flew directly to their breeding grounds. Offshore wind energy research showed that red knots and other shorebirds have average altitudes (1,709 ft [521 m] or greater), depending on the migration season and time of day (Loring et al. 2021-TN10018). Mean spring migration altitudes (2,999 ft [914 m)] were greater than mean fall migration altitudes (1,788 ft [545 m]). Rapid migration speed, migration altitudes, and limited expected time within the action area make it unlikely that red knots would collide with plant infrastructure or vehicles (Loring et al. 2021-TN10018).

Between 2013 and 2023, VistraOps recorded 20 bird incidents (one injury and at least 85 mortalities) on the Perry Plant site (Vistra 2024-TN9925: Attachment 42). None were piping plovers, red knots, or shorebirds of any species. None of these mortalities were from vehicle collisions; a few were related to collisions with structures on the Perry Plant site. VistraOps has policies and procedures relating to avian incidents and reporting any incidents of federally listed or State-listed species (Vistra 2024-TN9925: Attachment 43). Accordingly, the NRC staff finds the likelihood of future piping plover and red knot collisions with Perry Plant site structures or vehicles to be extremely unlikely and, therefore, discountable.

Habitat Loss, Degradation, Disturbance, or Fragmentation, and Associated Effects

Both the piping plover and red knot require sparsely vegetated beaches, mudflats, or sand flats for foraging (FWS 2003-TN8841, FWS 2020-TN8850). These habitats are present elsewhere along the Lake Erie shoreline (see Section 3.4). However, because these habitats are not present within the Perry Plant action area, the NRC staff assume that these species could occasionally pass through the site, along the shoreline or over water, to more suitable foraging habitat along Lake Erie.

The proposed action would not involve any construction, land clearing, or other ground-disturbing activities. The NRC staff do not anticipate any habitat loss, disturbance, or fragmentation from relicensing activities.

In its ER, VistraOps describes a potential future shoreline protection project within the site boundary (EH 2023-TN9534: Section 3.1.4). The project area would be adjacent to shoreline protection features north of the cooling tower and would extend east approximately 1,200 ft (366 m). In connection with this project, VistraOps would obtain appropriate permits, such as a CWA Section 404 permit from the USACE. Because the USACE is a Federal agency, the USACE would be required to consider the effects of issuing such a permit on federally listed species and consult with the FWS under ESA Section 7, if effects are anticipated.

Behavioral Changes Resulting from Refurbishment or Other Site Activities

Construction or refurbishment and other site activities, including site maintenance and infrastructure repairs, could prompt behavioral changes in piping plovers and red knots. Noise and vibration and general human disturbance are stressors that may disrupt normal feeding, sheltering, and breeding activities. At low noise levels or farther distances, piping plovers and red knot initially may be startled but would likely habituate to the low background noise levels. At closer range and louder noise levels, birds would likely be startled to the point of fleeing from the area. Fleeing individuals would expend increased levels of energy and would forgo the foraging or resting opportunity that the action area may have otherwise provided.

Within the Perry Plant action area, noise, vibration, and other human disturbances could dissuade piping plovers and red knots from passing through. However, both species have likely become habituated to such disturbance because Perry Plant has been consistently operating for several decades. Additionally, much of the Lake Erie shoreline is developed, so piping plovers and red knots have likely developed some level of tolerance to human activity based on human activity in other areas of preferred habitat.

Continued operation of Perry Plant during the LR term would not include major construction or refurbishment and would involve no other maintenance or infrastructure repair activities besides routine activities already performed on the site. Levels and intensity of noise, lighting, and human activity associated with continued day-to-day activities and site maintenance during the LR term would be similar to ongoing conditions since Perry Plant began operating, and such activity would only occur on the developed, industrial-use portions of the site. While these disturbances could cause behavioral changes in migrating, the NRC staff assumes that piping plover and red knots, if present in the action area, have already acclimated to regular site disturbances. Thus, continued disturbances during the LR term would not cause behavioral changes in birds to a degree that would be able to be meaningfully measured, detected, or evaluated or that would reach the scale where a take might occur.

Summary of Effects

The potential stressors evaluated in this section are unlikely to result in effects on the piping plover or red knot that could be meaningfully measured, detected, or evaluated, or such stressors are otherwise unlikely to occur for the following reasons:

- Piping plover and red knots would only be passing through the Perry Plant site on the way to suitable habitats. No piping plover, red knot, or shorebird collisions have been documented on the Perry Plant site.
- Piping plovers generally fly close to the ground and are, therefore, adept at navigating various flight hazards, such as the Perry Plant’s tall buildings and structures. Piping plovers exhibit high flight speeds, which makes individuals unlikely to collide with site vehicles.
- Red knots are unlikely to collide with plant structures or vehicles. Their expected presence in the action area is brief, during their rapid migration to and from their summer Breeding ranges. Migration heights are above the height of plant structures, and their rapid flight speeds mean they pass through the action area very quickly.
- The proposed action would not involve any construction, land clearing, or other ground-disturbing activities. Thus, shoreline habitat would be unaffected.

Piping plovers and red knots, if present in the action area, have likely already acclimated to the noise, vibration, and general human disturbances associated with site maintenance, infrastructure repairs, and other site activities. During the proposed LR term, such disturbances and activities would continue at current rates and would be limited to the industrial-use portions of the site. Onsite presence is most likely limited in duration, as the plovers and red knot fly to areas of more suitable habitat.

Conclusion for Piping Plover

All potential effects on the piping plover resulting from the proposed action would be insignificant or discountable. Therefore, the NRC staff concludes that the proposed action *may affect but is not likely to adversely affect* the piping plover. Following issuance of this draft SEIS, the NRC staff will request the FWS's concurrence with this determination in accordance with 50 CFR 402.13(c).

Conclusion for Red Knot

All potential effects on the red knot resulting from the proposed action would be insignificant or discountable. Therefore, the NRC staff concludes that the proposed action *may affect but is not likely to adversely affect* the red knot. Following issuance of this draft SEIS, the NRC staff will request FWS's concurrence with this determination in accordance with 50 CFR 402.13(c).

3.8.4.4 Monarch Butterfly

In Section 3.8.1.1 of this draft SEIS, the NRC staff concludes that monarch butterflies may occur in the action area from late April to mid-October when individuals are moving between areas of more suitable habitat. If present, monarchs would occur occasionally and for short periods of time.

The FWS (2020-TN8593) identifies three primary factors affecting the health of the two North American migratory populations of monarch butterfly: (1) habitat loss and degradation, (2) insecticide exposure, and (3) climate change effects.

Monarch habitat loss and degradation has resulted from conversion of grasslands to agriculture, widespread use of herbicides, urban development, drought, logging/thinning at overwintering sites in Mexico, senescence, and incompatible management of overwintering sites in California, (FWS 2020-TN8593). The proposed Perry Plant LR would not involve any habitat loss, land-disturbing activities, or any activities that would degrade existing natural areas or potential habitat for monarch butterflies. The continued preservation of existing natural areas on the Perry Plant site would result in positive impacts on monarch butterflies.

Most insecticides are nonspecific and broad-spectrum in nature. Furthermore, the larvae of many Lepidopterans are considered major pest species, and insecticides are specifically tested on this taxon to ensure that they will effectively kill individuals at the labeled application rates (FWS 2020-TN8593). Although insecticide use is most often associated with agricultural production, any habitat where monarchs are found may be subject to insecticide use. Studies looking specifically at dose-response of monarchs to neonicotinoids, organophosphates, and pyrethroids have demonstrated toxicity in monarchs (e.g., Krischik et al. 2015-TN8596; James 2019-TN8595; Krishnan et al. 2020-TN8597; Bagar et al. 2020-TN8594). Larvae and pupae experience reduced survival rates, while adult monarchs are less affected. Moreover, the magnitude of risk posed by insecticides may be underestimated, as research usually examines the effects of the active ingredient alone, while many of the formulated products contain more than one active insecticide.

During the proposed LR period, VistraOps would continue applying herbicides, as needed, according to labeled uses, but has no plans to apply herbicides in natural areas. Application would primarily be confined to industrial use and other developed portions of the site, such as perimeters of parking lots, roads, and walkways. Continued herbicide application could directly affect monarchs in the action area by injuring or killing individuals exposed to these chemicals.

Certain herbicides, such as glyphosate (e.g., Round Up) can kill milkweed, which can affect the ability of female monarchs to lay eggs. Although milkweed is not specifically known to occur on the Perry Plant site (Vistra 2024-TN9925: Attachment 11), it has the potential to occur on site in the grasslands and open areas, given its occurrence within 1 mi (1.6 km) of the site boundary (iNaturalist 2024-TN10048). Monarchs are only likely to occur in the action area seasonally during spring and fall migration when individuals are moving between areas of more suitable habitat. Because of the low likelihood of monarchs to be exposed to hazardous levels of chemicals, this potential impact is insignificant because it is unlikely to reach the scale where a take might occur.

Because the current and projected monarch population numbers are low, both the eastern and western populations are more vulnerable to catastrophic events, such as extreme storms at the overwintering habitat, and other climate change related phenomena. The FWS (2020-TN8593) anticipates that the eastern population will gain habitat in the northcentral region of North America as the species expands northward in response to increasing ambient temperatures. The degree and rate at which this expansion occurs will depend on the simultaneous northward expansion of milkweed. In the southern region of the continent, the population will either experience no gain or some loss of habitat.

Impacts on climate change during normal operations at nuclear power plants can result from the release of GHGs from stationary combustion sources, refrigeration systems, electrical transmission and distribution systems, and mobile sources. However, such emissions are typically very minor because nuclear power plants do not normally combust fossil fuels to generate electricity. During the proposed LR term, the contribution of Perry Plant operations to climate change related effects on monarch butterflies would be too small to be meaningfully measured, detected, or evaluated.

Conclusion for the Monarch Butterfly

All potential effects on the monarch butterfly resulting from the proposed action would be insignificant. Therefore, the NRC staff concludes that the proposed action *may affect but is not likely to adversely affect* the monarch butterfly. Because the monarch is a candidate for Federal listing, the ESA does not require the NRC to consult with or receive concurrence from the FWS regarding this species.

3.8.4.5 Federally Listed Species and Critical Habitats under National Marine Fisheries Service Jurisdiction

No federally listed species or critical habitats under NMFS jurisdiction occur within the action area (see Section 3.8.1.1). Therefore, the NRC staff concludes that the proposed action would have no effect on federally listed species or habitats under this agency's jurisdiction.

3.8.4.6 Magnuson-Stevens Fishery Conservation and Management Act

No EFH occurs within the affected area (see Section 3.8.1.10). Therefore, the NRC staff concludes that the proposed action would have no effect on EFH.

3.8.4.7 National Marine Sanctuaries Act

No national marine sanctuaries occur within the affected area (see Section 3.8.2). Therefore, the NRC staff concludes that the proposed action would have no effect on sanctuary resources.

3.8.5 No-Action Alternative

Under the no-action alternative, the NRC would not issue a renewed license, and the Perry Plant would permanently shut down on or before the expiration of the current facility operating license. Upon shutdown, the plant would require substantially less cooling water and would produce little to no discernible thermal effluent. The ESA action area under the no-action alternative would most likely be the same or similar to the area described in Section 3.8.1. Northern long-eared bats, Indiana bats, tricolored bats, piping plovers, red knots, and monarch butterflies may occur within the action area (see Section 3.8.1.1). Collisions hazards for birds and bats would remain the same. Noise and vibration and general human disturbance would continue into the decommissioning period. Landscape maintenance and herbicide use would also likely continue for a period. The NRC would consult with the FWS, as appropriate, to address potential effects on these species resulting from shutdown and decommissioning of the plant. No EFH or national marine sanctuaries occur in the affected area (see Sections 3.8.1.10 and 3.8.2). Thus, shutdown would not result in impacts on EFH or sanctuary resources. Actual impacts would depend on the specific shutdown activities and whether any listed species or critical habitats are present when the no-action alternative is implemented.

3.8.6 Replacement Power Alternatives: Common Impacts

All power replacement alternatives would be located within Ohio. The ESA action area and waters potentially containing designated EFH or national marine sanctuary resources for any of the replacement alternatives would depend on various factors, including site selection, current land uses, planned construction activities, temporary and permanent structure locations and parameters, and the timeline of the alternative. The listed species, critical habitats, EFH, and national marine sanctuaries potentially affected by a replacement power alternative would depend on the boundaries of that alternative’s effects and the species and habitats federally protected at the time the alternative is implemented. For instance, if the Perry Plant continues to operate until the end of the current license term and a replacement power alternative is implemented at that time, the FWS and NMFS may have listed new species, delisted currently listed species whose populations have recovered, or revised EFH designations. These listing and designation activities would change the potential for the various alternatives to affect federally protected ecological resources. Additionally, requirements for consultation under ESA, MSA, and NMSA would depend on whether Federal permits or authorizations are required to implement each alternative.

Sections 3.6 and 3.7 describe the types of impacts that terrestrial and aquatic resources would experience under each alternative. Impacts on federally protected ecological resources would likely be similar in type. However, the magnitude and significance of such impacts could be greater for federally protected ecological resources because such species and habitats are rare and more sensitive to environmental stressors.

3.8.7 Natural Gas-Fired Combined-Cycle Alternative

The NRC does not license NGCC facilities; therefore, the NRC would not be responsible for ESA, MSA, or NMSA consultations for this alternative. The Federal and private responsibilities for addressing impacts on federally protected ecological resources under this alternative would be like those described in Section 3.8.5 of this SEIS. Ultimately, the magnitude and significance of adverse impacts on federally protected ecological resources resulting from the NGCC alternative would depend on the site location and layout, plant design, plant operations, and the protected species and habitats present in the area when the alternative is implemented.

3.8.8 Renewable and Natural Gas Combination Alternative

The NRC does not license NGCC or renewable energy facilities; therefore, the NRC would not be responsible for ESA, MSA, or NMSA consultations for this alternative. The Federal and private responsibilities for addressing impacts on federally protected ecological resources under this alternative would be like those described in Section 3.8.5 of this SEIS. Ultimately, the magnitude and significance of adverse impacts on federally protected ecological resources resulting from the NGCC alternative would depend on the site location and layout, plant design, plant operations, and the protected species and habitats present in the area when the alternative is implemented.

3.9 Historic and Cultural Resources

Historic and cultural resources describe material culture left behind from past human activity. Cultural resources include sites, objects, landscapes, structures, or other natural features of significance to groups of people who have traditional association with it. Historic properties may include a diverse range of resources depending on the project location and type of undertaking.

Section 106 of NHPA requires Federal agencies to consider the effects of their undertakings on historic properties included on, or eligible for inclusion on, the National Register of Historic Places (NRHP [54 U.S.C. § 306108-TN4839]). The NRHP is the Nation's official list recognizing buildings, structures, objects, sites, and districts of national, State, or local places that are historically significant and worthy of preservation. The criteria for eligibility are listed in 36 CFR 60.4, *Criteria for Evaluation* (TN1682).

In Ohio, the Ohio History Connection is the State Historic Preservation Office (SHPO) and is responsible for administering Federal and State-mandated historic preservation programs to identify, evaluate, register, and protect Ohio's archaeological and historic resources. The Ohio History Connection maintains a database of all its inventoried historic, cultural, and architectural resources registered in the State.

This review addresses the requirements of the NHPA Section 106 process, specifically 36 CFR 800.3 through 800.5, to determine whether there is a potential for project-related activities to cause direct or indirect effects to NRHP-eligible historic properties, and if so, to address those potential impacts. This section describes the cultural background and the historic and cultural resources found at the Perry Plant and its surrounding environs. As part of the license application, the applicant completes an initial environmental review, including Section 106 compliance, for NRC's confirmatory review and to satisfy the Federal requirement of completing Section 106 compliance. The description of the resources is followed by the NRC staff's analysis of the potential impacts on historic and cultural resources from the proposed action and alternatives to the proposed action.

3.9.1 Cultural Background

Archaeological records indicate that northeastern Ohio was generally occupied by Indigenous populations during the Paleoindian Period (13,000 before present [BP] to 8000 BP), Archaic Period (8000 BP to 1000 BP), the Woodland Period (1000 BP to 500 anno Domini [AD]), and the Late Prehistoric Period (500 AD to 1650 AD). European contact (the Historic Period) occurred around 1650 AD (Abel 2012-TN9871). The following are brief descriptions of each period.

3.9.1.1 Paleoindian Period (13,000 to 8000 BP)

The Paleoindian Period in Ohio is documented as occurring between 13,000 BP to around 8,000 BP. The time period is characterized by small groups of highly mobile nomadic hunters who followed big game such as mammoths, mastodons, and bison across the landscape.

Stone tool typology of this era consists of finely flaked flint spear points, known as fluted points. Fluted points were large well-made spear points characterized by a groove notched out in the middle to bottom half of the point that allowed for attachment to handles.

The Paleo Crossing site in Medina County, about 80 mi (130 km) southeast of the Perry Plant, is a well-known Paleoindian site in Ohio. Artifacts from this site were manufactured with Wyandotte chert, typically found in Indiana. Artifacts from another Paleoindian site, Sheriden Cave in Wyandot County, were found alongside now-extinct remains such as giant beaver, stag moose, and short-faced bear (Redmond 2006-TN9867). Fluted points and flint hide scrapers were also encountered.

3.9.1.2 Archaic Period (8000 to 1000 BP)

The Archaic Period in Ohio is documented as starting around 8,000 years ago. During the Archaic Period, populations began to be more sedentary, relying more on wild plants such as hickory nuts, acorns, walnuts, and tubers, fish, and reducing big game hunting (Redmond 2006-TN9867). Stone tool technologies also changed. Larger spear points were replaced by smaller points. The Archaic toolkit now included stone grinding implements and tools such as projectile points, knives, drills, and scrapers. Artifacts such as bone hooks, harpoon heads, stone net weights, and similar fishing tackle indicated that Lake Erie was an important resource for marine subsistence during this period (Redmond 2006-TN9867; Peskin 2011-TN9872).

3.9.1.3 Woodland Period (1000 BP to 900 AD)

The Woodland Period is represented by more intensive plant cultivation, the first use of pottery, and the emergence of earthworks and burial mounds. Pottery began during the Early Woodland (1000–100 before Christ [BC]; Cook and Thompson 2023-TN9874). Early pottery was thick and made from local river clays and crushed granite rocks that were dropped by receding Ice Age glaciers (Redmond 2006-TN9867). The pottery was originally coiled and low fired with a wide mouth and flat-to-rounded bases. Simple decorations such as cord-wrapping were stamped on the exterior of the pots (Griffin 1967-TN9876).

Earthworks and burial mounds developed during the Early Woodland as well. Mounds were usually singular conical structures while earthworks were a combination of mounds and walls built into geometric shapes (NPS 2021-TN9875). The Adena Culture (500 BC to 100 AD) were considered to be the first to engage in mound and earthwork construction (Abrams 2009-TN9873). The contemporary Hopewell Culture (200 BC to 400–500 AD) emerged during the Middle Woodland Period (100 BC–500 AD), developing larger and more complex earthworks associated with religious and ceremonial purposes.

During the Hopewell culture, smaller populations which expanded across eastern North America, exchanged resources via the Hopewell Interaction Sphere, the term to describe the vast trade network on how raw materials and finished goods were exchanged in this region. In addition to exchanging resources with populations in the now-Midwest, the Ohio Hopewell also procured obsidian from as far as Yellowstone, mica from the Blue Ridge Mountains in the

Carolinas, and shells from the Gulf of Mexico (NPS 2021-TN9875; National Geographic 2023-TN9878). Sites such as Tremper Mound in Scioto County observed pipes which were made from Minnesota catlinite, despite having a source of Ohio pipestone nearby (Abrams 2009-TN9873).

Archaeological records indicate that the Hopewell culture declined around 200 AD (Abrams 2009-TN9873). The use of exotic non-local materials declined, and it appears that people began to move away from the earthwork centers. One of the best preserved examples of Hopewellian mounds is at the Hopewell Culture National Historic Park in Chillicothe, Ohio, managed by the National Park Service (NPS 2024-TN9879). Also known as the Hopewell Mound Group, the site became a world UNESCO site in 2023. Closer to the project area, earthworks from the Early, Middle, and Late Woodland periods have been recorded in the Cleveland area (Peskin 2011-TN9872). These earthworks appeared to be smaller than known Adena and Hopewell mounds recorded in other parts of the State (Redmond 2006-TN9867). It is important to note that not all sites dating to the Middle Woodland were associated with the Hopewell culture. Some sites, such as the Huntington Road Site in Lake County, uncovered artifacts that were not traditionally associated with the Hopewell.

The bow and arrow was introduced in the Late Woodland Period (500–900 AD). Bow launched points had greater impact, which further maximized wild game hunting (Peskin 2011-TN9872). This change in technology allowed for greater hunting success. Earthworks continued to be erected. Some earthworks have remnants of log stockades, indicating that they were possibly constructed for defense purposes, not ceremonial (Peskin 2011-TN9872).

3.9.1.4 Late Prehistoric Period (900 AD to 1650 AD)

During the Late Prehistoric Period, populations began to cluster into more permanent settlements around large river valleys (Redmond 2006-TN9867). Elements of the Mississippian culture (1200–1600 AD), more prominent in the now-southern States, was contemporary with the Late Prehistoric Period. Both had significant cultural development such as ownership of land tied to specific territories, social hierarchies, specialization of labor, religious plazas centered around crop production, and markets for the exchange of goods (Griffin 1967-TN9876). Villages were divided by housing and related mortuary areas. Features such as open plazas with large central posts were common. Mortuary practices changed from the use of burial mounds to simple shallow graves in villages (Brose 2024-TN9880). Maize agriculture was also supplemented with marine resources such as fish and freshwater clams. The Cahokia site in Illinois is a classic example of a Mississippian village.

Archaeological sites in northeast Ohio dating to the Late Prehistoric Period are associated with the Whittlesey tradition (1350 to around 1640 AD). Charles Whittlesey, after whom the Whittlesey culture is named after, was a scientist and antiquarian who first reported on many of the Late Prehistoric sites. Whittlesey sites are typically found on high ridge tops with steep bluff edges that overlook major river valleys.

Archaeological features encountered from Late Prehistoric sites such as Tuttle Hill and South Park village in Cuyahoga County, and the Fairport Harbor village site in Lake County have uncovered post molds from rectangular and circular house walls, hearths (fire pits), fire cracked rock, and storage pits (Redmond 2006-TN9867). Refuse such as pottery, triangular arrow points, and other fragments were observed in deep storage pits.

The latter end of this period intersects with European contact. European explorers and missionaries documented their encounters with Indigenous groups as they made their way westward across North America.

3.9.1.5 Historic (1650 to present)

Ohio is an Iroquois word for beautiful or big river. It derived from *O-Hee-Yo* (Crow 2022-TN9877). Northeastern Ohio served as a hunting area for the Iroquois and several Indigenous groups, including the Wyandot, Mississauga, and others (Keener and Nelson 2019-TN9909). The Iroquois, who refer to themselves as the Haudenosaunee, originally comprised of the Seneca, Cayuga, Onondaga, Oneida, and Mohawk Nations (Haudenosaunee Confederacy 2024-TN9881; NPS 2023-TN9882). Other Indigenous groups who had presence in now-Ohio include Erie, Neutral, Petun, and Huron.

Around 1650, the Iroquois claimed ownership over southern Lake Erie. Over the decades, they conquered territories across what is now Indiana, Wisconsin, New York, and southeast to West Virginia (Peskin 2011-TN9872; Crow 2022-TN9877). As Europeans came in, the Iroquois established trading relations with the Dutch, Swedes, and English (Crow 2022-TN9877). Goods such as beaver pelts and other animal skins were valuable to Europeans while the Iroquois were interested in goods such as firearms, powder, cooking pots, and clothes (Crow 2022-TN9877; Haudenosaunee Confederacy 2024-TN9881).

Various treaties were signed in the 1700s that eventually ceded Tribal-controlled lands throughout the northeastern United States, including the present State of Ohio. Treaties included the 1784 and 1789 treaties with the Six Nations, 1794 Treaty of Canandaigua, and the 1795 Treaty of Greenville (ONW 2024-TN9883; NPS 2015-TN9884). The cession of lands opened up the area for settlement.

Lake County was established in 1840 from lands originally claimed by Geauga and Cuyahoga counties (LCHC Undated-TN9885; OCPI 2024-TN9888). Farming was dominant in the 19th century. Over the decades, the county established the tree-growing nursery industry. The county has become one of the primary locations for nurseries in the Nation due to its excellent soil and climate that makes it an ideal environment for agriculture and horticulture. Communities in the county today include Eastlake, Kirtland, Madison, Mentor, Perry, Painesville and Willoughby (LCO 2024-TN9886).

3.9.2 Historic and Cultural Resources at Perry

Historic and cultural resources can include prehistoric and historic era archaeological sites, buildings, historic districts, as well as any site, structure, or object that may be considered eligible for listing on the NRHP. Historic and cultural resources also include traditional cultural properties that are important to a living community of people for maintaining their culture.

To gain a better understanding of the archaeological resources within the region, a literature review was conducted through the Ohio History Connection’s Ohio Archaeological Inventory using a 1 mi (1.6 km) radius to identify all historic properties that could be potentially affected by the undertaking. This information helps cultural resources professionals understand what resources may potentially be in the area of potential effect (APE). The results are discussed in the following sections.

3.9.2.1 Previously Recorded Sites and Surveys

A total of 38 cultural resources are within 1 mi (1.6 km) of the project area, consisting of six archaeological sites and 32 historic-age buildings. None are within the Perry project area. In addition, four cemeteries are within the 1 mi (1.6 km) buffer. The closest is Mayers Wood, 800 m (2,624 ft) east of the APE. NRHP eligibility determinations were not available for any of the cultural resources.

There are no historic buildings within the APE. Because construction of the Perry Plant began in the mid-1970s, it appeared that the buildings were approaching 50 years, which is the minimum age needed to evaluate the facility for potential listing on the NRHP. VistraOps clarified that construction was completed in 1985 (Vistra 2024-TN9925). In consultation with the Ohio History Connection, their office recommended waiting until the facilities were closer to being 45 years old (around 2031–2035) before doing an architectural survey to determine the eligibility of the facilities.

Three previous surveys are within 1 mi (1.6 km) of the APE. In late spring 1973, Brose and Lee surveyed 160 ac (64 ha) of the proposed Perry Plant site. Their investigation consisted of a pedestrian survey and the excavation of 15 test units. Their work resulted in the recording of two archaeological sites, both of which are outside the APE (Brose and Lee 1973-TN9907).

In 2005, Professional Archaeological Services Team excavated four test units for the installation of a 220 ft (67 m) cell tower. Testing and examination resulted in negative findings for all four test units (Keener 2005-TN9908). In 2019, the same company performed a survey for the installation of a 250 ft (76 m) tall self-support tower. A total of 10 test units and 2 shovel tests were excavated. No cultural resources were identified during their investigation (Keener and Nelson 2019-TN9909).

3.9.3 Procedures

VistraOps has two procedures which aim to identify, protect, and minimize the potential of impact to cultural resources within the Perry Plant. *FirstEnergy Nuclear Operating Company Environmental Evaluations* (NOP-OP-2010 R-9) and the *Excavation and Trenching Controls* (NOP-WM-4007 R-6) procedures were provided for NRC staff’s confirmatory review.

Although VistraOps’ work processes do not require advanced preparation for activities that may occur in previously undisturbed areas, work control documents require activities to pause if archaeological, cultural, or historic resources are encountered (Vistra 2024-TN9925). The *Excavation and Trenching Controls* procedure (NOP-WM-4007 R-6) defines what actions are taken in the event human remains are to be encountered. All resources identified would meet the threshold generating a condition report and would be tracked in their corrective action program (Vistra 2024-TN9925).

3.9.4 Proposed Action

The NHPA of 1966, as amended (54 U.S.C. 300101 et seq. [TN4157]), requires Federal agencies to consider the effects of their undertakings on historic properties. Issuing a renewed operating license to a nuclear power plant is a Federal undertaking that could potentially affect historic properties. Historic properties are defined as resources included on, or eligible for inclusion on, the NRHP. The criteria for eligibility are listed in “Parks, Forests, and Public Property” of the 36 CFR Part 60 (TN1682) Section 60.4 “Criteria for Evaluation,” and include

(A) association with significant events in history, (B) association with the lives of persons significant in the past, (C) embodiment of distinctive characteristics of a type, period, or method of construction, or (D) sites or places that have yielded, or may be likely to yield, information important in prehistory or history.

In accordance with NHPA provisions, the NRC is required to make a reasonable effort to identify historic properties included on, or eligible for inclusion on, the NRHP in the APE. The APE for a LR action includes the power plant site, the transmission lines up to the first substation and immediate environs, and land-disturbing activities associated with continued operations that may be affected during the LR term.

In Ohio, the Ohio History Connection office administers the State's historic preservation program. The NRC also notifies all consulting parties, including American Indian Tribes, and makes this finding public (through the NEPA process) before issuing renewed operating licenses. Similarly, if historic properties are present and could be affected by the undertaking, the NRC is required to assess and resolve any adverse effects in consultation with the SHPO and any American Indian Tribe that attaches religious and cultural significance to identified historic properties. In addition, the NRC is required to notify the SHPO if historic properties would not be affected by the LR or if no historic properties are present.

The proposed undertaking is the renewal of the current operating license, which would extend the current operating term another 20 years. The APE consists of the 1,030 ac (416 ha) Perry Plant site boundary where activities associated with the operation of the facility may compromise the integrity of historic properties.

As part of the environmental audit, a Perry Plant site visit occurred on February 1, 2024. The visit consisted of a tour through the Perry Plant's protected area and its surrounding environment. After the tour, technical staff drove around the vicinity of the APE to observe the remainder of the APE. The area consisted of thin, second growth trees. A power line easement and two-track road was observed in the southern portion of the APE.

The only area that appeared to have an elevation change was in the northeastern section of the APE. A small creek was located at the bottom. A mix of gray and brown eroded soils were noted. No extant buildings or features were observed in the brief walkthrough.

3.9.5 Consultation

In accordance with 36 CFR 800.8, "Coordination with the National Environmental Policy Act," NRC initiated Section 106 consultation with the Advisory Council on Historic Preservation (ACHP) (NRC 2023-TN10052, NRC 2023-TN10053), Ohio History Connection (NRC 2023-TN10054), and six Tribes on October 18, 2023 (NRC 2023-TN10053) as part of this SEIS. Letters were sent to the Eastern Shawnee Tribe of Oklahoma, Hannahville Indian Community in Michigan, Little Traverse Bay Bands of Odawa Indians in Michigan, Miami Tribe of Oklahoma, Seneca-Cayuga Nation, and the Seneca-Iroquois National Museum. In the letters, the NRC provided information about the proposed action, defined the APE, and indicated that the NHPA review would be integrated with the NEPA process. The NRC invited participation of the aforementioned American Indian Tribes in the scoping process and in the identification of, and possible decisions concerning, historic properties. No responses were received from consulting Tribes (Vistra 2024-TN9925).

The Ohio History Connection responded November 13, 2023, referring to their response previously sent September 28, 2022, to the applicant during their informal engagement with them (OHC 2023-TN10073). Appendix C includes copies of all the consultation documents.

3.9.6 Findings

The NHPA, as amended (TN4157), requires Federal agencies to consider the effects of their undertakings on historic properties. Issuing a renewed operating license to a nuclear power plant is an undertaking that could potentially affect historic properties.

There are no previously recorded cultural resources or historic properties within the APE. VistraOps does not plan to alter operations, expand existing facilities, modify facilities, or disturb additional land to continue the operation of the power plant. Plant operations and maintenance activities necessary to support the continued operation would be limited to previously disturbed areas and would be expected to be similar to current operations.

For the purposes of the NRC's NHPA review, the undertaking will result in No Historic Properties Affected, as defined in 36 CFR 800.4 (d)(1). In the event that ground disturbance is necessary for future development, VistraOps has procedures in place to reduce impacts to any cultural resources encountered.

3.9.7 No-Action Alternative

Under the no-action alternative, VistraOps would continue operating the Perry Plant until the existing operating license expires. Cultural resources would not be affected as ground disturbing activities or dismantlement would be conducted during decommissioning. In the GEIS on Decommissioning of Nuclear Facilities (NRC 2002-TN7254), the NRC concluded that impacts on cultural resources would be SMALL at nuclear plants where decommissioning activities would only occur within existing industrial site boundaries. For potential impacts outside of existing industrial site boundaries, impacts cannot be predicted generally as it would depend on site-specific conditions (NRC 2002-TN665).

3.9.8 Replacement Power Alternatives: Common Impacts

Impacts to cultural resources from construction and operation of a replacement power alternative would be dependent on the site at which these efforts are localized. For construction, impacts to historic properties would vary depending on the degree of ground disturbance (i.e., land clearing, excavations). If the project has a Federal nexus (i.e., license, permit), the Federal agency would need to make a reasonable effort to identify historic properties within the area of potential effects and consider the effects of their undertaking on historic properties, in accordance with Section 106 of the NHPA. Identified historic and cultural resources would need to be recorded and evaluated for eligibility for listing on the NRHP. If historic properties are present and could be affected by the undertaking, adverse effects would be assessed, determined, and mitigated with the SHPO and any American Indian Tribe that attaches religious and cultural significance to identified historic properties through the Section 106 consultation process.

Similar to construction, the potential for impacts from the operation of replacement power alternatives would be related to ground disturbing activities at the site or modifications to the facility. Areas subject to ground disturbance would need to be surveyed to identify and record historic and cultural material. Avoidance of historic and cultural resources should be possible and effectively managed. Modifications to structures may have the potential to impact viewsheds of historic and cultural resources.

3.9.9 Natural Gas-Fired Combined-Cycle Alternative

This alternative would involve the construction and installation of multiple natural gas-fired turbines and steam generators with associated support structures, including exhaust stacks and MDCTs on the Perry Plant.

Impacts on historic and cultural resources would be similar to those described for other alternatives and would include the effects of connecting to existing natural gas pipelines. Potential impacts during construction would depend on the location chosen for construction. This may be on the Perry Plant or potentially at another VistraOps site slated for sale or closure. If the alternative were to be constructed on the Perry Plant, the installation of additional infrastructure would be minimal since a natural gas pipeline already exists within the plant site.

3.9.10 Renewable and Natural Gas Combination Alternative

This alternative would involve the construction and installation of a 764 MW NGCC plant, six 125 MW solar installations with battery storage, and three wind installations totaling 540 MW. For the solar installations, a total of 450 MW of battery backup is assumed, using DOE estimates of 60 MW of battery storage for each 100 MW of installed solar (DOE 2019-TN9717). Both the solar and wind portions of the combination alternative would be located offsite somewhere in Ohio. This alternative corresponds to about 65 percent (natural gas), 20 percent (wind), and 15 percent (solar) of the Perry Plant's net generation (EH 2023-TN9534).

Similar to the other alternatives, impacts to cultural resources from the construction and operation of a renewable and natural gas alternative would be dependent on the location chosen for construction. Impacts would include those discussed above that would be common to all replacement alternatives. Under this alternative, solar panels with battery storage and three wind installations would be installed offsite somewhere in Ohio. If there is a Federal nexus, the agency would need to make a reasonable effort to identify historic properties within the area of potential effects and consider the effects of their undertaking on historic properties, in accordance with Section 106 of the NHPA.

The new NGCC plant could be located at the Perry Plant or at one of the two coal-fired plants operated by VistraOps that are slated for sale or closure. The footprint for the new power plant would be contained to approximately 60 ac (24 ha) and not need additional land for new infrastructure. As it would be in previously disturbed contexts, impacts to cultural resources if present, may be minimal. Solar power generation and wind installations would require a larger footprint—6,000 ac (2,428 ha) for the solar power generation and about 46,000 ac (18,615 ha) for the wind power generation. Impacts cannot be considered broadly as it would be dependent on site-specific conditions. Additionally, historic viewsheds would need to be taken into consideration as any potential modification to the landscape may have adverse impacts.

3.10 <u>Socioeconomics</u>

This section describes current socioeconomic factors that have the potential to be affected by changes in nuclear power plant operations at Perry Plant. Perry Plant and the communities that support it can be described as a dynamic socioeconomic system. The communities support the people, goods, and services required to operate the nuclear power plant. Nuclear power plant operations, in turn, supply wages and benefits for people as well as dollar expenditures for goods and services. The measure of a community's ability to support Perry Plant's operations depend on the community's ability to respond to changing environmental, social, economic, and demographic conditions.

3.10.1 Nuclear Power Plant Employment

The socioeconomic region of influence is defined by the areas where Perry Plant workers and their families reside, spend their income, and use their benefits, thus affecting the economic conditions in the region. VistraOps employed approximately 645 non-outage workers at the Perry Plant site, including 615 permanent full-time employees and an additional 30 long-term contract workers. (EH 2023-TN9534). As of February 2022, approximately, 92 percent (568) of permanent workers reside in three Ohio counties:

- Lake County (44 percent of the workers)
- Ashtabula County (32 percent of the workers)
- Geauga County (16 percent of the workers) (EH 2023-TN9534).

Most of the remaining 8 percent of non-outage workers are spread among other counties in Ohio, and approximately 1 percent reside in Pennsylvania (EH 2023-TN9534). Because most of Perry's permanent workers are concentrated in Lake County, Ashtabula County, and Geauga County, the greatest socioeconomics effects from Perry Plant are likely to be experienced there. The socioeconomic impact analysis is therefore concentrated on these three counties.

Refueling and maintenance outages occur on a 2-year cycle. During the last five refueling outages, which on average lasted 39 days each, there was an average of an additional 1,323 contract employees onsite at Perry Plant (EH 2023-TN9534).

3.10.2 Regional Economic Characteristics

Goods and services are needed to operate Perry Plant. Although then can be procured from a wider region, some portion of these goods and services are purchased directly from within the socioeconomic region of influence (ROI). These transactions sustain existing jobs and maintain income levels in the local economy. This section presents information on employment and income in the Perry Plant socioeconomic ROI.

3.10.2.1 Regional Employment and Income

According to the U.S. Census Bureau's (USCB) 2017–2021 American Community Survey 5-Year Estimates, the educational services, and healthcare and social assistance industry represented the largest employment section in the socioeconomic ROI, followed by manufacturing (USCB 2021-TN9769). The civilian labor force in the three-county ROI was 220,229 persons and the number of individuals employed was 209,207 (USCB 2021-TN9769). Estimated income information for the socioeconomic ROI is presented in Table 3-22. As shown in Table 3-22 people living in the Lake County and Geauga County had a median household income higher than the State average while people living in the Ashtabula County had a median household income under the State average. Additionally, the percentage of individuals living below the poverty level in the Lake County and Geauga County were lower than the percentage of individuals living below the poverty level statewide.

Table 3-22 Estimated Income Information for the Perry Nuclear Power Plant's Socioeconomic Region of Influence, 2017–2021 (5-Year Estimates)

Metric	Ashtabula County	Geauga County	Lake County	Ohio
Median household income (dollars)[(a)]	49,680	90, 285	70,168	61,938
Per capita income (dollars)[(a)]	26,777	45,199	37,586	34,526
Families living below the poverty level (percent)	14.4	3.4	4.4	9.3
People living below the poverty level (percent)	18.9	5.8	7.5	13.4

(a) In 2021 inflation-adjusted dollars.
Source: USCB 2021-TN9769.

3.10.2.2 Unemployment

According to the USCB 2017–2021 American Community Survey 5-Year Estimates, the unemployment rate in Ashtabula County, Geauga County, and Lake County were 7.6, 3.1, and 4.8 percent, respectively. Comparatively, the unemployment rate in the State of Ohio during the same time period was 5.3 percent (USCB 2021-TN9769).

3.10.3 Demographic Characteristics

According to the 2020 Census, an estimated 282,921 people live within a 20 mi (32 km) radius of Perry Plant, which equates to a population density of 225 persons per square mile (persons/mi^2) (87 persons/km^2) (EH 2023-TN9534). This amount translates to a Category 4, "Least sparse" population density using the NRC's LR GEIS (NRC 1996-TN288) measure of sparseness, which is defined as "greater than or equal to 120 persons per square mile within 20 mi [32 km]." An estimated 2,264,642 people live within a 50 mi (80 km) radius of the Perry Plant site, which equates to a population density of 288 persons/mi^2 (111 persons/km^2)(EH 2023-TN9534). This translates to a Category 4 proximity index. Therefore, Perry is in a high population area based on the LR GEIS spareness and proximity matrix (NRC 1996-TN288).

Table 3-23 shows population projections and percent growth from 2000 to 2050 for Ashtabula, Geauga, and Lake counties. During the last 2 decades, while the population in Geauga County and Lake County were increasing at a relatively low rate, the population in Ashtabula County was declining. Based on population projections, the populations in Lake County and Ashtabula County are expected to continue to decline through 2050 if current rates of fertility, mortality, and migration remain unchanged, while the population in Geauga County is expected to increase slowly.

The 2020 Census demographic profile of the Perry Plant ROI population is presented in Table 3-24 (USCB 2020-TN9803). According to the 2020 Census, minorities (race and ethnicity combined) comprised approximately 13 percent of the total population for the ROI. The largest minority population in the ROI were Hispanic or Latino population (4.1 percent of the total population; 32 percent of the total minority population). According to both the USCB's 2020 Census and 2010 Census (USCB 2010-TN9804), since 2010, minority populations in the three-county ROI were estimated to have increased by approximately 21,442 persons. The largest changes occurred in the population of people who identify themselves as white alone (and not Hispanic or Latino) and two or more races (not Hispanic or Latino). Since 2010, the white alone (and not Hispanic or Latino) population reduced by more than 20,000 (approximately 5 percent), while the two or more races population grew by more than 11,000 persons (200 percent).

Table 3-23 Population and Percent Growth in Perry Nuclear Power Plant's Three-County Socioeconomic Region of Influence

Metric	Year	Ashtabula County Population	Ashtabula County Percent Change	Geauga County Population	Geauga County Percent Change	Lake County Population	Lake County Percent Change	ROI Population	ROI Percent Change
Recorded	2000	102,728	-	90,895	-	227,511	-	421,134	-
Recorded	2010	101,497	-1.2%	93,389	2.7%	230,041	1.1%	424,927	0.9%
Recorded	2020	97,574	-3.9%	95,397	2.2%	232,603	1.1%	425,574	0.2%
Projected	2030	93,604	-4.1%	96,327	1.0%	226,501	-2.6%	416,432	-2.1%
Projected	2040	89,364	-4.5%	99,966	3.8%	215,440	-4.9%	404,770	-2.8%
Projected	2050	85,569	-4.2%	102,664	2.7%	201,932	-6.3%	390,165	-3.6%

ROI = region of influence.
"-" denotes no entry in table cell.
Sources: 2000 data from USCB 2000-TN9802, 2010 data from USCB 2010-TN9804, 2020 data from USCB 2020-TN9803, 2030–2050 projected data from ODOD 2022-TN9764.

Table 3-24 Demographic Profile of the Population in the Perry Nuclear Power Plant Region of Influence in 2020

Demographic	Ashtabula County	Geauga County	Lake County	Region of Influence
Total Population	97,574	95,397	232,603	425,574
Percent White race	86.2	93.3	84.7	87.0
Percent Black or African American race	3.6	1.1	4.6	3.6
Percent American Indian and Alaska Native race	0.2	0.04	0.1	0.1
Percent Asian race	0.3	0.7	1.4	1.0
Percent Native Hawaiian and other Pacific Islander race	0.01	0.01	0.02	0.01
Percent some other race	0.3	0.2	0.3	0.3
Percent two or more races	4.9	2.9	4.0	3.9
Hispanic, Latino, or Spanish Ethnicity of any race (total population)	4,489	1,664	11,362	17,515
Percent Hispanic, Latino, or Spanish Ethnicity of any race of total population	4.6	1.7	4.9	4.1
Total minority	13,510	6,439	35,534	55,483
Percent of total population	13.8	6.7	15.3	13.0

Source: USCB 2020-TN9803: Table P2.

3.10.3.1 Transient Population

Ashtabula County, Geauga County, and Lake County can experience seasonal transient population growth as a result of local tourism, recreational activities, or college and university attendance. For instance, Lake County sees nearly 3.5 million visitors annually at its 38 parks, more than 60 mi (97 km) of trails, and recreational facilities (LM 2024-TN9607). A transient population creates a demand for temporary housing and services in the area. Based on the Census Bureau's 2017–2021 American Community Survey 5-Year Estimates (USCB 2021-TN9805), 4,512 seasonal housing units are located in the three-county socioeconomic ROI.

3.10.3.2 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 in another area, and some may follow the harvesting of crops, particularly fruit and vegetables, throughout rural areas of the United States. Migrant workers may also be members of minority or low-income populations.

Since 2002, the Census of Agriculture reports the number of farms hiring migrant workers which are defined as a farm worker whose employment required travel that prevented the worker from returning to their permanent place of residence the same day (USDA 2019-TN9770). The Census of Agriculture is conducted every 5 years and results in a comprehensive compilation of agricultural production data for every county in the Nation.

Information about both migrant and temporary farm labor (i.e., working fewer than 150 days) can be found in the 2017 Census of Agriculture. Table 3-25 presents information on migrant and temporary farm labor in Ashtabula, Geauga, and Lake counties. According to the 2017 Census of Agriculture, 1,897 farm workers were hired to work for fewer than 150 days and were employed on 480 farms in the three-county ROI. However, only 26 farms in the three-county ROI reported hiring migrant workers.

Table 3-25 Migrant Farm Workers and Temporary Farm Labor in Perry Power Nuclear Plant Region of Influence

County	Number of Farms with Hired Farm Labor[(a)]	Number of Farms Hiring Workers for Less Than 150 days[(a)]	Number of Farm Workers Working for Less Than 150 days[(a)]	Number of Farms Reporting Migrant Farm Labor[(a)]
Total	597	480	1,897	26
Ashtabula	292	251	643	1
Geauga	221	159	560	8
Lake	84	70	694	17

(a) Source: Table 7. Hired farm Labor—Workers and Payroll: 2017 (USDA 2019-TN9770).

3.10.4 Housing and Community Services

This section presents information on housing and local public services, including education and water supply.

3.10.4.1 Housing

Table 3-26 lists the total number of occupied and vacant housing units, vacancy rates, and median values in the three-county ROI. Based on the USCB's 2017–2021 American Community Survey 5-year estimates, there were 188,541 housing units in the ROI, of which 171,798 were occupied. The median values of owner-occupied housing units in the ROI range from $121,100 in Ashtabula County to $259,900 in Geauga County. The homeowner vacancy rate was approximately 1.6 percent in Ashtabula County, 0.7 percent in Geauga County and 0.8 percent in Lake County (USCB 2021-TN9806).

Table 3-26 Housing in the Perry Power Nuclear Plant Region of Influence, 2017–2021

Housing Characteristic	Ashtabula County	Geauga County	Lake County	Region of Influence
Total housing units	46,206	37,334	105,001	188,541
Occupied housing units	38,332	35,249	98,217	171,798
Total vacant housing units	7,874	2,085	6,784	16,743
Percent total vacant	17	5.6	6.5	8.9
Owner-occupied units	27,437	30,738	73,148	131,323
Median value (dollars)	121,100	259,900	166,200	178,709[a]
Owner vacancy rate (percent)	1.6	0.7	0.8	1.0[b]
Renter-occupied units	10,895	4,511	25,069	40,475
Median rent (dollars/month)	735	895	952	889[c]
Rental vacancy rate (percent)	4.4	0.9	4.1	3.5[b]

(a) Weighted average by owner-occupied units in Ashtabula, Geauga, and Lake Counties.
(b) Weighted average by total housing units in Ashtabula, Geauga, and Lake Counties.
(c) Weighted average by occupied units paying rent in Ashtabula, Geauga, and Lake Counties.
Source: USCB 2021-TN9806.

3.10.4.2 Education

As of the 2022–2023 school year, Lake County featured 13 public school districts with 29,436 students and 63 schools. Mentor Exempted Village is the largest district by student population with 13 schools and 7,429 students, though Perry Local is the closest school district to the Perry Plant and directly benefits from property tax payments. Perry Local consists of 4 schools serving 1,471 students (NCES 2022-TN9813). Ashtabula County has 9 public school districts, which comprises 34 public schools with approximately 12,752 students for the 2022–2023 school year (NCES 2022-TN9814). Geauga County has 5 public school districts with 20 public schools and 9,541 students during the 2022–2023 school year (NCES 2022-TN9815).

3.10.4.3 Public Water Supply

Lake County provides all water services to residents who do not have individual onsite wells. The water is sourced from Lake Erie and the distribution system is divided into two districts: the East and West sub-districts, with a total design capacity of 29 MGD. The Lake County General Health District estimates about half of the homes in Lake County have private well water, particularly in rural areas (EH 2023-TN9534).

Lake County’s Sanitary Sewer Division is responsible for wastewater treatment at six plants. The Gary L. Kron Water Reclamation Facility, located in Mentor, Ohio serves the central portion of the county, and the Madison Wastewater Treatment Facility, located in Madison, Ohio serves most of the eastern portion of the county. The two facilities have a combined design capacity of 25 MGD and discharge their effluent to Lake Erie, whereas the four remaining fully automated package plants serve smaller subdivisions and discharge their effluent to various nearby creeks and rivers (EH 2023-TN9534). Lake County is estimated to have around 15,000 private home sewage treatment systems in total. Ohio residents with septic systems must follow the Ohio Administrative Code 3701-29-09(I) and participate in local operation and maintenance program. To date about one-third of Lake County systems have been phased into the program. All remaining systems are scheduled for enrollment by 2025 (EH 2023-TN9534).

The Perry Plant's domestic water supply is mainly from the Lake County Department of Utilities. The Perry Plant does not treat sanitary wastewater onsite but relies on public wastewater treatment facilities for disposal (EH 2023-TN9534).

3.10.5 Tax Revenues

VistraOps provides annual property tax payments to Lake County, which then distributes the payment to various county tax jurisdictions on behalf of the Perry Plant. The largest of these tax payments is distributed to Perry Local School District and Lake County itself. Other notable recipients include Perry Township, North Perry Corporation, Auburn Joint Vocational School District, Lakeland Community College, Metropolitan Park District, Lake County Financing District, Perry Township Library District, and Perry Joint Fire District. The Lake County Appraisal Department conducts the property appraisals which in turn determine the tax payments (EH 2023-TN9534).

Table 3-27 presents total annual property tax payments to Lake County and its tax jurisdictions for the years 2017 through 2021, as well as an evaluation of the Perry Plant property tax as a percent of Lake County's total revenues (EH 2023-TN9534). The Perry Plant total annual property tax payment to tax jurisdictions in 2021 was $ 7,705,161.90, of which 52 percent was paid to Perry Local School District, 13 percent was paid to Lake County. VistraOps' annual property tax payments for the Perry Plant have remained consistent over the last 4 years, representing between 1.8 and 1.9 percent of them Lake County total revenue. Currently, no substantial future tax payment changes are expected.

In 2021, Energy Harbor (now VistraOps) also contributed $620,940 in support of emergency planning to Geauga County, Ashtabula County Emergency Management Agency, Ashtabula County Radiological Emergency Preparedness Plan, Lake County Emergency Management Agency, and Lake County Health (EH 2023-TN9534).

Table 3-27 Perry Nuclear Power Plant Total Property Tax Payments, 2017–2021

Parameter	2017	2018	2019	2020	2021
Lake County Revenues	380,646,848	399,444,648	397,161,814	409,124,112	423,391,184
Perry Plant property tax payment	11,027,443	7,375,057	7,398,981	7,663,732	7,705,162
Perry Plant Proportion of total county revenue	2.9%	1.8%	1.9%	1.9%	1.8%

Source: EH 2023-TN9534.

3.10.6 Local Transportation

Transportation in the Perry Plant region includes a rural and urbanized road network, plus rail and air travel. I-90 moves traffic between Cleveland, Ohio and Buffalo, New York and provides commuter access to the plant from communities in the region. US 20/N. Ridge Road, which is south of the Perry Plant, is a four-lane paved highway which traverses the cities and villages located along the shoreline of Lake Erie, routing local and commuter traffic to the Perry Plant entrance road. Parmly Road and Center Road are paved two-lane local streets from US 20/N. Ridge Road, providing access to the plant itself (EH 2023-TN9534).

Table 3-28 shows the average annual daily traffic volumes for US 20/N. Ridge Road between 2011 and 2021. As shown in Table 3-28, traffic volume counts on US 20/N. Ridge Road, west of the intersection with Center Road have been on the rise since 2016, whereas traffic volume counts on US 20/N. Ridge Road east of the intersection with Parmly Road have stayed consistent (ODOT 2023-TN9807).

Table 3-28 Total Average Annual Daily Traffic Counts on US 20/N. Ridge Road

Roadway and Location	Annual Average Daily Traffic Volume Estimates for 2011	Annual Average Daily Traffic Volume Estimates for 2016	Annual Average Daily Traffic Volume Estimates for 2021
US 20/N. Ridge Rd, West of Center Rd	14,760	12,691	21,439
US 20/N. Ridge Rd, East of Parmly Rd	15,400	15,675	15,538

Ohio's statewide transportation improvement programs for 2021–2024 has listed highway projects for Lake County. One identified statewide transportation improvement programs project located within Perry Township is described as a major rehabilitation of US 20/N. Ridge Road involving minor widening and drainage replacement (ODOT 2022-TN9922).

3.10.7 Proposed Action

As described in the 2013 LR GEIS (NRC 2013-TN2654), for generic issues related to socioeconomics, the impacts of LR on socioeconomic issues would be SMALL. No new or significant information was identified for these issues. Socioeconomic effects of ongoing reactor operations at the Perry Plant have become well established as regional socioeconomic conditions have adjusted to the presence of the nuclear power plant. Changes in employment and tax revenue could affect the availability of community services and housing, as well as traffic on roads near the nuclear power plant.

VistraOps indicated in its ER that there are no LR-related refurbishment activities, and that VistraOps has no plans to add additional permanent employees to support plant operations during the proposed renewal term (EH 2023-TN9534). There are also no plans to add additional permanent operation staff to support surveillance, monitoring, inspections, testing, trending, and recordkeeping activities during the proposed renewal term (EH 2023-TN9534). Consequently, people living near the Perry Plant would not experience any changes in socioeconomic conditions during the LR term beyond what is currently being experienced. Therefore, the impact of continued reactor operations during the renewal term would not exceed the socioeconomic impacts predicted in the 2013 LR GEIS.

3.10.8 No-Action Alternative

3.10.8.1 Socioeconomics

Under the no-action alternative, the NRC would not renew the operating license, and Perry Plant would shut down on or before the expiration of the current operating license. This would have a noticeable impact on socioeconomic conditions in the counties and communities near Perry. The loss of jobs, income, and tax revenue would have an immediate socioeconomic impact. As jobs are eliminated, some, but not all of the approximately 650 workers could leave the region. Income from the buying and selling goods and services needed to maintain the nuclear power plant would also be reduced. In addition, loss of tax revenue could affect the availability of public services.

If Perry Plant workers and their families move out of the region, increased vacancies and reduced demand for housing would likely cause housing prices to fall. The greatest socioeconomic impact would be experienced in the communities located nearest to Perry Plant, in Ashtabula, Geauga, and Lake counties. However, the loss of jobs, income, and tax revenue, may not be as noticeable in larger communities due to the time and steps required to prepare the nuclear plant for decommissioning. Therefore, depending on the jurisdiction, socioeconomic impacts from not renewing the operating license and terminating reactor operations at Perry Plant (no-action alternative) could range from SMALL to MODERATE.

3.10.8.2 Transportation

Traffic volume on roads near Perry Plant may be noticeably reduced after the termination of reactor operations. Any reduction in traffic volume would coincide with workforce reductions at Perry Plant. Similarly, truck deliveries and shipments would also be reduced until active decommissioning. Therefore, due to the time and steps required to prepare the nuclear power plant for decommissioning, traffic-related transportation impacts would be SMALL.

3.10.9 Replacement Power Alternatives

Workforce requirements for replacement power alternatives were evaluated to measure their possible effects on current socioeconomic and transportation conditions. Table 3-29 summarizes socioeconomic and transportation impacts of replacement power alternatives. The following provides a discussion of the common socioeconomic and transportation impacts during construction and operations of replacement power-generating facilities.

Table 3-29 Socioeconomic and Transportation Impacts of Replacement Power Alternatives at Perry Nuclear Power Plant

Alternative	Resource Requirements	Impacts	Discussion
NGCC	Construction: peak 1,200 workers for several months	MODERATE to LARGE	If all combined-cycle combustion turbines are constructed/installed at the same time. Some operations workers could transfer from Perry. Noticeable traffic volume impacts on local roads during construction.
NGCC	Operations: 150 workers	SMALL to MODERATE	If all combined-cycle combustion turbines are constructed/installed at the same time. Some operations workers could transfer from Perry.
Combination, NGCC, Solar, and Wind	Construction: peak 800 (NGCC), 500 (Solar), and 330 (Wind) workers for several months	SMALL to MODERATE	Workers would likely be scattered throughout the region and would not likely have a noticeable effect on local economy. Traffic volume impacts on local roads may be noticeable during construction.
Combination, NGCC, Solar, and Wind	Operations: 100 (NGCC), 60 (Solar), and 35 (Wind) workers	SMALL to MODERATE	Workers would likely be scattered throughout the region and would not likely have a noticeable effect on local economy.

NGCC = natural gas-fired combined-cycle.
Source: NRC 2019-TN6824, DOE 2011-TN8387, BLM 2019-TN8386, Tegen 2016-TN8826.

3.10.9.1 Socioeconomics

Socioeconomic impacts are defined in terms of changes in the social and economic conditions of a region. For example, the creation of jobs and the purchase of goods and services during the construction and operation of a replacement power plant could affect regional employment, income, and tax revenue. For each alternative, two types of jobs would be created: (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.

While the selection of a replacement power alternative could create opportunities for employment and income and generate tax revenue in the local economy, employment, income, and tax revenue would be greatly reduced or eliminated in communities near Perry Plant. These impacts on the communities near the Perry Plant are described in the "No-Action Alternative" (Section 3.10.8). The following provides a discussion of the common socioeconomic and transportation impacts on the communities near replacement power plants during the construction and operations of these alternatives.

<u>Construction</u>

During construction of a replacement power plant, the relative economic effect of an influx of workers on the local economy and tax revenue would vary and depend on the size of the workforce and construction completion time. The greatest impact would occur in the communities where the majority of construction workers would reside and spend their income. As a result, some communities could experience a short-term economic boom during construction from increased tax revenue and income generated by expenditures for goods and services and increased demand for temporary (rental) housing. After construction, local communities would likely experience a return to preconstruction economic conditions.

<u>Operation</u>

Before the commencement of startup and operations at a replacement power plant, local communities would see an influx of operations workers and their families and increased demand for permanent housing and public services. These communities would also experience the economic benefits from increased income and tax revenue generated by the purchase of goods and services needed to operate a new replacement power plant. Consequently, when compared to construction, power plant operations would have a greater potential for effecting permanent, long-term socioeconomic impacts on the region.

3.10.9.2 Transportation

Transportation impacts are defined in terms of changes in level-of-service conditions on local roads near the replacement power plant. Additional vehicles during construction and operations could lead to traffic congestion, level-of-service impacts, and delays at intersections.

<u>Construction</u>

Transportation impacts would consist of commuting workers and truck deliveries of equipment and material to the construction site. Traffic volumes would increase during shift changes. In addition, trucks would deliver equipment and material to the construction site and remove waste material, thus increasing the amount of traffic on local roads. The increase in traffic volumes could result in levels of service impacts and delays at intersections during certain hours of the day. In some instances, construction material could also be delivered and removed by rail or barge.

Operation

Traffic-related transportation impacts on local roads would be greatly reduced after construction has been completed. Transportation impacts would include daily commuting by the operations workforce and deliveries of material, and the removal of commercial waste material.

3.11 Human Health

Perry Plant is both an industrial facility and a nuclear power plant. Similar to any industrial facility or nuclear power plant, the operation of Perry Plant during the LR period will produce various human health risks for workers and members of the public. This section describes the human health risks resulting from the operation of Perry Plant, including those related to radiological exposure, chemical hazards, microbiological hazards, electromagnetic fields, and other hazards. The description of these risks is followed by the NRC staff's analysis of the potential impacts on human health of the proposed action of LR and the alternatives to the proposed action.

3.11.1 Radiological Exposure and Risk

Operation of a nuclear power plant involves the use of nuclear fuel to generate electricity. Through the fission process, the nuclear reactor splits uranium atoms, resulting very generally in (1) the production of heat, which is then used to produce steam to drive the nuclear power plant's turbines and generate electricity; and (2) the creation of radioactive byproducts. As required by NRC regulations at 10 CFR 20.1101 (TN283), "Radiation protection programs," VistraOps designed a radiation protection program to protect onsite personnel (including employees and contractor employees), visitors, and offsite members of the public from radiation and radioactive material at Perry Plant. The Perry Plant radiation protection program is extensive and includes, but is not limited to, the following:

- organization and administration (e.g., a radiation protection manager who is responsible for the program and ensures trained and qualified workers for the program)
- implementing procedures
- an as low as reasonably achievable (ALARA) program to minimize radiation dose to workers and members of the public
- dosimetry program (i.e., measure radiation dose to nuclear power plant workers)
- radiological controls (e.g., protective clothing, shielding, filters, respiratory equipment, and individual work permits with specific radiological requirements)
- radiation area entry and exit controls (e.g., locked or barricaded doors, interlocks, local and remote alarms, personnel contamination monitoring stations)
- posting of radiation hazards (i.e., signs and notices alerting nuclear power plant personnel of potential hazards)
- recordkeeping and reporting (e.g., documentation of worker dose and radiation survey data)

- radiation safety training (e.g., classroom training and use of mockups to simulate complex work assignments)
- radioactive effluent monitoring management (i.e., controlling and monitoring radioactive liquid and gaseous effluents released into the environment)
- radioactive environmental monitoring (e.g., sampling and analysis of environmental media, such air, water, groundwater, milk, food products, and sediment to measure the levels of radiation emitted into the environment that may impact human health)
- radiological waste management (i.e., controlling, monitoring, processing, and disposing of radioactive solid waste)

For radiation exposure to Perry Plant personnel, the NRC staff reviewed the data contained in NUREG-0713, Volume 43, Occupational Radiation Exposure at Commercial Nuclear Power Reactors and other Facilities 2021: Fifty-Fourth Annual Report (NRC 2024-TN9915). The Fifty-Fourth Annual Report was the most recent annual report available at the time of this environmental review. It summarizes the occupational exposure data in the NRC's Radiation Exposure Information and Reporting System database through 2021. Nuclear power plants are required by 10 CFR 20.2206 (TN283), "Reports of individual monitoring," to report their occupational exposure data to the NRC annually.

NUREG-0713 contains a calculation of a 3-year average collective dose per reactor for workers at all nuclear power reactors licensed by the NRC. The 3-year average collective dose is one of the metrics that the NRC uses in the Reactor Oversight Process to evaluate the applicant's ALARA program. Collective dose is the sum of the individual doses received by workers at a facility licensed to use radioactive material during a 1-year time period. There are no NRC or EPA standards for collective dose. Based on the data for operating boiling water reactors like the unit at Perry Plant, the average annual collective dose per reactor year was 104-person roentgen equivalent man (rem) (NRC 2024-TN9915). In comparison, Perry Plant had a reported annual collective dose per reactor year of 197 person-rem. As discussed in depth during the virtual and in-person audits with Perry Plant in January 2024, Perry Plant is a BWR-6 GE design with smaller diameter recirculation piping than comparable BWR 2-4 designs resulting in higher corrosion rates and source term transport in the recirculation system. The heater drain system is a forward pumped design resulting in approximately one-third of the total feedwater flow diverted forward to the reactor vessel without the benefit of condensate filtration/demineralization. Perry Plant has a higher-than-average TEDE per worker than the BWR industry average due to a generally higher source term based on plant design, past equipment reliability issues, and the lower number of workers with measurable TEDE onsite. This causes the average TEDE per worker at Perry Plant (0.231 rem) to consequently be higher than the BWR industry average (0.118 rem) (NRC 2024-TN9915). However, this average TEDE is still well below regulatory limit for worker occupational dose of 5 rem (10 CFR Part 20-TN283). In addition, when compared with similarly designed BWR plants, the average collective dose is comparable. Perry Plant continues to maintain a focus on exposure and source term reduction. There are no plans to change the ALARA program during the LR term, but Perry Plant plans to continue to implement strategies for dose reduction along with ALARA program reviews and periodic assessments for good radiation worker practices.

Section 3.13.1, "Radioactive Waste," of this SEIS discusses offsite dose to members of the public.

3.11.2 Chemical Hazards

State and Federal environmental agencies regulate the use, storage, and discharge of chemicals, biocides, and sanitary wastes. Such environmental agencies also regulate how facilities like Perry Plant manage minor chemical spills. Chemical and hazardous wastes can potentially affect workers, members of the public, and the environment.

VistraOps currently controls the use, storage, and discharge of chemicals and sanitary wastes at Perry Plant in accordance with its pollution prevention plan and associated procedures, waste management procedures, and Perry Plant site-specific chemical accident prevention provisions. VistraOps monitors and controls discharges of chemical and sanitary wastes through Perry Plant's NPDES permit process, discussed in Section 3.5.1.3, "Surface Water Quality and Effluents." These plant procedures, plans, and processes are designed to prevent and minimize the potential for a chemical or hazardous waste release and, in the event of such a release, minimize the impact on workers, members of the public, and the environment.

3.11.3 Microbiological Hazards

Microbiological hazards occur when workers or members of the public come into contact with disease-causing microorganisms, also known as etiological agents. Thermal effluents associated with nuclear power plants that discharge to a lake, such as Perry Plant, have the potential to promote the growth of certain thermophilic microorganisms linked to adverse human health effects. Microorganisms of particular concern include several types of bacteria and the free-living amoeba *Naegleria fowleri* (*N. fowleri*). There are optimum growth temperatures for the microorganisms of concern as further discussed in the 2013 LR GEIS (NRC 2013-TN2654).

As discussed in Section 2.2.3 of the VistraOps ER (EH 2023-TN9534), Perry Plant utilizes a closed-cycle cooling system including a natural draft cooling tower to remove thermal energy. Water is withdrawn from Lake Erie via an intake tunnel and returned to the lake after completing the cooling cycle through the discharge tunnel located at the bottom of the lake. Liquid biocides are used, as required, to minimize algae and plant growth. Sample points in the discharge piping determine biocide concentrations to ensure water quality is maintaining in accordance with Perry Plant's NPDES permit.

The public can be exposed to the thermophilic microorganisms during swimming, boating, or other recreational uses of freshwater. If these organisms are naturally occurring and a nuclear power plant's thermal effluent enhances their growth, the public could experience an elevated risk of infection when recreating in the affected waters. Public exposure to *Legionella* from nuclear power plant operation is generally not a concern because exposure risk is confined to cooling towers and related components and equipment, which are typically within the protected area of the site and, therefore, not accessible to the public.

In addition, algal blooms have become more prevalent during the last few years. Some of these blooms are due to cyanobacteria that could produce toxins, also termed harmful algal blooms. These harmful algal blooms can impact recreational activities in lakes and rivers. The State of Ohio monitors and samples for cyanobacterial blooms and is responsible for posting advisories when necessary (OEPA 2024-TN9916). The location of Perry Plant is along an area of the Lake Erie coastline with a low potential for these harmful algal blooms (EH 2023-TN9534).

Nuclear power plant workers can be exposed to *Legionella* when performing maintenance in cooling towers and on condenser tubes through inhalation of cooling tower vapors because these vapors are often within the optimum temperature range for *Legionella* growth. Perry Plant has an industrial safety program that includes procedures for entry to cooling water systems where occurrence of *Legionella* is possible. Additional monitoring and precautions, including sampling for *Legionella* and respiratory protection, as appropriate, for work in these areas is part of the industrial safety program (EH 2023-TN9534).

3.11.4 Electromagnetic Fields

EMFs are generated by any electrical equipment. All nuclear power plants have electrical equipment and power transmission systems associated with them. Power transmission systems consist of switching stations (or substations) located on the nuclear power plant site and the transmission lines needed to connect the plant to the regional electrical distribution grid. Transmission lines operate at a frequency of 60 hertz (Hz) (60 cycles per second), which is low compared to the frequencies of 55 to 890 MHz for television transmitters and 1,000 MHz and greater for microwaves.

The scope of the evaluation of transmission lines includes only those transmission lines that connect the plant to the switchyard where electricity is fed into the regional power distribution system (encompassing those lines that connect the plant to the first substation of the regional electric power grid) and power lines that feed the plant from the grid are considered within the regulatory scope of the LR environmental review. Transmission lines in scope are confined to the Perry Plant site, spanning the short distance between the generating units and the switchyards, as depicted in Figure 2.2-2 of VistraOps' ER (EH 2023-TN9534).

Electric fields are produced by voltage and their strength increases with increase in the voltage. A magnetic field is produced from the flow of current through wires or electrical devices, and its strength increases as the current increases. Electric and magnetic fields, collectively referred to as EMFs, are produced by operating transmission lines.

Occupational workers or members of the public near transmission lines may be exposed to the EMFs produced by the transmission lines. The EMF varies in time as the current and voltage change, so that the frequency of the EMF is the same (e.g., 60 Hz for standard alternating current). Electrical fields can be shielded by objects such as trees, buildings, and vehicles. Magnetic fields, however, penetrate most materials, but their strength decreases with increasing distance from the source. The EMFs resulting from 60 Hz power transmission lines fall under the category of non-ionizing radiation. The LR GEIS (NRC 2013-TN2654) summarizes NRC accepted studies on the health effects of electromagnetic fields. There are no U.S. Federal standards limiting residential or occupational exposure to EMFs from transmission power lines, but some States have set electric field and magnetic field standards for transmission lines (NIEHS 2002-TN6560). A voluntary occupational standard has been set for EMFs by the International Commission on Non-Ionizing Radiation Protection (ICNIRP 1998-TN6591). The National Institute for Occupational Safety and Health does not consider EMFs to be a proven health hazard (NIOSH 1996-TN6766).

3.11.5 Other Hazards

This section addresses two additional human health hazards: (1) physical occupational hazards and (2) occupational electric shock hazards.

Nuclear power plants are industrial facilities that have many of the typical occupational hazards found at any other electric power-generation utility. Nuclear power plant workers may perform electrical work, electric powerline maintenance, repair work, and maintenance activities and may be exposed to potentially hazardous physical conditions. A physical hazard is an action, agent, or condition that can cause harm upon contact. Physical actions could include slips, trips, and falls from height. Physical agents could include noise, vibration, and ionizing radiation. Physical conditions could include high heat, cold, pressure, confined space, or psychosocial issues, such as work-related stress.

The Occupational Safety and Health Administration (OSHA) is responsible for developing and enforcing workplace safety regulations. Congress created OSHA by enacting the Occupational Safety and Health Act of 1970, as amended (TN4453) to safeguard the health of workers. With specific regard to nuclear power plants, plant conditions that result in an occupational risk, but do not affect the safety of licensed radioactive materials, are under the statutory authority of OSHA rather than the NRC, as set forth in a memorandum of understanding (NRC 2013-TN10165) between the NRC and OSHA. Occupational hazards are reduced when workers adhere to safety standards and use appropriate protective equipment; however, fatalities and injuries from accidents may still occur. Perry Plant maintains an industrial safety program for its workers in accordance with OSHA regulations (EH 2023-TN9534).

Based on its evaluation in the 2013 LR GEIS (NRC 2013-TN2654), the NRC has not found electric shock resulting from direct access to energized conductors or from induced charges in metallic structures to be a problem at most operating plants. Generally, the NRC staff also does not expect electric shock from such sources to be a human health hazard during the LR period. However, a 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. Transmission lines that are within the scope of the NRC's LR environmental review are limited to (1) those transmission lines that connect the nuclear plant to the substation where electricity is fed into the regional distribution system, and (2) those transmission lines that supply power to the nuclear plant from the grid (NRC 2013-TN2654).

As discussed in Section 2.1.6.5, "Power Transmission Systems," of this SEIS, all in-scope transmission lines are located within the Perry Plant site boundary. Specifically, there are two transmission corridors that encompass the in-scope transmission lines. These transmission corridors include the lines to the Perry Plant Unit 1 and Unit 2 startup transformers and the line to main transformer spanning between the switchyard and the power block. Given that all lines are located completely within Perry Plant's protected area boundary and controlled by VistraOps, the public does not have access to this area and, therefore, there is no potential shock hazard to offsite members of the public from these onsite transmission lines. The transmission corridors comply with the National Electrical Safety Code clearance standards and therefore the site documents evaluations of changes that would potentially affect the electrical shock hazard of the in-scope transmission lines per their procedures. Perry Plant maintains an industrial safety program and electrical safety program, which includes protection from acute electrical shock and is conducted in accordance with OSHA regulations.

3.11.6 Proposed Action

According to the LR GEIS (NRC 2013-TN2654), the generic issues related to human health as identified in Table 3-1 would have SMALL impacts resulting from LR. The NRC staff identified no new and significant information about these issues. Thus, as concluded in the LR GEIS, the impacts of the generic issues related to human health would be SMALL.

Table 3-2 identifies one uncategorized issue (chronic exposure to EMFs) and two site-specific (Category 2) issues (electric shock hazards and microbiological hazards to the public) related to human health applicable to Perry Plant LR. These issues are analyzed below.

3.11.6.1 Microbiological Hazards to the Public

In the 2013 LR GEIS (NRC 2013-TN2654), the NRC staff determined that effects of thermophilic microorganisms on the public for nuclear power plants using cooling ponds, lakes, or canals or cooling towers that discharge to a river is a Category 2 issue that requires site-specific evaluation during each LR review.

The thermophilic microorganism *N. fowleri* can pose public health concerns in recreational use waters when these organisms are present in high enough concentrations to cause infection. During the review for the power uprate at Perry Plant that was performed in 2000, the NRC staff considered the projected temperature increase and evaluated the impact of the power uprate. The NRC subsequently issued a Finding of No Significant Impact (65 FR 26858-TN9917). The daily maximum temperature at the discharge canal would remain within the NPDES discharge limits and well below the optimal growth rate temperature for thermophilic organisms. During the proposed LR term, the public health risk from *N. fowleri* remains extremely low and the proposed action would not result in operational changes that would affect thermal effluent temperature or otherwise create favorable conditions. The NRC staff concludes that the impacts of thermophilic microorganisms on the public due to continued nuclear power plant operations at Perry Plant during the LR term would be SMALL because thermal effluent discharges from Perry Plant during the proposed LR term would not contribute to the proliferation of microorganisms of concern in Lake Erie.

3.11.6.2 Uncategorized Issue Related to Human Health: Chronic Effects of Electromagnetic Fields

The LR GEIS (NRC 2013-TN2654) does not designate the chronic effects of 60 Hz EMFs from powerlines as either a Category 1 or 2 issue. Until a scientific consensus is reached about the health implications of EMFs, the NRC will not include them as Category 1 or 2 issues.

The potential for chronic effects from these fields continues to be studied and is not known at this time. The National Institute of Environmental Health Sciences (NIEHS) directs related research through the DOE. The NIEHS report (NIEHS 1999-TN78) 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 noncancer health outcomes provide sufficient evidence of a risk to currently warrant concern.

This statement was not sufficient to cause the NRC to change its position with respect to the chronic effects of EMFs. The NRC staff considers the LR GEIS finding of “UNCERTAIN” still appropriate and will continue to follow developments on this issue.

3.11.6.3 Electric Shock Hazards

Based on the 2013 LR GEIS (NRC 2013-TN2654), the Commission found that electric shock resulting from direct access to energized conductors or from induced charges in metallic structures has not been identified as a problem at most operating plants and generally is not expected to be a problem during the LR term. However, a 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 Perry Plant LR review.

As discussed in Section 3.11.5, “Other Hazards,” there are no offsite transmission lines that are in scope for this SEIS. Therefore, there are no potential impacts on members of the public. The onsite overhead transmission lines with the potential for electric shock to workers through induced currents are depicted in Figure 2.2-2 of the ER. To address this occupational hazard, VistraOps adheres to the National Electrical Safety Code for clearances in these transmission corridors and OSHA compliance requirements for shock hazard avoidance (EH 2023-TN9534, Vistra 2024-TN9925). As discussed in Section 3.11.5, “Other Hazards,” Perry Plant maintains an industrial safety program and an electrical safety program in accordance with OSHA regulations for its workers, which includes protection from acute electric shock. Therefore, the NRC staff concludes that the potential impacts from acute electric shock during the LR term would be SMALL.

3.11.6.4 Environmental Consequences of Postulated Accidents

The 2023 draft LR GEIS (NRC 2023-TN10070) evaluates the following two classes of postulated accidents as they relate to LR:

- design-basis accidents: postulated accidents that a nuclear facility must be designed and built to withstand without loss to the systems, structures, and components necessary to ensure public health and safety
- severe accidents: postulated accidents that are more severe than design-basis accidents because they could result in substantial damage to the reactor core

As shown in Table 3-1, the 2023 draft LR GEIS (NRC 2023-TN10070) addresses design-basis accidents as a Category 1 issue and concludes that the environmental impacts of design-basis accidents are of SMALL significance for all nuclear power plants. Additionally, Table 3-1 designates severe accidents as a Category 1 issue and concludes that the environmental impacts of severe accidents are SMALL. No new and significant information related to design basis accidents or severe accidents was identified during the review of the Perry Plant ER (EH 2023-TN9534), site audit, scoping process, or evaluation of other available information. Therefore, there are no impacts related to these issues beyond those discussed in the 2024 LR GEIS.

The LR GEIS also specifies that the probability-weighted consequences of atmospheric releases, fallout onto open bodies of water, releases to groundwater, and societal and economic impacts from severe accidents are SMALL for all plants. However, alternatives to mitigate severe accidents must be considered for all plants that have not considered such alternatives and would be the functional equivalent of a Category 2 issue requiring plant-specific analysis (NRC 2023-TN10070).

Furthermore, Section 51.53(c)(3)(ii)(L) requires that LR applicants consider alternatives to mitigate severe accidents if the NRC staff has not previously evaluated severe accident mitigation alternatives (SAMAs) for the applicant's plant in an 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 the environmental impact of severe accidents are identified and evaluated. SAMAs have not been previously considered for Perry Plant; therefore, the remainder of this section addresses those alternatives.

Overview of SAMA Process

This section presents a summary of the SAMA evaluation for Perry Plant conducted by VistraOps 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 Perry Plant's ER.

The SAMA evaluation for Perry Plant was conducted with a four-step approach. In the first step VistraOps 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 VistraOps 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. VistraOps initially identified 157 potential SAMAs for Perry Plant. VistraOps performed an initial screening to determine if any SAMAs could be eliminated because they are not applicable to Perry Plant due to design differences, had already been implemented at Perry Plant, or were combined into a more comprehensive or plant-specific SAMA. The remaining unscreened SAMA candidates were grouped into 12 SAMA candidate groups.

In the third step, VistraOps estimated the benefits and the costs associated with each of the 12 SAMAs. Estimates were made of how much each SAMA could reduce risk. Those estimates were developed in terms of dollars in accordance with NRC guidance for performing regulatory analyses (NRC 1997-TN676). The cost of implementing the proposed SAMAs was also estimated.

Finally, in the fourth step, the costs and benefits of each of the remaining SAMAs were compared to determine whether the SAMA was cost beneficial, meaning the benefits of the SAMA were greater than the cost (a positive cost benefit).

Based on the latter two screening criteria, 10 of the SAMA candidate groups were screened out. The remaining two SAMAs, referred to as Phase II SAMAs, were evaluated in Section G.2.4 of Attachment G to the applicant's ER (EH 2023-TN9534). In response to NRC staff request for additional information (Vistra 2024-TN10350), 4 SAMAs were also evaluated as a Phase II SAMAs.

In Phase II, a detailed evaluation was performed for each of these six remaining SAMA candidates. VistraOps concluded in its ER that none of the SAMAs evaluated are potentially cost-beneficial (EH 2023-TN9534; Vistra 2024-TN10350; Vistra 2024-TN10351). However, the NRC staff suggests that three SAMAs to reduce internal flooding risk in the Switchgear Rooms be considered for implementation since they are potentially cost-beneficial after consideration of sensitivity and uncertainty analyses.

The potentially cost-beneficial SAMAs do not relate to adequately managing the effects of aging during the period of extended operation; therefore, the NRC recommends considering them under the current license rather than as part of LR pursuant to 10 CFR Part 54. VistraOps' SAMA analyses and the NRC's review are discussed in more detail below.

Estimate of Risk

VistraOps submitted an assessment of SAMAs for Perry Plant as part of the ER (EH 2023-TN9534). This assessment was based on the most recent revision of the Perry Plant PRA, which is an internal events, including internal flooding, model and a seismic model; plant specific offsite consequence analysis performed using the MELCOR Accident Consequence Code System (WinMACCS) computer program; and insights from the Perry Plant Individual Plant Examination (IPE) (CE 1992-TN10352) and Individual Plant Examination of External Events (IPEEE) (CE 1996-TN10353).

VistraOps combined two distinct analyses to form the basis for the risk estimates used in the SAMA analysis: (1) the Perry Plant Level 1 and 2 PRA model, which is an updated version of the IPE (CE 1992-TN10352), and (2) a supplemental analysis of offsite consequences and economic impacts (essentially a Level 3 PRA model) developed specifically for the SAMA analysis. Other than seismic events, the scope of the models does not include external events.

The Perry Plant core damage frequency (CDF) for internal events is 1.3×10^{-6} per year and for seismic events is 1.5×10^{-5} per year. The breakdown of CDF by initiating event for Perry Plant is provided in Table 3-30 for internal events, including internal flooding, and in Table 3-31 for seismic events. VistraOps used the PRA model for Perry Plant in determining the potential risk reduction benefits of each SAMA. VistraOps accounted for the potential risk reduction benefits associated with external events (e.g., seismic events, fire events) by explicitly developing estimated external events benefits for each SAMA candidate.

VistraOps estimated the dose to the population within 50 mi (80 km) of the Perry Plant site to be approximately 0.171 person-Sievert (Sv) (17.1 person-rem) per year for internal events, including internal flooding, and 2.78 person-SV per year (278 person-rem per year) for seismic events (EH 2023-TN9534). The breakdown of the total population dose and offsite economic cost risk by containment release mode are summarized in Table 3-32 and Table 3-33 for internal events (including internal flooding) and seismic events, respectively. Large, early (L/E) and large, intermediate (L/I) releases are the dominant contributors to population dose risk.

The NRC staff has reviewed VistraOps' 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 CDFs, offsite doses, and offsite economic costs reported by VistraOps.

Potential Plant Improvements

Once the dominant contributors to plant risk were identified, VistraOps searched for ways to reduce that risk. In identifying potential SAMAs, VistraOps considered SAMAs identified in industry documents including the SAMA analyses performed for other operating plants, insights from the plant-specific PRA models, and plant improvements identified in the Perry Plant IPE and IPEEE. VistraOps identified 157 potential risk-reducing improvements (SAMAs) to plant components, systems, procedures, and training.

Table 3-30 Perry Nuclear Power Plant Core Damage Frequency for Internal Events (Including Internal Flooding)

Initiating Event	Core Damage Frequency (CDF) (per reactor-year)	% CDF Contribution
Pipe Breaks (Flood) in Control Complex that Propagates to Switchgear Rooms	4.3×10^{-7}	32
Open Phase Condition on Startup Transformers	1.8×10^{-7}	14
Pipe Breaks (Flood) in Control Complex that Propagates to Auxiliary Building and/or Fuel Handling Building	1.7×10^{-7}	13
Loss of Offsite Power	1.2×10^{-7}	9
Pipe Breaks (Nominal Flood) in Control Complex	1.1×10^{-7}	8
Loss of Power Conversion System	7.5×10^{-8}	6
Pipe Breaks (Major Flood) in Control Complex	7.2×10^{-8}	6
Pipe Breaks (Flood) in Auxiliary Building	4.7×10^{-8}	4
Loss of Bus	3.9×10^{-8}	3
Loss of Feedwater	1.9×10^{-8}	1
Loss of Coolant Accident	1.9×10^{-8}	1
Other Pipe Breaks (Flood) in Control Complex	1.3×10^{-8}	1
Other Initiating Events[(a)]	2.7×10^{-8}	2
Total CDF (Internal Events)	$\mathbf{1.3 \times 10^{-6}}$	**100**

cdf = core damage frequency

(a) Multiple initiating events with each contributing less than 1 percent.

Table 3-31 Perry Nuclear Power Plant Core Damage Frequency for Seismic Events

Initiating Event	Core Damage Frequency (CDF) (per reactor-year)	% CDF Contribution
%G05 (0.5 to 0.6g)	3.5×10^{-6}	24
%G04 (0.4 to 0.5g)	3.0×10^{-6}	20
%G06 (0.6 to 0.7g)	2.2×10^{-6}	15
%G09 (1.0 to 4.0g)	1.9×10^{-6}	13
%G08 (0.8 to 1.0g)	1.6×10^{-6}	11
%G07 (0.7 to 0.8g)	1.4×10^{-6}	10
%G03 (0.25 to 0.4g)	9.9×10^{-7}	7
Other Initiating Events[(1)]	6.5×10^{-8}	<1
Total CDF (Seismic Events)	$\mathbf{1.5 \times 10^{-5}}$	**100**

CDF = core damage frequency.

(a) Multiple initiating events with each contributing less than 1 percent.

Table 3-32 Base Case Mean Population Dose Risk and Offsite Economic Cost Risk for Internal Events at Perry Nuclear Power Plant, Including Internal Flooding

Release Category: ID[(b)]	Release Category: Frequency (per year)	Population Dose Risk: Person-rem/yr[(a)]	Population Dose Risk: % Contribution	Offsite Economic Cost Risk: $/yr	Offsite Economic Cost Risk: % Contribution
BOC	0	0	0	0	0
L/E	1.9×10^{-7}	9.3	54	4.2×10^{4}	55
L/I	3.7×10^{-7}	6.1	35	3.2×10^{4}	42
M/I	6.8×10^{-8}	0.35	2	9.6×10^{2}	1
M/L	0	0	0	0	0
S/E	6.4×10^{-7}	1.3	8	7.2×10^{2}	1
S/I	4.5×10^{-9}	0.013	<1	1.2×10^{1}	<<1
Intact	6.0×10^{-8}	0.11	1	3.7×10^{2}	<1
Total	**1.3×10^{-6}[(c)]**	**17.1[(c)]**	**100[(d)]**	**7.6×10^{4}[(c)]**	**100[(d)]**

BOC = break outside containment; ID = identification; L/E = large/early; L/I = large/intermediate; M/I = medium/intermediate; M/L = medium/late; S/E = small/early; RAI = request for additional information; S/I = small/intermediate.
(a) Unit Conversion Factor: 1 Sv = 100 rem.
(b) Release Category descriptions provided in response to an RAI (Vistra 2024-TN10350).
(c) Sum of contributors may not add up to total due to round off error.
(d) Sum of contributors may not add up to 100 percent due to round off error.

Table 3-33 Base Case Mean Population Dose Risk and Offsite Economic Cost Risk for Seismic Events at Perry Nuclear Power Plant Site

Release Category: ID[(b)]	Release Category: Frequency (per year)	Population Dose Risk: Person-rem/yr[(a)]	Population Dose Risk: % Contribution	Offsite Economic Cost Risk: $/yr	Offsite Economic Cost Risk: % Contribution
BOC	0	0	0	0	0
L/E	5.2×10^{-6}	256	92	1.2×10^{6}	97
L/I	2.2×10^{-7}	3.6	1	1.9×10^{4}	2
M/I	6.4×10^{-8}	0.33	<1	9.0×10^{2}	<1
M/L	0	0	0	0	0
S/E	9.0×10^{-6}	18.6	7	1.0×10^{4}	1
S/I	4.6×10^{-10}	0.0013	<<1	1.0×10^{0}	<<1
Intact	6.4×10^{-8}	0.12	<<1	4.0×10^{2}	<<1
Total	**1.5×10^{-5}[(c)]**	**278[(c)]**	**100[(d)]**	**1.2×10^{6}[(c)]**	**100[(d)]**

BOC = break outside containment; ID = identification; L/E = large/early; L/I = large/intermediate; M/I = medium/intermediate; M/L = medium/late; S/E = small/early; S/I = small/intermediate.
(a) Unit Conversion Factor: 1 Sv = 100 rem.
(b) Release Category descriptions provided in response to an RAI (Vistra 2024-TN10350).
(c) Sum of contributors may not add up to Total due to round off error.
(d) Sum of contributors may not add up to 100 percent due to round off error.

In evaluating potential SAMAs, VistraOps performed a qualitative screening and eliminated many SAMAs from further consideration because they are not applicable to Perry Plant due to design differences, because they had already been implemented at Perry Plant, or because they were similar in nature or could be combined with another SAMA. The remaining unscreened SAMA candidates were grouped into 12 SAMA candidate groups. Six of these SAMA candidates were screened out if the SAMA had an excessive implementation cost or if the SAMA was expected to have a very low benefit. A detailed cost-benefit analysis was performed for each of the six remaining SAMAs. In response to NRC staff inquiries, VistraOps identified and performed a cost-benefit analysis for two additional SAMA candidates to reduce fire risk.

The NRC staff concludes that VistraOps used a systematic and comprehensive process for identifying potential plant improvements for Perry Plant, and that the set of SAMAs evaluated in the ER, together with those evaluated in response to NRC staff inquiries, is reasonably comprehensive and, therefore, acceptable.

Evaluation of Risk Reduction and Costs of Improvements

VistraOps evaluated the risk reduction potential of the eight candidate SAMAs. The SAMA evaluations were performed using generally conservative assumptions. VistraOps used PRA model re-quantification to determine the potential benefits for each SAMA, except for determining the benefit of reducing the risk of fire events. The CDF, population dose, and offsite economic cost reductions for internal events, including internal flooding, were estimated using the Perry Plant PRA models (EH 2023-TN9534). For the two internal fire-related SAMAs, VistraOps used the IPEEE fire analysis results to estimate the reduction in CDF. The reduction in population dose and offsite economic cost for these two SAMAs was then calculated by multiplying the fire CDF reduction by the estimated population dose and offsite economic cost for the respective release categories. The IPEEE fire analysis results were also used to develop an estimate of the reduction in fire risk for other SAMAs that impact fire risk.

The NRC staff reviewed VistraOps assumptions used to evaluate the benefit or risk reduction estimate for each of the plant improvements and concludes that the rationale and assumptions for estimating risk reduction are sufficient and appropriate for use in the SAMA evaluation because they are technically sufficient and meets the guidance provided in NEI 05-01A (NEI 2005-TN1978).

VistraOps estimated the costs of implementing each of the candidate SAMAs through the development of Perry Plant-specific cost estimates. The cost estimates conservatively did not account for the cost of replacement power during extended outages if required to implement the modifications, nor did the cost estimates include contingency costs associated with unforeseen implementation obstacles.

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 licensees’ analyses of SAMAs for operating reactors. The NRC staff also reviewed the basis for the cost estimates during the NRC audit of the SAMA analysis (NRC 2024-TN10378). The NRC staff concludes that the cost estimates provided by VistraOps are sufficient and appropriate for use in the SAMA evaluation.

Cost-Benefit Comparison

The cost benefit analysis performed by VistraOps was based primarily on NUREG/BR-0184 (NRC 1997-TN676) and was executed consistent with this guidance. NEI 05-01A states that two sets of estimates should be developed—one at 3 percent and one at 7 percent (NEI 2005-TN1978). VistraOps provided a base set of results using a discount rate of 7 percent and a 24-year LR period and based its decisions on potentially cost-beneficial SAMAs on these values.

In VistraOps analysis, if the implementation costs for a candidate SAMA exceeded the calculated benefit, the SAMA was determined to be not cost beneficial. If the SAMA benefit exceeded the estimated cost, the SAMA candidate was considered to be potentially cost beneficial. Considering the results from the baseline and sensitivity analyses, no cost-beneficial SAMAs were identified in the ER or in response to NRC staff inquiries. However, based on its assessment, the NRC staff suggests that three SAMAs be considered for implementation since they are potentially cost-beneficial after consideration of sensitivity and uncertainty analyses. The three SAMAs address the same contributions to internal flooding risk so implementation of just one or two of these SAMAs may achieve most of the risk reduction.

The NRC staff reviewed VistraOps' cost-benefit evaluations of each SAMA and concludes that, with the exception of the potentially cost-beneficial SAMAs discussed above, the costs of the SAMAs evaluated would be higher than the associated benefits.

Conclusions

The NRC staff reviewed VistraOps analysis and concluded 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 VistraOps are reasonable and sufficient for the LR submittal.

The NRC staff generally agrees with VistraOps conclusion that none of the candidate SAMAs discussed in this section are potentially cost beneficial, which was based on generally conservative treatment of costs, benefits, and uncertainties. The exception to this conclusion is that the NRC staff suggests three SAMAs be considered for implementation since they are potentially cost-beneficial after consideration of sensitivity and uncertainty analyses. This conclusion of a small number of potentially cost beneficial SAMAs is consistent with the low residual level of risk indicated in the Perry Plant PRA and the fact that VistraOps has already implemented many of the plant improvements identified from the IPE and IPEEE. Because the potentially cost beneficial SAMAs do not relate to aging management during the period of extended operation, the NRC recommends considering them under the current license rather than as part of LR in accordance with 10 CFR Part 54.

3.11.7 No-Action Alternative

Under the no-action alternative, the NRC would not issue a renewed license, and Perry Plant would shut down on or before the expiration of the current license. Human health risks would be smaller after plant shutdown. The reactor unit, which currently operates within regulatory limits, would emit less radioactive gaseous, liquid, and solid material to the environment. In addition, after shut down, the variety of potential accidents at the plant (radiological or industrial) would be reduced to a limited set associated with shutdown events and fuel handling and storage. In Section 3.11.6, "Proposed Action," the NRC staff concludes that the impacts of continued plant operation on human health would be SMALL, except for "Chronic Effects of EMFs," for which the impacts are UNCERTAIN. In Section 3.11.6.4, “Environmental Consequences of Postulated Accidents,” the NRC staff concludes that the impacts of accidents during operation are SMALL. Therefore, as radioactive emissions to the environment decrease, and as the likelihood and types of accidents decrease after shutdown, the NRC staff concludes that the risk to human health following plant shutdown would be SMALL.

3.11.8 Replacement Power Alternatives: Common Impacts

Impacts on human health from construction of a replacement power station would be similar to the impacts associated with the construction of any major industrial facility. Compliance with worker protection rules, the use of personal protective equipment, training, and placement of engineered barriers would limit the impacts on workers to acceptable levels.

The human health impacts from the operation of a power station include public risk from inhalation of gaseous emissions. Regulatory agencies, including the EPA and State of Ohio agencies, base air emission standards and requirements on human health impacts. These agencies also impose site specific emission limits to protect human health.

3.11.9 Natural Gas-Fired Combined-Cycle Alternative

The construction impacts of the NGCC alternative would include those identified in Section 3.11.8, “Replacement Power Alternatives: Common Impacts”. Because the NRC staff expects that the licensee would limit access to active construction areas to only authorized individuals, the impacts on human health from the construction of an NGCC facility would be SMALL.

The human health effects from the operation of the NGCC alternative would include those identified in Section 3.11.8, “Replacement Power Alternatives: Common Impacts,” as common to the operation of all replacement power alternatives. Health risk may be attributable to nitrogen oxide emissions that contribute to ozone formation (NRC 2013-TN2654). Given the regulatory oversight exercised by the EPA and State agencies, the NRC staff concludes that the human health impacts from the NGCC alternative would be SMALL, except for, “Chronic Effects of Electromagnetic Fields (EMFs),” for which the impacts are UNCERTAIN. Therefore, the NRC staff concludes that the impacts on human health from the operation of the NGCC alternative would be SMALL.

3.11.10 Renewable and Natural Gas Combination Alternative

Impacts on human health from construction of the combination alternative would include those identified in Section 3.11.8, “Replacement Power Alternatives: Common Impacts,” as common to the construction of all replacement power alternatives. Because the NRC staff expects that the builder will limit access to the active construction area to only authorized individuals, the impacts on human health from the construction of the renewable and NGCC alternative to include NGCC, solar PV with battery storage, and onshore wind would be SMALL.

As discussed in Section 3.11.9, “Natural Gas-Fired Combined-Cycle Alternative,” the human health effects would be SMALL except for the “Chronic Effects of Electromagnetic Fields (EMFs),” for which the impacts are UNCERTAIN from the operation of the NGCC portion of this combination alternative.

Solar PV panels are encased in heavy duty glass or plastic. Therefore, there is little risk that the small amounts of hazardous semiconductor material that they contain would be released into the environment. In the event of a fire, hazardous particulate matter could be released into the atmosphere. Given the short duration of fires and the high melting points of the materials found in the solar PV panels, the impacts from inhalation would be minimal. Also, the risk of fire at ground mounted solar installations is minimal because of precautions taken during site preparation, such as the removal of fuels and the lack of burnable materials contained in the solar PV panels. Another potential risk associated with PV systems and fire is the potential for shock or electrocution from contact with a high voltage conductor. Proper procedures and clear marking of system components should be used to provide emergency responders with appropriate warnings to diminish the risk of shock or electrocution (Good Company 2011-TN8599). Solar PV panels do not produce EMFs at levels considered harmful to human health, as established by the International Commission on Non-Ionizing Radiation Protection. These small EMFs diminish significantly with distance and are indistinguishable from normal background levels within several yards (Good Company 2011-TN8599). Based on this information, the human health impacts from the operation of the solar PV component for the combination alternative would be SMALL.

Lithium-Ion batteries are used for utility-scale storage and would fall under industrial safety plans, environmental protection rules, and OSHA regulations. Lithium-ion batteries have the potential to catch fire due to an effect called thermal runaway; although an uncommon occurrence, thermal runaway is one of the most recognized safety issues for lithium-ion batteries. The self-perpetuating process can end in battery destruction, release of toxic gases, and has a high risk of fire or explosion (Łukasz et al. 2023-TN9618). Although thermal runaway is a concern, industrial safety practices would limit the impacts on human health and therefore overall impacts would be SMALL as part of this alternative.

Operational hazards at a wind facility for the workforce include working at heights, working near rotating mechanical or electrically energized equipment, and working in extreme weather. Adherence to safety standards and the use of appropriate protective equipment through implementation of an OSHA-approved worker safety program would minimize occupational hazards. Potential impacts on workers and the public include broken blades thrown as a result of mechanical failure. Adherence to proper worker safety procedures and limiting public access to wind turbine sites would minimize the impacts from thrown ice and broken rotor blades. Potential impacts also include EMF exposure, aviation safety hazards, and exposure to noise and vibration from the rotating blades. Impacts from EMF exposure would be minimized by adhering to proper worker safety procedures and limiting public access to any components that could create an EMF. Aviation safety hazards would be minimized by proper siting of the wind turbine facilities and maintaining all proper safety warning devices, such as indicator lights, for pilot visibility. The NRC staff has identified no epidemiologic studies of noise and vibration from wind turbines that would suggest any direct human health impact. Based on this information, the NRC staff concludes that the human health impacts from the operation of the wind portion of the combination alternative would be SMALL except for the “Chronic Effects of Electromagnetic Fields (EMFs),” for which the impacts are UNCERTAIN.

Therefore, given the expected compliance with worker and environmental protection rules and the use of personal protective equipment, training, and engineered barriers, the NRC staff concludes that the potential human health impacts for the combination alternative would be SMALL.

3.12 Environmental Justice

3.12.1 Background

EO 12898, “Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations” (59 FR 7629-TN1450), requires Federal agencies to identify and address disproportionately high and adverse human health and environmental effects of agency actions on minority and low-income populations. Independent agencies, such as the NRC, are not bound by the terms of EO 12898 but are “requested to comply with the provisions of [the] order.” In 2004, the Commission issued the agency’s “Policy Statement on the Treatment of Environmental Justice Matters in NRC Regulatory and Licensing Actions” (69 FR 52040-TN1009), 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 on Environmental Quality provides the following information in “Environmental Justice: Guidance Under the National Environmental Policy Act” (CEQ 1997-TN452):

> **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-TN452).
>
> **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-TN452).

This environmental justice analysis assesses the potential for an NRC action (Perry Plant LR and continued operations) to cause disproportionate and adverse human health or environmental effects on minority and low-income populations. The NRC staff will also assess whether any alternatives to the proposed action of LR could result in disproportionate and adverse human health or environmental effects on minority or low-income populations. In assessing the impacts, the NRC staff defined minority individuals, minority populations, and low-income population as follows (CEQ 1997-TN452):

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, White 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.

In determining the location of minority and/or low-income populations, the NRC staff uses a 50 mi (80 km) radius from the facility as the geographic area to perform a comparative analysis. The 50 mi (80 km) radius is consistent with the impact analysis conducted for human health impacts. The NRC staff compares the percentage of minority and/or low-income populations in the 50 mi (80 km) geographic area to the percentage of minority and/or low-income populations in each census block group to determine which block groups exceeds the percentage, thereby identifying the location of these populations (NRC 2020-TN6399).

<u>Minority Population</u>

According to the USCB's 2020 Census data, there are a total of 1,988 block groups within a 50 mi (80 km) radius of the Perry Plant site and approximately 30 percent of the population residing within a 50 mi (80 km) radius of the Perry Plant identified themselves as minority individuals (USCB 2020-TN9816). The largest minority populations were Black or African American (approximately 18 percent) and Hispanic, Latino, or Spanish origin of any race (approximately 5 percent).

According to the Council on Environmental Quality definition, a minority population exists if the percentage of the minority population of an area (e.g., census block group) exceeds 50 percent or is meaningfully greater than the minority population percentage in the general population. The NRC staff's environmental justice analysis applied the meaningfully greater threshold in identifying higher concentrations of minority populations; with the meaningfully greater threshold being any percentage greater than the minority population within 50 mi (80 km) radius of the Perry Plant site. Therefore, for the purposes of identifying higher concentrations of minority populations, census block groups within the 50 mi (80 km) radius of the Perry Plant were identified as minority block groups if the percentage of the minority population in the block group exceeded 30 percent, the percent of the minority population within the 50 mi (80 km) radius of the Perry Plant.

Based on this analysis, there are 755 minority block groups within a 50 mi (80 km) radius of the Perry Plant. Therefore, approximately 38 percent of block groups within a 50 mi (80 km) radius of the Perry Plant are minority block groups. As shown in Figure 3-14, minority block groups (race and ethnicity) are predominantly clustered southwest of and adjacent to the Perry Plant site.

Low-Income Population

The U.S. Census Bureau's 2017–2021 American Community Survey data identifies approximately 14 percent of individuals residing within a 50 mi (80 km) radius of the Perry Plant site as living below the Federal poverty threshold (USCB 2021-TN10019). The 2021 Federal poverty threshold was $26,500 for a family of four (USCB 2021-TN8833).

Figure 3-14 shows the location of predominantly low-income block groups within a 50 mi (80 km) radius of the Perry Plant. In accordance with NRC guidance (NRC 2020-TN6399), census block groups were considered low-income population block groups if the percentage of individuals living below the Federal poverty threshold within the block groups exceeded the percent of the individuals living below the Federal poverty threshold within 50 mi (80 km) radius of the Perry Plant site.

Based on this analysis, there are 791 low-income block groups within a 50 mi (80 km) radius of the Perry Plant site. Therefore, approximately 40 percent of the block groups within a 50 mi (80 km) radius of the Perry Plant are low-income population block groups. As shown in Figure 3-14, the low-income population block groups are distributed throughout the 50 mi (80 km) radius of the Perry Plant site as well as adjacent to the site.

As discussed in Section 3.10.2 of this report, according to the USCB's 2017–2021 American Community Survey 5-Year Estimates, people living in the Lake County and Geauga County had a median household income higher than the State average while people living in the Ashtabula County had a household income lower than the State average. Additionally, the percentage of individuals living below the poverty level in the Lake County and Geauga County was lower than the percentage of individuals living below the poverty level in Ohio.

3.12.2 Proposed Action

The following section address the site-specific environmental impacts of the Perry Plant LR on the environmental issues identified in Table 3-2 that relate to minority and low-income populations.

3.12.2.1 *Minority and Low-Income* Populations

The NRC addresses environmental justice matters for LR by: (1) identifying the location of minority and low-income populations that may be affected by the continued operation of the nuclear power plant during the LR term; (2) determining whether there would be any potential human health or environmental effects on these populations and special pathway receptors (groups or individuals with unique consumption practices and interactions with the environment; and (3) determining whether any of the effects may be disproportionate and adverse.

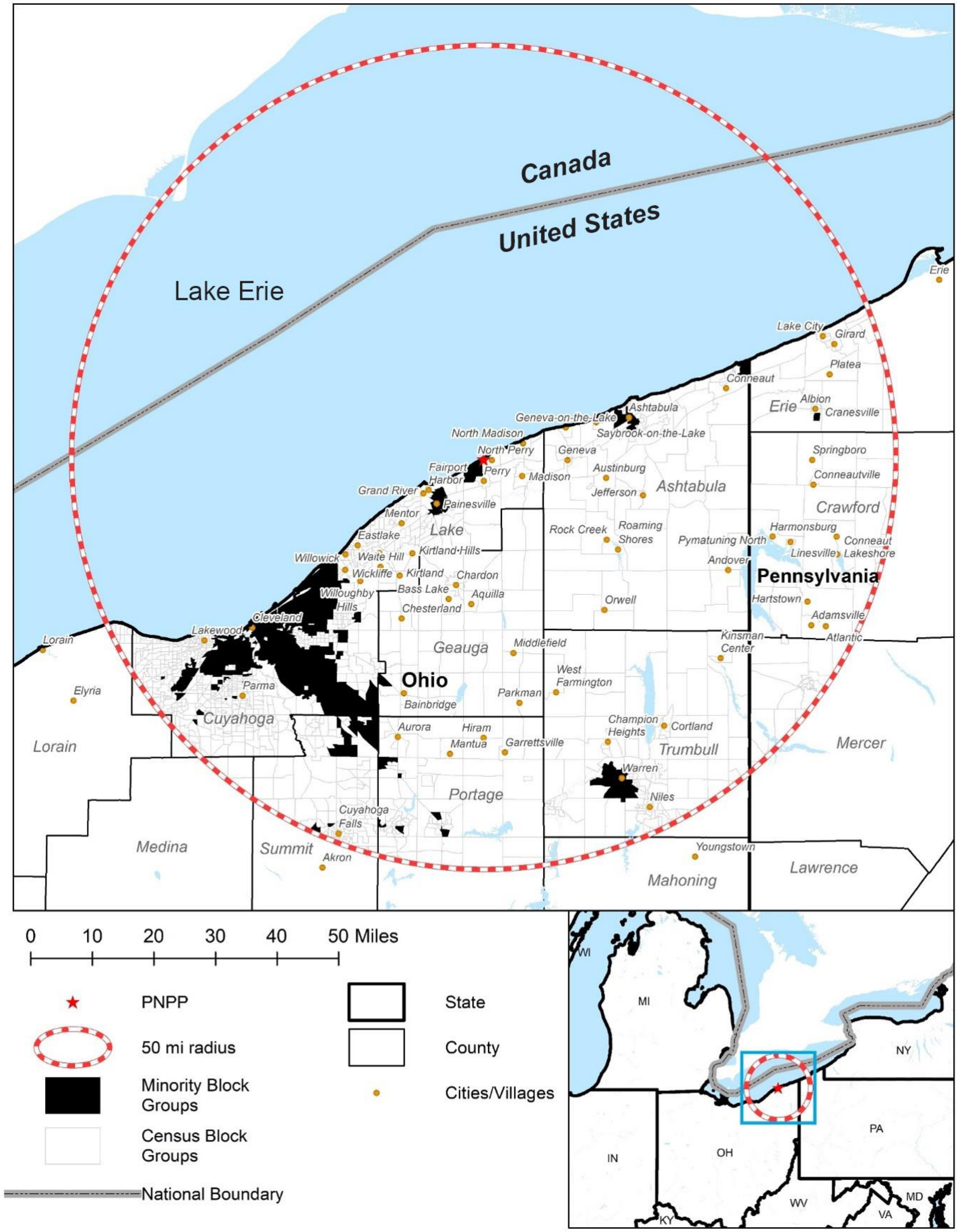


Figure 3-14 Minority Block Groups within a 50 mi (80 km) Radius of Perry Nuclear Power Plant, Ohio. Source: USCB 2020-TN9816.

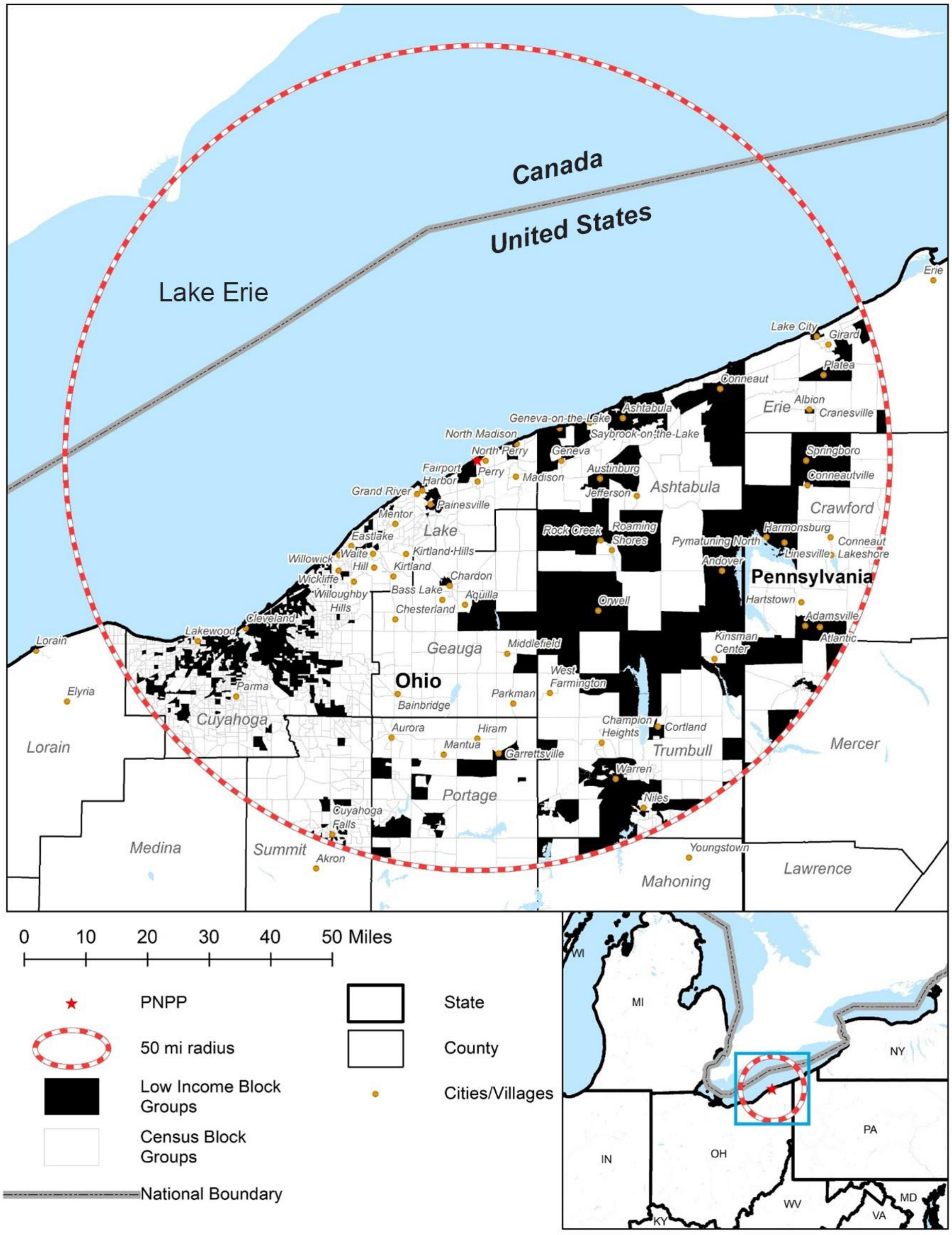


Figure 3-15 Low Income Block Groups within a 50 mi (80 km) Radius of Perry Nuclear Power Plant, Ohio. Source: USCB 2021-TN10019.

Adverse health effects are measured in terms of the risk and rate of fatal or nonfatal adverse impacts on human health. Disproportionate 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. Disproportionate environmental effects refer to impacts or risks of impacts 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.

Figure 3-14 and Figure 3-15 show the location of predominantly minority or low-income population block groups residing within a 50 mi (80 km) radius of the Perry Plant site. This area of impact is consistent with the 50 mi (80 km) impact analysis for public and occupational health and safety. This chapter of this draft SEIS presents the assessment of environmental and human health impacts for each resource area. The analyses of impacts for all environmental resource areas indicated that the impact from LR would be SMALL.

Potential impacts on minority and low-income populations (including migrant workers or Indian Tribes) would mostly consist of socioeconomic and radiological effects; however, radiation doses from continued operations during the LR term are expected to continue at current levels, and they would remain within regulatory limits. Section 3.11.6.4 discusses the environmental impacts from postulated accidents that might occur during the LR term, which include both design-basis and severe accidents. In both cases, the Commission has generically determined that impacts associated with design-basis accidents are small because nuclear power plants are designed and operated to withstand such accidents, and the probability-weighted consequences of severe accidents are SMALL.

Minority and low-income populations near Perry Plant could experience human health and environmental effects from the continued operation of Perry Plant. Based on the information and the analysis presented in this chapter, all human health and environmental impacts from the continued operation of Perry Plant would be SMALL. Consequently, minority and low-income populations would not likely experience disproportionate and adverse human health and environmental effects from the proposed action and the continued operation of Perry Plant.

<u>Subsistence Consumption of Fish and Wildlife</u>

As part of addressing environmental justice concerns associated with LR, the NRC also assessed the potential radiological risk to special population groups (such as migrant workers or Indian Tribes) from exposure to radioactive material received through their unique consumption practices and interactions with the environment. Such exposure could occur through subsistence consumption of fish, wildlife, and native vegetation; contact with surface waters, sediments, and local produce; absorption of contaminants in sediments through the skin; and inhalation of airborne radioactive material released from the nuclear power plant during routine operation. The special pathway populations analysis is an important part of the environmental justice analysis because consumption patterns may reflect the traditional or cultural practices of minority and low-income populations in the area.

Section 4-4 of EO 12898, “Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations,” (59 FR 7629-TN1450) directs Federal agencies, whenever practical and appropriate, to collect and analyze information about the consumption patterns of populations that rely principally on fish and wildlife for subsistence and to communicate the risks of these consumption patterns to the public. In this SEIS, the NRC considered whether there were any means for minority or low-income populations to be disproportionately affected by examining impacts on American Indians, Hispanics, migrant workers, and other traditional lifestyle special pathway populations. VistraOps queried Perry Plant staff, government organizations with a social welfare mission, and private social welfare organizations to identify whether there are any subpopulations near Perry Plant (Lake, Ashtabula, and Geauga counties) that engage in a subsistence-like lifestyle (EH 2023-TN9534). VistraOps did not identify subsistence activity in the vicinity of the Perry Plant site (EH 2023-TN9534).

The assessment of special pathways considered the levels of radiological contaminants in air, drinking water, surface water, vegetation, fish, and shoreline sediment on or near Perry Plant. Radionuclides released to the atmosphere may deposit on soil and vegetation and may therefore eventually be incorporated into the human food chain. To assess the impact of reactor operations on humans from the ingestion pathway, VistraOps collects and analyzes samples of air, water, sediment, fish, vegetation, if available, for radioactivity as part of its ongoing, comprehensive Radiological Environmental Monitoring Program (REMP). Each year a REMP land use census is conducted to assess the contribution of radionuclides to the environment resulting from Perry Plant operation. The census is conducted within a 5 mi (8 km) radius of the Perry Plant site with the locations of the nearest resident, available milk animal, and vegetable garden being recorded and mapped. The results for each sample type are discussed in the publicly available annual radiological environmental operating reports and compared to historical data to determine if there are any observable trends.

The REMP results for 2020 and 2021 concluded that there are no discernable trends or increase in radiological parameters when comparing current monitoring results to pre-operational studies. There is no detectable radiological effect on the surrounding environment due to operation of Perry Plant (EH 2023-TN9534).

In addition to the REMP, Perry Plant implemented a GPP in 2006 designed to monitor the onsite plant environment. This program initially began with a baseline evaluation of the site hydrogeologic characteristics and assessment of potential plant operations that could impact site groundwater quality. Nearly all groundwater monitoring results for 2020 and 2021 were less than the analysis instrument’s minimal detection level. The maximum level detected in groundwater in 2020 was 382 pCi/L tritium and in 2021 it was 336 pCi/L tritium. Any positive result less than 500 pCi/L is considered as background activity and not due to plant operations (EH 2023-TN9534).

Based on the REMP data, special pathway receptor populations in the region would not likely experience disproportionate and adverse human health impacts because of subsistence consumption. In addition, the continued operation of Perry Plant would not have disproportionate and adverse human health and environmental effects on these populations.

3.12.3 No-Action Alternative

Under the no-action alternative, the NRC would not renew a operating license, and Perry Plant would permanently shut down on or before the expiration of the current renewed facility operating license. Impacts on minority and low-income populations would depend on the number of jobs and the amount of tax revenues lost by communities in the immediate vicinity of the nuclear power plant after it ceases operations. Not renewing the operating license and terminating reactor operations could have a noticeable impact on socioeconomic conditions in the communities located near the Perry Plant site. The loss of jobs and income could have an immediate socioeconomic impact. Some, but not all, of the approximately 600 permanent workers could leave the area. In addition, the Perry Plant would generate less tax revenue, which could reduce the availability of public services. This reduction could disproportionately affect minority and low-income populations that may have become dependent on these services.

3.12.4 Replacement Power Alternatives: Common Impacts

The following discussions identify common impacts from the construction and operation of replacement power facilities that could disproportionately affect minority and low-income populations. Disproportionate and adverse human health and environmental effects on minority and low-income populations would depend on site location, plant design, and operational characteristics of the new facility.

Construction

Potential impacts to minority and low-income populations from the construction of a replacement power plant would mostly consist of environmental (e.g., noise, dust, and traffic) and socioeconomic effects (employment and housing impacts). The extent of the effects experienced by these populations is difficult to determine because it would depend on the location of the power plant and affected transportation routes. Noise and dust impacts from construction would be short-term and primarily limited to onsite activities. Minority and low-income populations residing onsite access roads would be affected by increased truck and commuter vehicle traffic during construction, especially during shift changes. However, these effects would be temporary, limited to certain hours of the day, and would not likely be high and adverse. Increased demand for temporary housing during construction could disproportionately affect low-income populations reliant on low-cost rental housing. However, given the proximity of Perry Plant to the Cleveland metropolitan area, construction workers could commute to the site, thereby reducing the potential demand for rental housing.

Operation

Minority and low-income populations living near the replacement power plant that rely on subsistence consumption of fish and wildlife could be disproportionately affected. Emissions during power plant operations could disproportionately affect nearby minority and low-income populations, depending on the type of replacement power generation. However, to operate, emissions must remain within regulatory limits.

Conclusion

Based on this information and the analysis of human health and environmental impacts presented in this SEIS, it is unlikely that a replacement power plant would be constructed and allowed to operate in a manner that would result in disproportionate and adverse human health and environmental effects on minority and low-income populations. However, this determination would also depend on the location, plant design, and operational characteristics of the replacement power plant. Therefore, the NRC cannot determine whether a replacement power alternative (NGCC or combination) would result in disproportionate and adverse human health and environmental effects on minority and low-income populations.

3.13 Waste Management and Pollution Prevention

Like any operating nuclear power plant, Perry Plant will produce both radioactive and nonradioactive waste during the LR period. This section describes waste management and pollution prevention at Perry Plant site. The description of these waste management activities is followed by the NRC staff's analysis of the potential impacts of waste management activities from the proposed action (LR) and alternatives to the proposed action.

3.13.1 Radioactive Waste

The NRC licenses nuclear power plants with the expectation that they will release a limited amount of radioactive material to both the air and water during normal operations. However, NRC regulations require that gaseous and liquid radioactive releases from nuclear power plants meet radiation dose-based limits specified in 10 CFR Part 20 (TN283), "Standards for Protection Against Radiation," and the ALARA criteria in 10 CFR Part 50 (TN249), Appendix I, "Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion 'As Low as is Reasonably Achievable' for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents." In other words, the NRC places regulatory limits on the radiation dose that members of the public can receive from radioactive effluents of a nuclear power plant. For this reason, all nuclear power plants use radioactive waste management systems to control and monitor radioactive wastes.

Perry Plant uses liquid, gaseous, and solid waste processing systems to collect and treat, as needed, radioactive materials produced as a byproduct of nuclear power plant operations. Radioactive materials in liquid, gaseous, and solid effluents are reduced before being released into the environment so that the resultant dose to members of the public from these effluents is well within the NRC and EPA dose standards. Radionuclides that can be efficiently removed from the liquid and gaseous effluents before release are converted to a solid waste form for disposal in a licensed disposal facility.

VistraOps maintains a REMP to assess the radiological impact, if any, to the public and the environment from radioactive effluents released during operations at Perry Plant (EH 2023-TN9534).

VistraOps has an Offsite Dose Calculation Manual (ODCM) that contains the methods and parameters for calculating offsite doses resulting from liquid and gaseous radioactive effluents. These methods ensure that radioactive material discharges from Perry Plant meet NRC and EPA regulatory dose standards. The ODCM also contains the requirements for the REMP (Offsite Dose Calculation Manual [EH 2021-TN9954]).

3.13.1.1 Radioactive Liquid Waste Management

VistraOps uses waste management systems to collect, analyze, and process radioactive liquids produced at Perry Plant. Perry Plant liquid waste disposal system meets the design objectives of 10 CFR Part 50 (TN249), Appendix I, and controls the processing, disposal, and release of radioactive liquid wastes.

The liquid waste disposal system was designed to receive, process, and discharge potentially radioactive liquid waste. The liquid waste processing system consists mainly of two waste collector tanks (for high purity/low conductivity wastes) and two floor drain collector tanks (for medium-to-low purity/medium conductivity wastes). Equipment drains are the major inputs to the waste collector tanks, and floor washdown (e.g., from equipment leakage) is the major input to the floor drain collector tanks. Batches from these tanks are filtered, demineralized, and normally re-used. If the sample from a batch after treatment does not meet the water quality standards for reuse in the condensate makeup system the batch is either sent back for further treatment or discharged under controlled conditions, depending on the chemical content and activity level. The liquid radioactive waste system collects spent resin slurries prior to being solidified and shipped to an offsite disposal location.

All liquid wastes are monitored prior to their release to ensure that they will not exceed the limits specified in 10 CFR Part 20-TN283. The radiation monitoring system monitors the effluent and closes the discharge valve if the amount of radioactive material in the effluent exceeds preset values. VistraOps performs offsite dose calculations based on effluent samples obtained at this release point to ensure that the limits of 10 CFR Part 50-TN249, Appendix I are not exceeded. The ODCM prescribes the alarm/trip setpoints for the liquid effluent radiation monitors. VistraOps' use of these radiological waste systems and the procedural requirements in the ODCM provides assurance that the dose from radiological liquid effluents at Perry Plant complies with NRC and EPA regulatory dose standards. VistraOps calculates dose estimates for members of the public using radiological liquid effluent release data.

VistraOps' annual radioactive effluent release reports contain a detailed presentation of liquid effluents released from Perry Plant and the resultant calculated doses (Effluent Release Report). These reports are publicly available on the NRC's website (https://www.nrc.gov/). The NRC staff reviewed 5 years of radioactive effluent release data from 2019 through 2023 (FENOC 2019-TN9952, FENOC 2020-TN9953; EH 2021-TN9954, EH 2022-TN9955, EH 2023-TN9956). A 5-year period provides a dataset that covers a broad range of activities that occur at a nuclear power plant, such as refueling outages, routine operation, and maintenance, which can affect the generation of radioactive effluents into the environment. The NRC staff compared the data against NRC dose limits and looked for indications of adverse trends (i.e., increasing dose levels or increasing radioactivity levels).

The doses calculated for radioactive liquid effluents released from Perry Plant during 2022 (EH 2023-TN9956) are summarized below.

Perry Plant Liquid Effluents in 2022

- The total-body dose to an offsite member of the public from liquid radioactive effluents was 9.37×10^{-2} millirem (mrem) (9.37×10^{-4} millisievert [mSv]), which is well below the 3 mrem (0.03 mSv) dose criterion in Appendix I of the 10 CFR Part 50-TN249.
- The maximum organ dose (liver) to an offsite member of the public from liquid radioactive effluents was 1.02×10^{-1} mrem (1.02×10^{-3} mSv), which is well below the 10 mrem (0.1 mSv) dose criterion in Appendix I of the 10 CFR Part 50-TN249.

The NRC staff's review of VistraOps' radioactive liquid effluent control program shows that the applicant maintained radiation doses to members of the public within NRC and EPA radiation protection standards, as contained in Appendix I to 10 CFR Part 50-TN249, 10 CFR Part 20-TN283, and Title 40 of the *Code of Federal Regulations* (40 CFR) Part 190 (TN739), "Protection of Environment, Environmental Radiation Protection Standards for Nuclear Power Operations." The NRC staff observed no adverse trends in the dose levels.

Unplanned abnormal releases containing radioactive material have occurred in recent years, but they are monitored, reported, and fall within Federal release limits and guidelines. The following abnormal discharges or releases, or reportable events occurred in the period from 2018 through the time of the audit in 2024 (FENOC 2019-TN9952, FENOC 2020-TN9953; EH 2021-TN9954, EH 2022-TN9955, EH 2023-TN9956; Vistra 2024-TN9925; Vistra 2024-TN10193):

- The nuclear closed cooling system (which has had past leakage associated with the reactor coolant system) contained tritium activity that was recorded as continuous abnormal releases during specific quarters throughout this period. The licensee will continue to monitor this radioactivity. Any detectable activity measured from the nuclear closed cooling system to ESW will be tracked and recorded as a continuous abnormal release in effluent reports. The licensee has taken actions to identify and help eliminate the release from the nuclear closed cooling system to the ESW and is conducting a benchmarking effort of other nuclear sites to better understand continuous monitoring of normally nonradioactive systems that become systematically contaminated. This release pathway is monitored, reported, and falls within Federal release limits and guidelines (EH 2023-TN9956; Vistra 2024-TN9925; Vistra 2024-TN10193).
- In March of 2020, tritium activity was detected in the underdrain system (Manhole 23), the source of which was identified as auxiliary steam leaking into the auxiliary boiler deaerator. In turn, the auxiliary boiler deaerator tritium source was identified as a valve connecting to the reactor feed pump turbine. During the refueling outage in 2023, the site repaired the valve and is continuing to monitor to determine if the repair was successful. The licensee added ODCM-compliant sampling and analysis protocols for abnormal auxiliary boiler releases to site procedures to quantify the tritium releases using an ODCM-compliant methodology when the boiler is vented to atmosphere. This methodology remains in place to quantify any release to atmosphere when the auxiliary boiler is being vented. This release pathway is monitored, reported, and falls within Federal release limits and guidelines (EH 2021-TN9954; Vistra 2024-TN9925; Vistra 2024-TN10193).
- In December 2021, tritium was detected in underdrain Manhole 20. The underdrain manholes are sampled and analyzed quarterly for principal gamma emitters and tritium by Perry Plant personnel in accordance with site procedures. The underdrain Manhole 20 and 23 effluent pathway is through ESW. The tritium value measured on December 17, 2021 (2050 pCi/L), exceeded voluntary reporting requirements (2000 pCi/L) to local agencies as specified in Perry Plant procedures. The licensee made a voluntary report and implemented an investigation, chemistry sampling plan, and Tritium Action Plan to identify the source of the tritium. Tritium activity in Manhole 20 decreased below 1,000 pCi/L for 2 weeks in March 2022. The final Tritium Action Plan action was completed on May 15, 2023, and the Tritium Action Plan was closed in June 2023. (Vistra 2024-TN9925, Vistra 2024-TN10193).
- On June 23, 2023 in NRC Event Number 56588 (NRC 2023-TN9961), Perry Plant reported elevated levels of tritium in the underdrain system to the State of Ohio as a non-voluntary reporting of tritium when tritium activity in internal plant piezometer 21 exceeded 20,000 pCi/L (reportable under 10 CFR 50.72(b)(2)(xi) (TN249). The internal plant piezometers were installed during construction to monitor the performance of the Underdrain System. Sampling these internal plant piezometers gives an early indication of the potential to contaminate groundwater. As such, NEI 07-07 reporting thresholds are applied to activity that may be identified during routine sampling. The source of the leak was under investigation as of April 2024, but no active leak identified. Any contributing activity from this tritium release has been accounted for in the effluent release report (Vistra 2024-TN9925; NRC 2023-TN9961; Vistra 2024-TN10193).

- In 2024, elevated tritium readings were identified for internal plant piezometers PZ-6 and PZ-21. On January 5, 2024, in NRC Event Number 56914 (NRC 2024-TN9963), Perry Plant reported elevated levels of tritium in the underdrain system to the State of Ohio as a non-voluntary reporting of tritium (reportable under 10 CFR 50.72(b)(2)(xi) [TN249]). As of April 2024, the source of the leak was under investigation, and it remained unconfirmed if the release was related to the June 2023 incident. In response to the January 2024 leak, the licensee installed higher-volume pumps in piezometers PZ-6, PZ-14, and PZ-21; these piezometers are being pumped to reduce the amount of contaminated water entering the underdrain system. Groundwater pumped from piezometers associated with both the July 2023 and January 2024 tritium releases is discharged to the radioactive waste treatment building. Any contributing activity from this tritium release has been accounted for in the effluent release report (Vistra 2024-TN9925).

Additional information on historical radiological spills and tritium in groundwater is presented in Section 3.5.2.5 of this SEIS. Tritium concentrations discharged to the ESW from the underdrain system are likely to be diluted below the lower limit of detection. Potential releases of radioactivity from the underdrain system are monitored and reported as part of the liquid effluent release data within the effluent reports. A review of the 2019–2023 effluent reports (FENOC 2020-TN9953; EH 2021-TN9954, EH 2022-TN9955, EH 2023-TN9956, Vistra 2024-TN10193) indicates the average diluted concentration of liquid effluent releases from plant operations have been within permitted values per 10 CFR Part 20-TN283. During the LR term, VistraOps will continue to perform routine plant refueling and maintenance activities. Based on VistraOps' past performance in operating a radioactive waste system at Perry Plant that maintains ALARA doses from radioactive liquid effluents, the NRC staff expects that VistraOps will maintain similar performance during the LR term.

3.13.1.2 Radioactive Gaseous Waste Management

Radioactive gaseous wastes develop from gases in liquid contained in tanks and piping at Perry Plant. The gaseous wastes are monitored and released at an acceptable rate designated by the ODCM. The ODCM determines the effluent release rate to ensure that releases are within predetermined limits, which ensures compliance with dose limitations of licensee commitments. The Gaseous Waste Disposal System maintains a non-oxidizing cover gas of nitrogen in tanks and equipment that may contain radioactive gas. These systems also provide for holdup gas decay, and they release the gases under controlled conditions.

VistraOps calculates dose estimates for members of the public based on radioactive gaseous effluent release data and atmospheric transport models. VistraOps' annual radioactive effluent release reports present in detail the radiological gaseous effluents released from Perry Plant and the resultant calculated doses. As described in Section 3.13.1.1, "Radioactive Liquid Waste Management," of this SEIS, the NRC staff reviewed 5 years of radioactive effluent release data from the 2018 through 2022 reports (FENOC 2019-TN9952, FENOC 2020-TN9953; EH 2021-TN9954, EH 2022-TN9955, EH 2023-TN9956). The NRC staff compared the data against NRC dose limits and looked for indications of adverse trends (i.e., increasing dose levels) over the period.

The calculated doses from radioactive gaseous effluents released from Perry Plant during 2022 (EH 2023-TN9956) are summarized below.

Perry Plant Gaseous Effluent in 2022

- The air dose due to noble gases with resulting gamma radiation in gaseous effluents was 1.52×10^{-3} millirad (mrad) (1.52×10^{-5} milligray), which is well below the 10 mrad (0.1 milligray) dose criterion in Appendix I of the 10 CFR Part 50-TN249.
- The air dose from beta radiation in gaseous effluents was 6.96×10^{-3} mrad (6.96×10^{-5} milligray), which is well below the 20 mrad (0.2 milligray) dose criterion in Appendix I of the 10 CFR Part 50-TN249.
- The critical organ dose (thyroid) to an offsite member of the public from radiation in gaseous effluents as a result of iodine-131, iodine-133, hydrogen-3, and particulates with greater than 8 day half-lives was 1.08×10^{-2} mrem (1.08×10^{-4} mSv), which is below the 15 mrem (0.15 mSv) dose criterion in Appendix I of the 10 CFR Part 50-TN249.

The NRC staff's review of Perry Plant's radioactive gaseous effluent control program showed radiation doses to members of the public that were well below NRC and EPA radiation protection standards contained in Appendix I of the 10 CFR Part 50-TN249, 10 CFR Part 20-TN283, and 40 CFR Part 190-TN739. The NRC staff observed no adverse trends in the dose levels over the 5 years reviewed.

During the LR term, VistraOps will continue to perform routine plant refueling and maintenance activities. Based on VistraOps' past performance in operating a radioactive waste system at Perry Plant that maintains ALARA doses from radioactive gaseous effluents, the NRC staff expects that Perry Plant will maintain similar performance during the LR term.

3.13.1.3 Radioactive Solid Waste Management

Perry Plant's solid waste disposal system provides for packaging and/or solidification of radioactive waste that will subsequently be shipped offsite to an approved burial facility. These activities reduce the amount of waste shipped for offsite disposal. Solid radioactive wastes are logged, processed, packaged, and stored for subsequent shipment and offsite burial. Solid radioactive wastes and potentially radioactive wastes include reactor components, equipment and tools removed from service; chemical laboratory samples; spent resins; used filter cartridges; and radioactively contaminated hardware, as well as compacted wastes such as contaminated protective clothing, paper, rags, and other trash generated from plant design modifications and operations and routine maintenance activities. In addition, nonfuel solid wastes result from treating and separating radionuclides from gases and liquids and from removing containment material from various reactor areas.

3.13.1.4 Radioactive Waste Storage

At Perry Plant, low-level radioactive waste (LLRW) is stored temporarily onsite at a low-level waste storage facility before being shipped offsite for processing or disposal at licensed LLRW treatment and disposal facilities. VistraOps has contracts or plans to have contracts with Energy*Solutions,* Unitech Services and Waste Control Specialists. LLRW is classified as Class A, Class B, or Class C (minor volumes are classified as greater than Class C). Class A includes both dry active waste and processed waste (e.g., dewatered resins). Classes B and C normally include a low percentage of the LLRW generated. Radioactive waste that is greater than Class C waste is the responsibility of the Federal government. Low-level mixed waste is managed and transported to the facility with which VistraOps has contracts. As indicated in VistraOps' ER and discussed with the NRC staff at the virtual audit, Perry Plant has sufficient existing capability to store all generated LLRW onsite. Also, in the event that mixed waste is generated, it would be stored in a designated storage locker and no other waste types would be stored with it. In addition, Perry Plant staff would consult with a mixed waste treatment/ disposal vendor regarding potential disposal paths for the waste. No additional construction of onsite storage facilities would be necessary for LLRW storage during the period of extended operation.

Perry Plant stores spent fuel in a spent fuel pool and in an onsite ISFSI. The ISFSI safely stores spent fuel onsite in licensed and approved dry cask storage containers. Spent fuel is stored in the ISFSI under a separate license. The ISFSI and the spent fuel pool are sized to accommodate all spent nuclear fuel generated through the period of extended operation. Consequently, ISFSI expansion is not expected during the LR term. During the audit discussion VistraOps personnel clarified that in a scenario where ISFSI expansion is needed, it would likely be on already disturbed land. The NRC staff understands that VistraOps is allowed under a 10 CFR Part 72 (TN4884) general license as part of the Unit's 10 CFR Part 50 (TN249) licenses to expand the ISFSI as necessary (see 10 CFR 72.210; TN4884). VistraOps confirms that they will ensure that there will be adequate spent fuel storage to safely accommodate spent fuel onsite for the current license term and during the proposed LR term. The NRC staff notes, however, that the impacts of onsite storage of spent nuclear fuel during the period of extended operation is a Category 1 issue and has been determined to be SMALL, as stated in 10 CFR Part 51 (TN250), Appendix B, Table B-1; see also NUREG-2157, *Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel* (TN4117).

As discussed during the audit, VistraOps currently stores slightly contaminated silt and sediment from the ESW pumphouse and forebay in the chemical cleaning lagoon and the Unit 2 circulating water pumphouse flume area. Placement and storage of the sediment is subject to the criteria specified in the Perry Plant Technical Specifications (Tech Specs) Section 5.5.1, which addresses the ODCM requirements to ensure compliance with 10 CFR Part 20 (TN283), 10 CFR Part 50 (TN249), and 40 CFR Part 190 (TN739). These criteria are also contained in Perry Plant procedures. Future retrieval of the sediment throughout the period of extended operation is expected to continue at roughly same frequency and amount as during the initial licensing term. If during the period of extended operation, the capacity becomes an issue, VistraOps will address it in the corrective action program. Potential corrective actions may include shipping the sediment to a low-level waste facility or establishing additional onsite storage locations. The use of any additional storage locations would undergo additional safety and environmental evaluations as required (Vistra 2024-TN9925).

3.13.1.5 Radiological Environmental Monitoring Program

VistraOps maintains a REMP to assess the radiological impact, if any, to the public and the environment from Perry Plant operations. The REMP measures the aquatic, terrestrial, and atmospheric environment for ambient radiation and radioactivity. Monitoring is conducted for the following: direct radiation, air, precipitation, well water, river water, surface water, milk, food products and vegetation (such as edible broad leaf vegetation), fish, silt, and shoreline sediment. The REMP also measures background radiation (i.e., cosmic sources, global fallout, and naturally occurring radioactive material, including radon). As part of the REMP program, VistraOps conducts analyses of selected wells for the presence of gamma emitters, tritium in groundwater on a quarterly basis (EH 2023-TN9534).

The NRC staff reviewed 5 years of annual radiological environmental monitoring data from 2018 through 2022 (FENOC 2019-TN9952, FENOC 2020-TN9953; EH 2021-TN9954, EH 2022-TN9969, EH 2023-TN9970). A 5-year period provides a dataset that covers a broad range of activities that occur at a nuclear power plant, such as refueling outages, routine operation, and maintenance that can affect the generation and release of radioactive effluents into the environment. The NRC staff reviewed the data for indications of adverse trends (i.e., increasing radioactivity levels) over the period of 2018 through 2022.

In addition to the REMP, VistraOps established an onsite groundwater protection initiative program in 2008 in accordance with NEI 07-07, "Industry Groundwater Protection Initiative" (NEI 2007-TN1913). This program monitors the onsite nuclear power plant environment to detect leaks from nuclear power plant systems and pipes containing radioactive liquid. Section 3.5.2.3, "Groundwater Quality," of this SEIS contains information on Perry Plant's groundwater protection initiative program. VistraOps performs groundwater monitoring from a network of groundwater monitoring wells, indoor and outdoor piezometers, and manholes to monitor for potential radioactive releases to groundwater, environmental conditions, and groundwater elevation in accordance with site procedures as described in Section 3.6.2.4 of the ER (EH 2023-TN9534).

Based on its review of the REMP and inadvertent release data, the NRC staff finds no apparent increasing trend in concentration or pattern indicating persistently high tritium or other radionuclide concentrations that might indicate an ongoing inadvertent release from Perry Plant. The groundwater monitoring program data at Perry Plant show that VistraOps monitors, characterizes, and actively remediates spills, and that there were no significant radiological impacts to the offsite environment from operations at Perry Plant.

3.13.2 Nonradioactive Waste

Perry Plant generates nonradioactive waste from nuclear power plant maintenance, cleaning, and operational processes. Perry Plant manages nonradioactive wastes in accordance with applicable Federal and State regulations, as implemented through its corporate procedures. Perry Plant generates and manages hazardous wastes, nonhazardous wastes, and universal wastes. VistraOps maintains a list of waste vendors that it has approved for use across the entire company to remove and dispose of the nonradioactive wastes offsite (EH 2023-TN9534).

Waste minimization and pollution prevention are important elements of operations at all nuclear power plants. Licensees are required to consider pollution prevention measures as dictated by the Pollution Prevention Act (Public Law 101 5084; TN6607) and the Resource Conservation and Recovery Act of 1976, as amended (Public Law 94 580; TN1281).

The Resource Conservation and Recovery Act governs the disposal of solid waste. The MPCA is authorized by the EPA to implement the Resource Conservation and Recovery Act and regulate solid and hazardous waste in Ohio (EH 2023-TN9534). Perry Plant has a nonradioactive waste management program to handle nonradioactive waste in accordance with Federal, State, and corporate regulations and procedures. Perry Plant maintains a waste minimization program that uses material control, process control, waste management, recycling, and feedback to reduce waste.

Perry Plant SWPPP identifies potential sources of pollution that may affect the quality of stormwater discharges from permitted outfalls. The SWPPP also describes BMPs for reducing pollutants in stormwater discharges and assuring compliance with the site's NPDES permit (EH 2023-TN9534).

Perry Plant also has an environmental management system (EH 2023-TN9534). Procedures are in place to monitor areas within the site that have the potential to discharge oil into or on navigable waters, in accordance with the regulations in 40 CFR Part 112, "Oil Pollution Prevention" (TN1041). The Pollution Incident/Hazardous Substance Spill Procedure identifies and describes the procedures, materials, equipment, and facilities that VistraOps uses to minimize the frequency and severity of oil spills at Perry Plant.

Perry Plant is subject to the EPA reporting requirements in 40 CFR Part 110, "Discharge of Oil," under CWA Section 311(b)(4) (TN8485). Under these regulations, Perry Plant must report to the EPA's national response center any discharges of oil if the quantity may be harmful to the public health or welfare or to the environment. Based on the NRC staff's review of Section 9.5.3.6 of the VistraOps ER (EH 2023-TN9534) and a review of records from 2018–2022, there have been no releases at Perry Plant that have triggered this notification requirement (EH 2023-TN9534). In addition, the applicant confirmed that there have been no reportable spills under the provisions of 40 CFR Part 110 in 2022, 2023 or through when the audit took place in January 2024 (Vistra 2024-TN9925).

Perry Plant is also subject to the reporting provisions of the Ohio Revised Code 3750.06 (ORC 3750.06-TN10020) for reporting accidental or intentional release of extremely hazardous substances (40 CFR Part 355; Appendix A and B [TN5493]), Comprehensive Environmental Response, Compensation, and Liability Act of 1980 Hazardous Substance (40 CFR Part 302; Table 302.4 [TN5489]), or any release of 25 gal or more of oil into the environment or any quantity of oil into or upon navigable waters which causes a visible film or sheen upon the surface of the water. Based on the NRC staff's review of Section 9.5.12.6 of the VistraOps ER (EH 2023-TN9534), and a review of records from 2017–2022, no reportable spills under the reporting provisions of the ORC 3750.06 (OAC 37-3750-TN10020) occurred during that period. In addition, the applicant confirmed that there have been no inadvertent releases or spills of nonradioactive contaminants at Perry Plant which would trigger a notification requirement as discussed in Section 9.5.3.7 Reportable Spills (ORC 3750.06) of the ER in 2022, 2023, or through the audit in January 2024 (Vistra 2024-TN9925).

3.13.3 Proposed Action

As described in the 2013 LR GEIS (NRC 2013-TN2654) and as cited in Table 3-1 for generic issues related to waste management, the impacts of nuclear power plant LR and continued operations would be SMALL during the LR term. The NRC staff's review did not identify any new and significant information that would change the conclusion in the LR GEIS. Thus, as concluded in the LR GEIS, for these Category 1 (generic) issues, the impacts of continued operation of Perry Plant on waste management during the LR term would be SMALL. The ultimate disposal of spent fuel in a potential future geologic repository is a separate and independent licensing action that is outside the regulatory scope of this review. Per 10 CFR Part 51 (TN250) Subpart A, Appendix B, the Commission concludes that the impacts presented in NUREG-2157 (NRC 2014-TN4117) would not be sufficiently large to require the NEPA conclusion, for any plant, that the option of extended operation under 10 CFR Part 54 (TN4878) should be eliminated. Accordingly, while the Commission has not assigned a single level of significance for the impacts of spent nuclear fuel and high-level waste disposal, this issue is considered generic to all nuclear power plants. There are no site-specific (Category 2) waste management issues applicable to Perry Plant (Table 3-2).

3.13.4 No-Action Alternative

Under the no-action alternative, Perry Plant would cease operation at the end of the term of the current operating license or sooner and enter decommissioning. After entering decommissioning, the plant would generate less spent nuclear fuel, emit fewer gaseous and liquid radioactive effluents into the environment, and generate less low-level radioactive and nonradioactive waste. In addition, after shutdown, the variety of potential accidents at the nuclear power plant (radiological and industrial) would be reduced to a limited set associated with shut down events and fuel handling and storage. Therefore, as radioactive emissions to the environment decrease, and the likelihood and variety of accidents decrease after shutdown and decommissioning, the NRC staff concludes that impacts resulting from waste management from implementation of the no-action alternative would be SMALL.

3.13.5 Replacement Power Alternatives: Common Impacts

Impacts from waste management common to all analyzed replacement power alternatives would be from construction-related nonradiological debris generated during construction activities. This waste would be recycled or disposed of in approved landfills.

3.13.6 Natural Gas-Fired Combined-Cycle Alternative

Impacts from the waste generated during the construction of the NGCC alternative would include those identified in Section 3.13.5, “Replacement Power Alternatives: Common Impacts,” of this SEIS as being common to all replacement power alternatives.

Waste generation from natural gas technology would be minimal. The only significant waste generated at a NGCC power plant would be spent selective catalytic reduction catalyst (plants use selective catalytic reduction catalyst to control nitrogen oxide emissions).

The spent catalyst would be regenerated or disposed offsite. Other than the spent selective catalytic reduction catalyst, waste generation at an operating NGCC plant would be limited largely to typical operations and maintenance of nonhazardous waste. Based on this information, the NRC staff concludes that the waste impacts for the NGCC alternative would be SMALL.

3.13.7 Renewable and Natural Gas Combination Alternative

Impacts from the waste generated during the construction of the combination alternative would include those identified in Section 3.13.5, “Replacement Power Alternatives: Common Impacts,” of this SEIS as being common to all replacement power alternatives. The impacts from the NGCC portion of this combined alternative are identified in Section 3.13.6, “Natural Gas-Fired Combined Cycle Alternative” of this SEIS.

The construction of the solar PV facilities would create sanitary and industrial waste. This waste could be recycled or shipped to an offsite waste disposal facility. All the waste would be handled in accordance with appropriate Ohio regulations. Impacts on waste management resulting from the construction and operation of the solar PV facilities of the combination alternative would be minimal compared to those of the natural gas. In summary, the NRC staff concludes that the waste management impacts resulting from the construction and operation of the PV facilities would be SMALL.

During construction of onshore wind facilities as part of the combination alternative, waste materials or the accidental release of fuels are expected to be negligible because of the limited amount of traffic and construction activity that might occur with construction, installation, operation, and decommissioning of onshore turbine generators. Therefore, the waste management impacts resulting from the construction and operation of the onshore wind portion would be SMALL.

Based on the above determinations, the NRC staff concludes that the waste impacts of the combination alternative would be SMALL.

3.14 Evaluation of New and Significant Information

As stated in Section 3.1 of this SEIS, for Category 1 (generic) issues, the NRC staff can rely on the analysis in the LR GEIS (NRC 2013-TN2654) unless otherwise noted. Table 3-1 lists the Category 1 issues that apply to Perry Plant during the proposed LR period. For these issues, the NRC staff did not identify any new and significant information based on its review of the VistraOps ER (EH 2023-TN9534), the environmental site audits, review of available information as cited in this SEIS, or the environmental scoping process that would change the conclusions presented in the LR GEIS.

New and significant information must be new based on a review of the LR GEIS (NRC 2013-TN2654) as codified in Table B-1 of Appendix B to Subpart A of 10 CFR Part 51 (TN250). Such information must also bear on the proposed action or its impacts, presenting a picture of the impacts that are seriously different from those envisioned in the LR GEIS (i.e., impacts of greater severity than impacts considered in the LR GEIS, considering their intensity and context).

The NRC defines new and significant information in Regulatory Guide (RG) 4.2, Supplement 1, "Preparation of Environmental Reports for Nuclear Power Plant License Renewal Applications" (NRC 2013-TN4791), as (1) information that identifies a significant environmental impact issue that was not considered or addressed in the LR GEIS and, consequently, not codified in Table B-1, in Appendix B to Subpart A of 10 CFR Part 51 (TN250); or (2) information not considered in the assessment of impacts evaluated in the LR GEIS leading to a picture of the environmental consequences of the action that is significantly different than previously considered, such as an environmental impact finding different from that codified in Table B-1. Further, a significant environmental issue includes, but is not limited to, any new activity or aspect associated with the nuclear power plant that can act upon the environment in a manner or with an intensity and/or scope (context) not previously recognized.

In accordance with 10 CFR 51.53(c) (TN250), "Operating License Renewal Stage," the applicant's ER must analyze the Category 2 (site-specific) issues in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B. Additionally, the applicant's ER must discuss actions to mitigate any adverse impacts associated with the proposed action and environmental impacts of alternatives to the proposed action. In accordance with 10 CFR 51.53(c)(3, the applicant's ER does not need to analyze any Category 1 issue unless there is new and significant information about a specific issue.

NUREG-1555, Supplement 1, Revision 1, "Standard Review Plans for Environmental Reviews for Nuclear Power Plants for Operating License Renewal," describes the NRC process for identifying new and significant information (NRC 2013-TN3547). The search for new information includes:

- review of the VistraOps ER (EH 2023-TN9534) and the process for discovering and evaluating the significance of new information
- review of public comments
- review of environmental quality standards and regulations
- coordination with Federal, State, and local environmental protection and resource agencies
- review of technical literature as documented through this SEIS

New information that the staff discovers is evaluated for significance using the criteria set forth in the LR GEIS. For Category 1 issues in which new and significant information is identified, reconsideration of the conclusions for those issues is limited in scope to assessment of the relevant new and significant information; the scope of the assessment does not include other facets of an issue that the new information does not affect.

The NRC staff reviewed the discussion of environmental impacts associated with operation during the LR term in the GEIS and has conducted its own independent review, including a public involvement process (e.g., public meetings and comments) to identify new and significant issues for the Perry Plant LRA environmental review. The assessment of new and significant information for each resource is addressed in each resource area discussion.

3.15 Impacts Common to All Alternatives

This section describes the impacts that the NRC staff considers common to all alternatives discussed in this SEIS, including the proposed action and replacement power alternatives. In addition, the following sections discuss the termination of operations, the decommissioning of a nuclear power plant and potential replacement power facilities, and GHG emissions.

3.15.1 Fuel Cycle

This section describes the environmental impacts associated with the fuel cycles of both the proposed action and all replacement power alternatives that are analyzed in detail in this SEIS.

3.15.1.1 Uranium Fuel Cycle

The uranium fuel 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. Section 4.12.1.1 of the LR GEIS describes in detail the generic potential impacts of the radiological and nonradiological environmental impacts of the uranium fuel cycle and transportation of nuclear fuel and wastes (NRC 2013-TN2654). The NRC staff incorporates the information in the LR GEIS, Section 4.12.1.1 (NRC 2013-TN2654: pp. 4-183 to 4-197), here by reference. The LR GEIS does not identify any site-specific (Category 2) uranium fuel cycle issues.

As stated in the LR GEIS (NRC 2013-TN2654), the generic issues related to the uranium fuel cycle as identified in Table 3-1 would not be affected by continued operations associated with LR. The NRC staff identified no new and significant information for these issues. Thus, as concluded in the LR GEIS, the impacts of generic issues related to the uranium fuel cycle would be SMALL.

3.15.1.2 Replacement Power Plant Fuel Cycles

Fossil Fuel Energy Alternatives

Fuel cycle impacts for a fossil fuel fired power plant result from the initial extraction of fuel, cleaning and processing of fuel, transport of fuel to the facility, and management and ultimate disposal of any solid wastes from fuel combustion. These impacts are discussed in more detail in Section 4.12.1.2 of the LR GEIS (NRC 2013-TN2654) and can generally include the following:

- significant changes to land use and visual resources

- impacts on air quality, including release of criteria pollutants, fugitive dust, volatile organic compounds, and methane into the atmosphere
- noise impacts
- geology and soil impacts caused by land disturbances and mining
- water resource impacts, including degradation of surface water and groundwater quality
- ecological impacts, including loss of habitat and wildlife disturbances
- historic and cultural resource impacts within the mine or pipeline footprint associated with the extraction of the fuel
- socioeconomic impacts from employment of both the mining workforce and service and support industries
- environmental justice impacts
- health impacts on workers from exposure to airborne dust and methane gases
- generation of industrial wastes

Renewable Energy Alternatives

For renewable energy technologies that rely on the extraction of a fuel source (e.g., biomass), such alternatives may have fuel cycle impacts with some similarities to those associated with the uranium fuel cycle. However, as stated in Section 4.12.1.2 of the LR GEIS (NRC 2013-TN2654) (under “Renewable Energy Alternatives”) the fuel cycle for renewable technologies such as wind, solar, geothermal, and ocean wave and current are difficult to define. This is because the associated natural resources exist regardless of any effort to harvest them for electricity production. Impacts from the presence or absence of these renewable energy technologies are often difficult to determine (NRC 2013-TN2654).

3.15.2 Terminating Power Plant Operations and Decommissioning

This section describes the environmental impacts associated with the termination of operations and the decommissioning of a nuclear power plant and replacement power alternatives. All operating power plants will terminate operations and be decommissioned at some point after the end of their operating life or after a decision is made to cease operations. For the proposed action at Perry Plant, LR would delay this eventuality for an additional 20 years beyond the current license period.

3.15.2.1 Existing Nuclear Power Plant

Decommissioning would occur whether Perry Plant is shut down at the end of the current operating license term or at the end of the LR term. NUREG-0586 evaluates the environmental impacts from the activities associated with the decommissioning of any reactor before or at the end of an initial or renewed license (NRC 2002-TN7254). As discussed in Section 2.2.3 of this SEIS, VistraOps characterizes the sediment that is stored in the Chemical Cleaning Lagoon and Unit 2 Circulating Water System Pumphouse flume area and logs the data in the site 10 CFR 50.75(g) (TN249) file, which will be used to inform decommissioning activities (Vistra 2024-TN9925). Additionally, Section 4.12.2.1 of the LR GEIS (NRC 2013-TN2654) summarizes the incremental environmental impacts associated with nuclear power plant decommissioning activities. As noted in Table 3-1, there is one Category 1 issue, “Termination of Nuclear Power

Plant Operations and Decommissioning," applicable to Perry Plant decommissioning. The LR GEIS did not identify any site specific (Category 2) decommissioning issues.

3.15.2.2 Replacement Power Plants

3.15.2.2.1 Fossil Fuel Alternatives

The environmental impacts from the termination of power plant operations and decommissioning of a power-generating facility are dependent on the facility's decommissioning plan. The decommissioning plan outlines the actions necessary to restore the site to a condition equivalent in character and value to the site on which the facility was first constructed (NRC 2013-TN2654). General elements and requirements for a fossil fuel energy facility decommissioning plan are discussed in Section 4.12.2.2 of the LR GEIS (NRC 2013-TN2654) and can include the removal of structures to at least 3 ft (1 m) below grade, the removal of all accumulated waste materials, the removal of intake and discharge structures, and the cleanup and remediation of incidental spills and leaks at the facility. The environmental consequences of decommissioning can generally include the following:

- short-term impacts on air quality and noise from the deconstruction of facility structures
- short-term impacts on land use and visual resources
- long-term reestablishment of vegetation and wildlife communities
- socioeconomic impacts caused by decommissioning the workforce and the long-term loss of jobs
- elimination of health and safety impacts on operating personnel and the general public.

The NRC staff considers these impacts to be representative of those associated with decommissioning any thermoelectric power-generating facility. The NRC staff incorporates the information in the LR GEIS, Section 4.12.2.2 (NRC 2013-TN2654: pp. 4-224, 4-225), herein by reference.

3.15.2.2.2 Renewable Energy Alternatives

Termination of power plant operation and decommissioning for renewable energy facilities would generally be similar to the activities and impacts discussed for fossil fuel alternatives above. Decommissioning would involve the removal of facility components and any operational wastes and residues to restore sites to a condition equivalent in character and value to the site on which the facility was first constructed. In other circumstances, supporting infrastructure (e.g., buried utilities and pipelines) could be abandoned in place (NRC 2013-TN2654). The range of possible decommissioning considerations and impacts, depending on the renewable energy alternative considered, are discussed in Section 4.12.2.2 of the LR GEIS (under "Renewable Alternatives") (NRC 2013-TN2654). The NRC staff incorporates the information in the LR GEIS, Section 4.12.2.2 (NRC 2013-TN2654: pp. 4-227, 4-228), herein by reference.

3.15.3 Greenhouse Gas Emissions and Climate Change

The following sections discuss GHG emissions and climate change impacts. Section 3.15.3.1 evaluates GHG emissions associated with operation of the Perry Plant and replacement power alternatives. Section 3.15.3.7 discusses the observed changes in climate and potential future climate change during the LR term, based on climate model simulations under future global

GHG emissions scenarios, and impacts from climate change on environmental resources where there are incremental impacts of the proposed action (LR).

3.15.3.1 Greenhouse Gas Emissions from the Proposed Project and Alternatives

Gases found in the Earth's atmosphere that trap heat and play a role in the Earth's climate are collectively termed GHGs. These GHGs include carbon dioxide (CO_2), methane (CH_4), nitrous oxide, water vapor, and fluorinated gases, such as hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride. The Earth's climate responds to changes in concentrations of GHGs in the atmosphere because these gases affect the amount of energy absorbed and heat trapped by the atmosphere. Increasing concentrations of GHGs in the atmosphere generally increase the Earth's surface temperature. Since 1850, CO_2 concentrations have increased by almost 50 percent, CH_4 concentrations have increased by more than 156 percent, and nitrogen dioxide by 23 percent (USGCRP 2023-TN9762). In 2019, global net GHG emissions were estimated to be 59±6.6 gigatons of CO_2 equivalents (CO_2eq), with the largest share in gross GHG emissions being CO_2 from fossil fuels combustion and industrial processes (IPCC 2023-TN8557). The annual rate of increase in atmospheric carbon dioxide over the last 60 years is 100 times faster than previous natural increases (USGCRP 2023-TN9762). The year 2023 set a record high concentration for global average atmospheric CO_2 concentration at 419.3 parts per million (NOAA 2024-TN10000).

Long-lived GHGs—CO_2, (CH_4, nitrous oxide, and fluorinated gases—are well mixed throughout the Earth's atmosphere, and their impact on climate is long-lasting and cumulative in nature as a result of their long atmospheric lifetimes (EPA 2016-TN7561, USGCRP 2023-TN9762). Therefore, the extent and nature of climate change is not specific to where GHGs are emitted. $CO_2$is of primary concern for global climate change because it is the primary gas emitted as a result of human activities. Climate change is the decades or longer change in climate measurements (e.g., temperature and precipitation) that has been observed on a global, national, and regional level (IPCC 2007-TN7421; EPA 2016-TN7561; USGCRP 2014-TN3472) Climate change research indicates that the cause of the Earth's warming over the last 50 to 100 years is due to the buildup of GHGs in the atmosphere resulting from human activities (IPCC 2013-TN7434, IPCC 2021-TN7435, IPCC 2023-TN8557; USGCRP 2014-TN3472, USGCRP 2017-TN5848, USGCRP 2018-TN5847). Climate change can vary regionally, spatially, and seasonally, depending on local, regional, and global factors. Just as regional climate differs throughout the world, the impacts of climate change can vary among locations.

The sixth assessment synthesis report from the Intergovernmental Panel on Climate Change (IPCC) states that "[i]t is unequivocal that human influence has warmed the atmosphere, ocean, and land" (IPCC 2023-TN8557). The Fifth National Climate Assessment states that "[i]t is unequivocal that human activities have increased atmospheric levels of carbon dioxide and other GHGs. It is also unequivocal that global average temperature has risen in response" (USGCRP 2023-TN9762). The EPA has determined that GHGs "may reasonably be anticipated both to endanger public health and to endanger public welfare" (74 FR 66496-TN245).

3.15.3.2 Proposed Action

Operation of the Perry Plant results in direct and indirect GHG emissions. VistraOps calculated direct (auxiliary boilers and diesel generators) and indirect (worker vehicles) GHG emissions, which are provided in Table 3-34. VistraOps does not maintain an inventory of GHG emissions resulting from visitors and delivery vehicles (EH 2023-TN9534). Fluorinated gas emissions from refrigerant sources can result from leakage, servicing, repair, or disposal of sources.

Perfluorocarbons are present at the Perry Plant. VistraOps maintains a program to manage stationary refrigeration appliances at the Perry Plant to recycle, recapture, and reduce emissions of ozone-depleting substances. Therefore, potential GHG emissions presented in Table 3-34 does not account for these sources.

Table 3-34 Annual Greenhouse Gas Emissions from Operation at the Perry Nuclear Power Plant (tons of carbon dioxide equivalents [CO_2eq])[(a)]

Year	Combustion Sources[(b)]	Workforce Commuting[(c)]	Total
2017	2,000	3,120	5,120
2018	420	3,120	3,540
2019	2,130	3,120	5,240
2020	500	3,120	3,620
2021	1,500	3,120	4,621

(a) Emissions were ported in metric tons and converted to short tons and rounded up. To convert to metric tons, multiply by 0.90718. Expressed in carbon dioxide equivalents (CO_2eq), a metric used to compare the emissions of greenhouse gases (GHG) based on their global warming potential (GWP). The GWP is a measure used to compare how much heat a GHG traps in the atmosphere. The GWP is the total energy that a gas absorbs over a period of time compared to carbon dioxide. CO_2eq is obtained by multiplying the amount of the GHG by the associated GWP.
(b) Combustion sources include two auxiliary boilers and three emergency diesel generators.
(c) Emissions based on a workforce of 645 and a 4.6 percent carpool rate was assumed.
Sources: EH 2023-TN9534 and Vistra 2024-TN9925.

3.15.3.3 No-Action Alternative

Under the no-action alternative, the NRC would not issue a renewed license, and the Perry Plant would permanently shut down on or before the expiration of the current renewed license. At some point, all nuclear plants will terminate operations and undergo decommissioning. The decommissioning GEIS (NUREG-0586) (NRC 2002-TN7254) considers the environmental impacts of decommissioning. Therefore, the scope of impacts considered under the no-action alternative includes the immediate impacts resulting from activities at the Perry Plant that would occur between plant shutdown and the beginning of decommissioning (i.e., activities and actions necessary to cease operation of the Perry Plant). Facility operations would terminate at before the expiration of the current renewed license. When the facility stops operating, a reduction in GHG emissions from activities related to plant operation, such as the use of generators and employee vehicles would occur. The NRC staff anticipates that GHG emissions for the no-action alternative would be less than those presented in Table 3-34, which shows the estimated direct GHG emissions from operation of Perry Plant and associated mobile emissions.

3.15.3.4 Natural Gas-Fired Combined-Cycle Alternative

The natural gas alternative would consist of a NGCC plant with a design capacity of 1,350 MWe. The LR GEIS (NRC 2013-TN2654) presents life-cycle GHG emissions associated with natural gas power generation. As presented in Table 4.12-5 of the LR GEIS, life-cycle GHG emissions from natural gas can range from 120 to 930 g C_{eq}/kWh. Using emission factors developed by the DOE's NETL (NETL 2019-TN7484), the NRC staff estimates that direct emissions from the operation of a 1,350 MWe NGCC plant would total 4.39 million tons (3.98 million MT) of CO_2eq per year.

3.15.3.5 *Renewable and Natural Gas Combination Alternative*

The combination alternative would consist of a 764 MW NGCC plant and six 125 MW solar installations with battery storage, and three wind installations totaling 540 MW. The 2013 LR GEIS (NRC 2013-TN2654) presents life-cycle GHG emissions associated with natural gas power generation and renewable energy sources. As presented in Tables 4.12-5 and 4.12-6 of the 2013 LR GEIS, life cycle GHG emissions from natural gas can range from 120 to 930 g C_{eq}/kWh, from wind power can range from 2 to 81 g C_{eq}/kWh, and from solar can range from 5 to 217 g C_{eq}/kWh. However, emissions associated with operation of renewable energy sources (wind and solar) would be negligible because no direct fossil fuels are burned to generate electricity. Associated GHG emission would primarily be from the new 764 MW NGCC. The NRC staff estimates that direct emissions from the operation of a 764 MW NGCC would emit 2.48 million tons (2.25 million MT) of carbon dioxide equivalents (CO_2eq) per year.

3.15.3.6 *Summary of Greenhouse Gas Emissions from the Proposed Action and Alternatives*

Table 3-35 below presents the direct GHG emission from facility operations under the proposed action of LR and alternatives to the proposed action. The GHG emissions from the NGCC alternative and the combination alternative are several orders of magnitude greater than those from continued operation of the Perry Plant. If Perry Plant’s generating capacity were to be replaced by the NGCC alternative or the combination alternative, there would be an increase in GHG emissions. Therefore, the NRC staff concludes that the continued Perry Plant (the proposed action) results in GHG emissions avoidance as compared to the NGCC alternative or the combination alternative.

Table 3-35 Direct Greenhouse Gas Emissions from Facility Operations at Perry Nuclear Power Plant under the Proposed Action and Alternatives

Technology/Alternative	CO_2eq TPY[(a)]
Proposed Action[(b)]	2,130
No-Action[(c)]	<2,130
NGCC	4.39 million
Combination Alternative[(d)]	2.48 million

CO_2eq = carbon dioxide equivalent; NGCC = natural gas-fired combined- cycle; TPY= ton(s) per year.
(a) Carbon dioxide equivalent (CO_2eq) is a metric used to compare the emissions of greenhouse gases (GHGs) based on their global warming potential (GWP). The GWP is a measure used to compare how much heat a GHG traps in the atmosphere. The GWP is the total energy that a gas absorbs over a period of time compared to carbon dioxide. CO_2eq is obtained by multiplying the amount of the GHG by the associated GWP.
(b) GHG emissions include direct emissions from onsite combustion sources.
(c) Emissions resulting from activities at the Perry Plant that would occur between plant shut down and the beginning of decommissioning and assumed not to be greater that GHG emissions from operation of the Perry Plant.
(d) Emission primarily from operation of a NGCC plant.

3.15.3.7 *Climate Change*

<u>Average Annual and Observed Trends in Climate Change Indicators</u>

Global surface temperature has increased faster since 1970 than in any other 50-year period over at least the last 2,000 years (IPCC 2023-TN8557). On a global level, from 2011 through 2020, the global surface temperature was 2°F (1.1°C) warmer than the preindustrial period (1850–1900) (IPCC 2023-TN8557). From 1901 to 2021, global precipitation has increased at an average rate of 0.04 in. (0.0.1 cm) per decade (EPA 2023-TN10021). From 1901 to 2021, the average surface temperature across the contiguous United States has increased by 0.17°F

(0.09°C) per decade (EPA 2023-TN10021). From 1901 to 2021, average annual precipitation has increased by 0.20 in. (50 cm) per decade in the contiguous United States (EPA 2022-TN9163).

The United States Global Change Research Program (USGCRP), reports that since 1970 the contiguous United States is warming at faster than the global average. Since 1970, global temperature has increased by 1.7°F (0.9°C) while average surface temperature in the contiguous United States have increased by 2.5°F (1.4°C) (USGCRP 2023-TN9762). Observed climate change indicators across the United States include increases in the frequency and intensity of heavy precipitation, earlier onset of spring snowmelt and runoff, rise of sea level and increased tidal flooding in coastal areas, an increased occurrence of heat waves, and a decrease in the occurrence of cold waves.

Climate change and its impacts can vary regionally, spatially, and seasonally, depending on local, regional, and global factors. Observed climate changes and impacts have not been uniform across the United States. Annual average temperature data for the Midwest between 2002–2021 (compared to 1901–1960) exhibit an increase of more than 2.0°F (1.1°C), and winter is warming nearly twice as fast as summer (USGCRP 2023-TN9762: Figure 2.4). The number of hot days (days at or above 95°F [35°C]) has decreased by 5.6 days, while the number of cold days (days at or below 32°F [0°C]) has decreased by 4.9 days in the Midwest from 2002–2021 compared to 1901–1960 (USGCRP 2023-TN9762). Average annual precipitation from 2002–2021 for the Midwest was 5–15 percent higher compared to the 1901–1960 average (USGCRP 2023-TN9762: Figure 2.4). The Midwest has experienced a 45 percent increase in the number of extreme precipitation days (defined as the top 1 percent of heaviest precipitation events) from 1958–2021 (USGCRP 2023-TN9762). Long term data (from 1900 to 2022) exhibits wetter conditions in the Midwest, with Ohio having a standardized precipitation evapotranspiration index ranging between 1.0 to 2.0 (USGCRP 2023-TN9762: Figure A4.9). Standardized precipitation evapotranspiration index measures the combination of precipitation and evapotranspiration to determine if an area is experiencing extreme drought or extreme moisture.

The Great Lakes have exhibited increases in surface temperatures, declining lake ice cover, increasing summer evaporation rates, and earlier seasonal stratification of temperatures (USGCRP 2018-TN5847). Between 1991 and 2020, water temperatures across the Great Lakes Basin increased by 0.43°C (0.77°F) per decade (ECCC/NOAA 2023-TN10049). Water levels in the Great Lakes have fluctuated since 1860, but annual average water levels over the last decades have declined (EPA 2024-TN10022; NOAA 2024-TN10023). Beginning in 1998 through 2019, Lake Erie experienced a decline in water levels, warmer temperatures, increased evaporation, decreased runoff, and low ice coverage (NOAA 2024-TN10024). Between 1973 and 2023, annual maximum ice coverage for the Great Lakes has decreased by approximately 5 percent per decade (NOAA 2024-TN10025). Seasonal maximum ice over on the Great Lakes is 53 percent of the lake areas and occurs mid-February to early March (NOAA 2024-TN10026). In February 2024, Lake Erie’s ice coverage reached a historic low at 0.05 percent (NOAA 2024-TN10027).

The NRC staff used the NOAA Climate at a Glance tool to analyze temperature and precipitation trends for Ohio’s Northeast climate division (where the Perry Plant is located). A trend analysis shows that between 1895 and 2023 the ambient average temperature has increased at a rate of 0.2°F (0.1°C) per decade, and average precipitation increased at a rate of 0.48 in. (1.2 cm) per decade (NOAA NCEI 2024-TN10028).

Climate Change Projections

Future global GHG emission concentrations (emission scenarios) and climate models are commonly used to project possible climate change. Climate model simulations often use GHG emission scenarios to represent possible future social, economic, technological, and demographic development that, in turn, drive future emissions. Climate models indicate that over the next decade, warming trends will be very similar across all emission scenarios (USGCRP 2023-TN9762). However, by mid-century (2040–2070) differences between projected temperatures under higher and lower emission scenarios become observable. The impacts of climate change increase with warming, and warming is certain to continue if emissions of carbon dioxide do not reach net zero (USGCRP 2023-TN9762).

The IPCC has generated various representative concentration pathway (RCP) scenarios commonly used by climate modeling groups to project future climate conditions (IPCC 2000-TN7652, IPCC 2013-TN7434, USGCRP 2017-TN5848, USGCRP 2018-TN5847). In the IPCC Fifth Assessment Report, four RCPs were developed and are based on the predicted changes in radiative forcing (a measure of the influence that a factor, such as GHG emissions, has in changing the global balance of incoming and outgoing energy) in the year 2100, relative to preindustrial conditions. The four RCP scenarios are numbered in accordance with the change in radiative forcing measured in watts per square meter (i.e., +2.6 [very low], +4.5 [lower], +6.0 [mid-high], and +8.5 [higher]) (USGCRP 2018-TN5847). For example, RCP 2.6 is representative of a mitigation scenario aimed at limiting the increase of global mean temperature to 3.6°F (2°C) (IPCC 2014-TN7651). The RCP 8.5 reflects a continued increase in global emissions resulting in increased warming by 2100. In the IPCC Working Group contribution to the Sixth Assessment Report, five shared socioeconomic pathways (SSPs) were used along with associated modeling results as the basis for their climate change assessments (IPCC 2021-TN7435). These five socioeconomic pathway scenarios (SSP1-1.9, SSP1-2.6, SSP2-4.5, SSP3-7.0, and SSP5-8.5) cover a range of GHG pathways and climate change mitigation.

The NRC staff considered the best available climate change studies performed by USGCRP as part of the NRC staff's assessment of potential climate change projections during the Perry Plant LR term (2026–2046). The Fourth National Climate Assessment uses RCPs when presenting projected climate change. The Fifth National Climate Assessment uses SSPs, RCPs, and global warming levels when presenting projected climate change. The results of these studies are summarized below.

Projections based on the intermediate (RCP 4.5) and very high (RCP 8.5) scenarios for mid-century (2036–2065) indicate annual average temperature increases across the Midwest ranging from 4.21 to 5.29°F (2.3 to 2.9°C) relative to 1976–2005 (USGCRP 2017-TN5848: Table 6.4) The coldest and warmest daily temperatures of the year are expected to increase by 9.44°F (5.2°C) and 6.71°F (3.7°C), respectively under a very high emission scenario (RCP 8.5) by mid-century (2036–2065) relative to 1975–2005 (USGCRP 2017-TN5848: Table 6.5). Projections based on the intermediate (RCP 4.5) emission scenario for the mid-century (2036–2065), indicate precipitation increases across the Midwest ranging from 0.5 to 2 in. (1.3 to 5.0 cm) relative to the previous five decades (1991–2020) (USGCRP 2023-TN9762: Figure 4.3).

Changes in precipitation and temperature are expected to exacerbate drought for portions of the U.S. Projected changes in evapotranspiration based on the intermediate (RCP 4.5) scenario for Ohio indicates an increase ranging from 0 to 1 in. (0 to 2.5 cm) by midcentury (2036–2065 relative to 1991–2020). Projected changes in average summer soil moisture by midcentury (2036–2065 relative to 1991–2020) under an intermediate (RCP 4.5) scenario for Ohio indicates a decrease of 0.05 to 0.2 in. (0.13 to 0.51 cm) (USGCRP 2023-TN9762: Figure 4.6). Projected changes in cumulative annual runoff for mid-century (2036–2065, relative to 1991–2020) for the Midwest under an intermediate scenario (RCP 4.5) and very high scenario (RCP 8.5) indicate increases ranging from 5 to 20 percent (USGCRP 2023-TN9762: Figure 24.11). Increases in cumulative annual runoff leads to increases in flooding.

Long-term lake level projections have high uncertainty (USGCRP 2023-TN9762). The complex interaction between lakes, land, and atmosphere have made it difficult to model long term projections of lake levels. For instance, based on the Great Lakes-Atmosphere Regional Model, Kayastha et al. 2022 (TN10037) reported projections in Lake Erie by 2020–2049 (relative to 2010–2019) under RCP 8.5 scenario ranging from -0.08 to +0.54 m (-3.1 to 21.3 in.), with an average annual water level increase of 0.28 m (11.0 in.). Lake surface temperatures are projected to increase across the Great Lakes. Under RCP 4.5 and RCP 8.5 scenarios, annual Lake Erie surface temperatures are projected to increase by 1.2–2.2°F (0.67–1.2°C) and 1.6–2.5°F (0.94–1.38°C), respectively, by mid-century (2030–2049 relative to 2000–2019) (Xue et al. 2022-TN10039).

Increases in runoff, lake temperatures, and precipitation intensity are conditions that are conducive to increases in occurrence of harmful agal blooms. Lake Erie is particularly sensitive to harmful algal blooms because of its shallow depth and proximity to agricultural land for nutrient runoff (GLISA Undated-TN10040; EPA 2024-TN10042).

The effects of climate change on Perry Plant structures, systems and components are outside the scope of the NRC staff's LR environmental review. The environmental review describes the potential effects of continued nuclear power plant operation on the environment. Site-specific environmental conditions are considered when siting nuclear power plants. This includes the consideration of meteorological and hydrologic siting criteria as set forth in 10 CFR Part 100 (TN282), "Reactor Site Criteria." NRC regulations require that plant structures, systems and components important to safety be designed to withstand the effects of natural phenomena such as flooding, without loss of capability to perform safety functions. Further, nuclear power plants are required to operate within technical safety specifications in accordance with the NRC operating license, including coping with natural phenomenon hazards. The NRC conducts safety reviews prior to allowing licensees to make operational changes because of changing environmental conditions. Additionally, the NRC evaluates the operating conditions and physical infrastructure of nuclear power plants to assure ongoing safe operations under the plant's initial and renewed operating licenses through the NRC's Reactor Oversight Program. If new information about changing environmental conditions (such as rising sea levels or potential flooding that threaten safe operating conditions or challenge compliance with the plant's technical specifications) becomes available, the NRC will evaluate the new information to determine whether any safety-related changes are needed at licensed nuclear power plants. This is a separate and distinct process from the NRC staff's LR environmental review conducted in accordance with NEPA. Nonetheless, changes in climate could have broad implications for certain resource areas. As discussed below, the NRC staff considers the impacts of climate change on environmental resources that are incrementally affected by the proposed action.

Air Quality: Climate change can impact air quality as a result of changes in meteorological conditions. The formation, transport, dispersion, and deposition of air pollutants depend, in part, on weather conditions (IPCC 2007-TN7421). As discussed in Section 3.3.2, Lake County (where the Perry Plant is located) is designated an attainment area for ozone and $PM_{2.5}$. Ozone and $PM_{2.5}$ are particularly sensitive to climate change (IPCC 2007-TN7421; EPA 2009-TN9068;

USGCRP 2023-TN9762). Ozone is formed by the chemical reaction of nitrogen oxides and volatile organic compounds in the presence of heat and sunlight. The emission of ozone precursors also depends on the temperature, wind, and solar radiation (IPCC 2007-TN7421). Warmer temperatures, air stagnation, droughts, and wildfires are favorable conditions for higher levels of ozone and $PM_{2.5}$ (USGCRP 2023-TN9762). USGCRP reports that there is medium confidence that climate change is projected to worsen air quality in many U.S. regions (USGCRP 2023-TN9762). Nolte et al. (2018-TN8571) examined the impact of climate change on ozone and $PM_{2.5}$ under RCP 4.5, RCP 6.0, and RCP 8.5 scenarios for 2025–2035 relative to 1995–2005. For the Ohio Valley, increases in spring, autumn, and summer mean maximum daily 8 h ozone was projected by 2030, with summer increases under the RCP 8.5 scenario being the most statistically significant. With respect to $PM_{2.5,}$ however, concentrations exhibited increases and decreases depending on the scenario considered. Under the RCP 4.5 and RCP 8.5 scenario, Nolte et al. (2018) found statistically significant decreases in annual mean concentrations of total $PM_{2.5}$ for the Ohio Valley. Under a RCP 6.0 scenario, however, an increase in annual mean concentrations of total $PM_{2.5}$ was exhibited in the Ohio Valley.

Surface Water Resources: As stated above, the frequency of extreme precipitation and the average annual precipitation has been observed to increase in the Midwest while the region is also becoming wetter. Extreme precipitation (defined as the top 1 percent of daily precipitation accumulations) have increased about 45 percent in the Midwest because of more frequent extreme precipitation events (USGCRP 2023-TN9762: Figure 2.8). Climate projections indicate that mid-century (2036–2065) precipitation will increase in the Midwest including in Ohio. There is very high confidence that extreme precipitation events are becoming more frequent (USGCRP 2023-TN9762: Traceable Account, Key Message 4.1). As stated above, projections of cumulative annual runoff for mid-century also show increases ranging from 5 to 20 percent for the intermediate (RCP 4.5) and very high (RCP 8.5) emission scenarios. These hydrologic conditions point to increases in extreme precipitation, and combined with wetter conditions, increases in terrestrial flood magnitudes and frequencies. There is high confidence that increases in the frequency, severity, duration, and damages from floods are likely (USGCRP 2023-TN9762: Traceable Account, Key Message 4.1). As stated above, projections of Great Lakes water levels are highly uncertain because of the complex interaction between the lakes, land, and atmosphere. Under the RCP 8.5 emission scenario, Lake Erie could experience an average annual water level increase of 0.28 m (11.0 in.) in the 2020–2049, compared to 2010–2019. Higher water levels, combined with high-wind events may lead to shoreline erosion (USGCRP 2023-TN9762). Lake surface water temperatures are rising since 1980 (USGCRP 2023-TN9762: Figure 24.13). As stated above, Lake Erie surface water temperatures are projected to increase by 1.2–2.2°F (0.67 to 1.2°C) and 1.6–2.5°F (0.94 to 1.38°C), respectively, by mid-century (2030–2049 compared to 2000–2019). Winter ice covers decline because of increasing lake surface temperatures (USGCRP 2023-TN9762). However, how the lake surface warming will affect the entire depth of the lake is not well understood (USGCRP 2023-TN9762). Therefore, projected variations in intake water temperatures near Plant Perry, as well as any temperature-related implications to NPDES permitting requirements, are also uncertain.

3.16 <u>Cumulative Effects of the Proposed Action</u>

Actions considered in the cumulative effects (impacts) analysis include the proposed LR action when added to the environmental effects from past, present, and reasonably foreseeable future actions. The analysis considers all actions including minor ones, because the effects of individually minor actions may be collectively significant over a period of time. The goal of the cumulative effects analysis is to identify potentially significant effects. The environmental effects of the proposed LR action when combined with the effects of other actions could result in a cumulative impact.

The cumulative effects or impacts analysis only considers resources and environmental conditions that could be affected by the proposed LR action, including the effects of continued reactor operations during the LR term and any refurbishment activities at a nuclear power plant. In order for there to be a cumulative effect, the proposed action must have an incremental new, additive, or increased physical effect or impact on the resource or environmental condition beyond what is already occurring.

For the purposes of analysis, past and present actions include all actions that have occurred since the commencement of reactor operations up to the submittal of the LR request. Older actions are accounted for in baseline assessments presented in the affected environment discussions in Sections 3.2 through 3.13. The time frame for the consideration of reasonably foreseeable future actions is the 20-year LR term. Reasonably foreseeable future actions include current and ongoing planned activities through the end of the period of extended operation.

The incremental effects of the proposed action when added to the effects from past, present, and reasonably foreseeable future actions and other actions result in the overall cumulative effect. A qualitative cumulative effects analysis is conducted in instances where the incremental effects of the proposed action and past, present, and reasonably foreseeable future actions are uncertain or not well known.

Information from VistraOps' ER, responses to requests for additional information; information from other Federal, State, and local agencies; scoping comments; and information gathered during the environmental site audit at Perry Plant were used to identify past, present, and reasonably foreseeable future actions in the cumulative effects analysis.

No major changes to Perry Plant operations are anticipated during the proposed LR term. A 1,200 ft (370 m) shoreline protection project is proposed to stop erosion along the Lake Erie shoreline that would extend past existing shoreline protection features north of the cooling towers. The project was funded in 2023 and expected to be installed in 2024.

Other projects in the vicinity of the Perry Plant site include:

- North Perry erosion control—initiated in 2021
- Perry Township erosion control project—initiated in 2021
- US 20/N. Ridge Road widening and drainage replacement—initiated in 2023, expected completion in 2025

3.16.1 Air Quality

The region of influence for the cumulative air quality analysis consists of Lake County, where the Perry Plant is located. VistraOps has not proposed any refurbishment related activities during the LR term. As a result, air emissions from the nuclear power plant during the LR term would be similar to those presented in Section 3.3 of this SEIS. Consequently, cumulative changes to air quality in Lake County would be the result of future projects and actions that change present-day emissions within Lake County, unrelated to the proposed action. Construction activities (e.g., widening of roads, shoreline protection) identified in Section 3.15 could increase air emissions during their respective construction periods, but those air emissions would be temporary and localized. The proposed action would have no cumulative effect on air quality beyond what is already being experienced.

3.16.2 Water Resources

3.16.2.1 Surface Water Resources

The description of the affected environment in Section 3.5.1, "Surface Water Resources," is used as the basis for the cumulative impacts assessment for surface water resources. Lake Erie serves as both the only source of cooling system water and also the discharge sink for heated water and plant effluents from the closed-cycle cooling system. The large volume of Lake Erie makes it a highly reliable source of fresh water. There are no limits on the annual volume of water that Perry Plant can withdraw from Lake Erie. Perry Plant does not withdraw water from streams in the vicinity of the site nor does it discharge any cooling or plant effluent into local surface water bodies other than Lake Erie.

Discharges from Perry Plant are regulated under the current OEPA NPDES Permit No. 3IB00016*MD (EH 2023-TN9746). Currently, there is no limit specified for discharge water temperature at the final outfall. The intake for the cooling system makeup water and auxiliary water systems is located approximately 2,600 ft (800 m) offshore and is submerged at a depth of 20 to 23 ft (6.1 to 7.0 m) below mean water level and 12 ft (3.7 m) below the historical low lake level (EH 2023-TN9979). Generally, Lake Erie water temperatures are cooler at the bottom of the lake during summer months. The effects of projected future warming of lake water surface temperatures would be expected to affect bottom temperatures to a smaller degree. Nonetheless, the OEPA would be expected to alter NPDES discharge conditions as necessary to protect water quality in Lake Erie. As stated in Section 3.5.1.3, Perry Plant's CWA Section 401 Water Quality Certification remains valid (EH 2023-TN9534). The Perry Plant will continue operating under the current and future renewed NPDES permits during the LR period. Perry Plant will also continue to implement its SWPPP and SPCC plan. There are no planned dredge-and-fill activities during the LR term (EH 2023-TN9534). Therefore, the proposed action would have no cumulative effect beyond what is occurring under current plant operations.

3.16.2.2 Groundwater Resources

The description of the affected environment in Section 3.5.2 "Groundwater Resources," of this SEIS serves as the baseline for the cumulative impacts assessment for groundwater resources. The normal flow of groundwater within onsite aquifers is toward Lake Erie. The Perry Plant's location near the lake and the distance from other groundwater users helps to limit the potential for any noticeable cumulative groundwater use impacts. Perry Plant does not withdraw groundwater for plant use, and the influence of the underdrain system is estimated to be less than 500 ft (152 m), which is within the plant boundaries. Groundwater use at the site is not anticipated to significantly increase during the proposed LR operating term.

As described in Section 3.5.2.3 of this SEIS, recent releases of tritium to onsite groundwater via the underdrain system have occurred at the Perry Plant site. Groundwater is monitored and reported according to the GPP and other site-specific procedures. VistaOps has taken corrective actions (i.e., pumping from onsite piezometers) to prevent the movement of affected groundwater offsite in response to these releases. Tritium and difficult-to-detect radionuclides were not detected above background levels of 500 pCi/L within onsite monitoring wells representative of water not captured by the underdrain system. Additionally, potential releases of radioactivity from the underdrain system are monitored and reported as part of the liquid effluent release data within the ARERRs. A review of the 2019–2023 ARERRs (FENOC 2019-TN9952, FENOC 2020-TN9953; EH 2021-TN9954, EH 2022-TN9955, EH 2023-TN9956) indicates the average diluted concentration of liquid effluent releases from plant operations have been within permitted values per 10 CFR Part 20-TN283. Therefore, the NRC staff expects that the activities described above would not contribute to cumulative impacts of the site and are bounded by those described in Section 3.5.2 of this SEIS.

3.16.3 Socioeconomics

As discussed in Section 3.10.7, continued operation of Perry Plant during the LR term would have no impact on socioeconomic conditions in the region beyond what is already being experienced. VistraOps has no planned activities at Perry Plant beyond continued reactor operations and maintenance.

Because VistraOps has no plans to hire additional workers during the LR term, overall expenditures and employment levels at Perry Plant would remain unchanged and there would be no new or increased demand for housing and public services. Therefore, the only contributory effects would come from reasonably foreseeable future planned operational activities at Perry Plant and other planned offsite activities, unrelated to the proposed action (LR). When combined with past, present, and reasonably foreseeable future activities, the proposed action would have no new or increased effect beyond what is currently being experienced.

3.16.4 Human Health

The NRC and EPA have established radiological dose limits to protect the public and workers from both acute and long-term exposure to radiation and radioactive materials. These dose limits are specified in 10 CFR Part 20 (TN283) and 40 CFR Part 190 (TN739), "Environmental Radiation Protection Standards for Nuclear Power Operations." As discussed in Section 3.11.6, "Human Health," of this SEIS, the NRC staff concludes that the impacts on human health from continued plant operations during the LR term would be SMALL.

For the purposes of this cumulative impact analysis, the geographical area considered is the area within a 50 mi (80 km) radius of Perry Plant. There are no other operational nuclear power plants within this 50 mi (80 km) radius. As discussed in Section 3.13.1, "Radioactive Waste," of this SEIS, Perry Plant stores spent nuclear fuel in a spent fuel pool and in an onsite ISFSI. The ISFSI and spent fuel pool are sized to accommodate all spent nuclear fuel generated through the period of extended operation (EH 2023-TN9534).

The EPA regulations at 40 CFR Part 190 (TN739) limit the dose to members of the public from all sources in the nuclear fuel cycle, including nuclear power plants, fuel fabrication facilities, waste disposal facilities, and transportation of fuel and waste. As discussed in Section 3.13.1 in this SEIS, Perry Plant has a REMP that measures radiation and radioactive materials in the environment from Perry Plant operations, its ISFSI, and all other sources. The NRC staff reviewed the radiological environmental monitoring results for the 5 year period from 2018 through 2022 as part of this cumulative impacts assessment (FENOC 2019-TN9952, FENOC 2020-TN9953; EH 2021-TN9954, EH 2022-TN9969, EH 2023-TN9970). The review of Perry Plant's data showed no indication of an adverse trend in radioactivity levels in the environment from either Perry Plant or the ISFSI. The data showed that there was no measurable impact on the environment from operations at Perry Plant.

In summary, the NRC staff concludes that there would be no cumulative effect on human health resulting from the proposed LR action beyond what is already being experienced, in combination with the cumulative effects from other sources. The NRC staff bases this conclusion on its review of REMP data, radioactive effluent release data, and worker dose data; the expectation that Perry Plant would continue to comply with Federal radiation protection standards during the period of extended operation; and the continued regulation of any future development or actions in the vicinity of the Perry Plant site by the NRC and the State of Ohio.

3.16.5 Environmental Justice

This cumulative impact analysis evaluates the potential for disproportionate 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 the continued operational effects of the Perry Plant during the LR term. Everyone living near Perry Plant, including minority and low-income populations, currently experience its operational effects. The NRC addresses environmental justice by identifying the location of minority and low-income populations, determining whether there would be any potential human health or environmental effects, and whether any of the effects may be disproportionate and adverse to these populations.

Adverse health effects are measured in terms of the risk and rate of fatal or nonfatal adverse impacts on human health. Disproportionate and adverse human health effects occur when the risk or rate of exposure to an environmental hazard for a minority or low-income population exceeds the risk or exposure rate for the general population or for another appropriate comparison group. Disproportionate environmental effects refer to impacts or risks of impacts in the natural or physical environment in a minority or low-income community that appreciably exceed 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 preceding sections of this chapter. As previously discussed in this chapter, the LR impacts for all resource areas (e.g., land, air, water, and human health) would be SMALL.

As discussed in Section 3.12.2, minority and low-income populations would not likely experience disproportionate and adverse human health and environmental effects from the proposed action and the continued operation of Perry Plant. Because VistraOps has no plans to hire additional workers during the LR term, employment levels at Perry Plant would remain unchanged, and there would be no additional demand for housing or increase in traffic. Based on this information and the analysis of human health and environmental effects, it is not likely that there would be any disproportionate and adverse contributory effects on minority and low-income populations from the continued operation of Perry Plant during the LR term beyond what is already being experienced. Therefore, the only contributory effects would come from reasonably foreseeable future planned activities at Perry Plant, and other reasonably foreseeable future offsite activities, unrelated to the proposed action (LR).

When combined with past, present, and reasonably foreseeable future activities, the NRC staff concludes that the proposed action (LR) would not likely cause disproportionate and adverse human health and environmental effects on minority and low-income populations near Perry Plant.

3.16.6 Waste Management and Pollution Prevention

This section considers the incremental waste management impacts of the LR term when added to the contributory effects of other past, present, and reasonably foreseeable future actions. As discussed in Section 3.13.3, “Proposed Action,” of this SEIS, the potential waste management impacts from continued operations at Perry Plant during the LR term would be SMALL. As discussed in Section 3.13.3, “Proposed Action,” of this SEIS, the NRC staff concludes that the potential waste management impacts from continued operations at Perry Plant during the LR term would be SMALL.

As discussed in Sections 3.13.1 and 3.13.2 of this SEIS, VistraOps maintains waste management programs for radioactive and nonradioactive waste generated at Perry Plant and is required to comply with Federal and State permits and other regulatory waste management requirements. All industrial facilities, including nuclear power plants and other facilities within a 50 mi (80 km) radius of Perry Plant, are also required to comply with appropriate NRC, EPA, and State requirements for the management of radioactive and nonradioactive waste. Current waste management activities at Perry Plant would likely remain unchanged during the LR term, and continued compliance with Federal and State requirements for radioactive and nonradioactive waste is expected.

Therefore, the NRC staff concludes that there would be no cumulative effect from the proposed action caused by continued radioactive and nonradioactive waste generation. This is based on Perry Plant’s continued compliance with Federal and State of Ohio requirements for radioactive and nonradioactive waste management and the regulatory compliance of other waste producers in the area.

3.17 Resource Commitments Associated with the Proposed Action

This section describes the NRC’s consideration of potentially unavoidable adverse environmental impacts that could result from implementation of the proposed action and alternatives; the relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity; and the irreversible and irretrievable commitments of resources.

3.17.1 Unavoidable Adverse Environmental Impacts

Unavoidable adverse environmental impacts are impacts that would occur after implementation of all workable mitigation measures. Carrying out any of the replacement 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 Federal EPA and State emissions standards. Chemical and radiological emissions would not exceed the national emission standards for hazardous air pollutants.

During nuclear power plant operations, workers and members of the public would face unavoidable exposure to low levels of radiation as well as 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 regulatory standards or administrative control limits. In comparison, the alternatives involving the construction and operation of a non-nuclear power-generating facility would also result in unavoidable exposure to hazardous and toxic chemicals, for workers and the public.

The generation of spent nuclear fuel and waste material, including low-level radioactive waste, hazardous waste, and nonhazardous waste, would be unavoidable. Hazardous and nonhazardous wastes would be generated at some 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, the NRC staff expects that power plant operators would optimize all waste management activities and operations in a way that generates the smallest possible amount of waste.

3.17.2 Relationship Between Short-Term Use of the Environment and Long-Term Productivity

The operation of power-generating facilities would result in short-term uses of the environment, as described in Sections 3.2 through 3.13 (see sections titled, “Proposed Action,” “No Action,” and “Replacement Power Alternatives: Common Impacts”). Short term is the period of time when continued power-generating activities take place.

Power plant operations require short-term use of the environment and commitment of resources (e.g., land and energy), indefinitely or permanently. Certain short-term resource commitments are substantially greater under most energy alternatives, including LR, than under the no-action alternative because of the continued generation of electrical power and the continued use of generating sites and associated infrastructure. During operations, all energy alternatives entail similar relationships between local short-term uses of the environment and the maintenance and enhancement of long-term productivity.

Air emissions from nuclear power plant operations introduce small amounts of radiological and nonradiological emissions to the region around the nuclear power plant site. Over time, these emissions would result in increased concentrations and exposure, but the NRC staff does not expect that these emissions would affect air quality or radiation exposure to the extent that they would impair public health and long-term productivity of the environment.

Continued employment, expenditures, and tax revenues generated during power plant operations 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 require an increase in energy and 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 are 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.

3.17.3 Irreversible and Irretrievable Commitment of Resources

Resource commitments are irreversible when primary or secondary impacts limit the future options for use of a resource. For example, the consumption or loss of nonrenewable resources is irreversible. An irretrievable commitment refers to the use or consumption of resources for a period of time (e.g., for the duration of the action under consideration) that are neither renewable nor recoverable for future use. Irreversible and irretrievable commitments of resources for electrical power generation include the commitment of land, water, energy, raw materials, and other natural and human-made resources required for power plant operations. In general, the commitments of capital, energy, labor, and material resources are also irreversible.

The implementation of any of the replacement energy alternatives considered in this SEIS would entail the irreversible and irretrievable commitments of energy, water, chemicals, and—in some cases—fossil fuels. These resources would be committed during the LR term and over the entire life cycle of the power plant, and they would be unrecoverable.

Energy expended would be in the form of fuel for equipment, vehicles, power plant operations, and electricity for equipment and facility operations. Electricity and fuel would be purchased from offsite commercial sources. Water would be obtained from existing water supply systems or withdrawn from surface water or groundwater. These resources are readily available, and the NRC staff does not expect that the amounts required would deplete available supplies or exceed available system capacities.

4 CONCLUSIONS

4.1 Environmental Impacts of License Renewal

This draft supplemental environmental impact statement (SEIS) contains the environmental review of the application for the renewed operating license for Perry Nuclear Power Plant (Perry Plant), Unit 1. After reviewing the site-specific (Category 2) environmental issues in this draft SEIS, the NRC staff concludes that issuing a renewed license for Perry Plant would have SMALL impacts for the Category 2 issues applicable to the LR at Perry Plant. The NRC staff considered mitigation measures for each Category 2 issue, as applicable. The NRC staff concludes that no additional mitigation measure is warranted.

4.2 Comparison of Alternatives

In Chapter 3 of this draft SEIS, the NRC staff considered the following alternatives to issuing a renewed operating license to Perry Plant:

- no-action alternative
- natural gas-fired combined-cycle
- renewable and natural gas combination alternative

Based on the review presented in this draft SEIS, the NRC staff concludes that the environmentally preferred alternative is the proposed action. The NRC staff recommends that a renewed Perry Plant operating license be issued. As shown in Table 2-2, all other power-generation alternatives have impacts in more than one resource area that are greater than LR, in addition to the environmental impacts inherent to new construction projects. To make up the lost power generation if the NRC does not issue a renewed license for Perry Plant (i.e., the no-action alternative), energy decision-makers may implement one of the replacement power alternatives discussed in Chapter 3, or a comparable alternative capable of replacing the power generated by Perry Plant.

4.3 Recommendation

The NRC staff's preliminary recommendation is that the adverse environmental impacts of LR for Perry Plant are not so great that preserving the option of LR for energy-planning decisionmakers would be unreasonable. The NRC is making this preliminary recommendation after carrying out the following activities:

- examined the analysis and findings in NUREG-1437
- reviewed the information provided in the applicant's ER
- consulted with other Federal, State, and local agencies and Native American Tribes
- conducted an independent evaluation of the issues during the site audit
- considered the public comments received for the review (during the scoping process)
- evaluate new and significant information

5 REFERENCES

10 CFR Part 2. *Code of Federal Regulations*, Title 10, *Energy*, Part 2, “Rules of Practice for Domestic Licensing Proceedings and Issuance of Orders.” TN6204.

10 CFR Part 20. *Code of Federal Regulations*, Title 10, *Energy*, Part 20, “Standards for Protection Against Radiation.” TN283.

10 CFR Part 50. *Code of Federal Regulations*, Title 10, *Energy*, Part 50, “Domestic Licensing of Production and Utilization Facilities.” TN249.

10 CFR Part 51. *Code of Federal Regulations*, Title 10, *Energy*, Part 51, “Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions.” TN250.

10 CFR Part 54. *Code of Federal Regulations*, Title 10, *Energy*, Part 54, “Requirements for Renewal of Operating Licenses for Nuclear Power Plants.” TN4878.

10 CFR Part 72. *Code of Federal Regulations*, Title 10, *Energy*, Part 72, “Licensing Requirements for the Independent Storage of Spent Nuclear Fuel, High-Level Radioactive Waste, and Reactor-Related Greater than Class C Waste.” TN4884.

10 CFR Part 100. *Code of Federal Regulations*, Title 10, *Energy*, Part 100, “Reactor Site Criteria.” TN282.

15 CFR Part 930. *Code of Federal Regulations*, Title 15, *Commerce and Foreign Trade*, Part 930, “Federal Consistency with Approved Coastal Management Programs.” TN4475.

18 CFR Part 157. *Code of Federal Regulations*, Title 18, *Conservation of Power and Water Resources*, Part 157, “Applications for Certificates of Public Convenience and Necessity and for Orders Permitting and Approving Abandonment Under Section of the Natural Gas Act.” TN7483.

36 CFR Part 60. *Code of Federal Regulations*, Title 36, *Parks, Forests, and Public Property*, Part 60, “National Register of Historic Places.” TN1682.

40 CFR Part 50. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 50, “National Primary and Secondary Ambient Air Quality Standards.” TN1089.

40 CFR Part 51. Code of Federal Regulations, Title 40, Protection of Environment, Part 51, “Requirements for Preparation, Adoption, and Submittal of Implementation Plans.” TN1090.

40 CFR Part 81. *Code of Federal Regulations*, Title 40, *Air Programs*, Subchapter C, *Protection of Environment*, Part 81, “Designation of Areas for Air Quality Planning Purposes.” TN7226.

40 CFR Part 110. *Code of Federal Regulations*, Title 40, Protection of Environment, Part 110, “Discharge of Oil.” TN8485.

40 CFR Part 112. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 112, "Oil Pollution Prevention." TN1041.

40 CFR Part 125. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 125, "Criteria and Standards for the National Pollutant Discharge Elimination System." TN254.

40 CFR Part 131. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 131, "Water Quality Standards." TN4814.

40 CFR Part 190. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 190, "Environmental Radiation Protection Standards for Nuclear Power Operations." TN739.

40 CFR Part 302. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 302, "Designation, Reportable Quantities, and Notification." TN5489.

40 CFR Part 355. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 302, "Emergency Planning and Notification." TN5493.

50 CFR Part 402. *Code of Federal Regulations,* Title 50, *Wildlife and Fisheries*, Part 402, "Interagency Cooperation—Endangered Species Act of 1973, as amended." TN4312.

50 CFR Part 600. *Code of Federal Regulations*. Title 50, *Wildlife and Fisheries*, Part 600, "Magnuson-Stevens Act Provisions." TN1342.

32 FR 4001. March 11, 1967. "Native Fish and Wildlife; Endangered Species." *Federal Register*, Fish and Wildlife Service. TN2750.

42 FR 47840. September 22, 1977. "Endangered and Threatened Wildlife and Plants: Correction and Augmentation of Public Rulemaking on Critical Habitats." *Federal Register*, Fish and Wildlife Service. TN5355.

48 FR 39911. September 2, 1983. "Endangered and Threatened Wildlife, Fish and Wildlife Service." *Federal Register*, U.S. Fish and Wildlife Service. TN9811.

50 FR 50726. December 11, 1985. "Endangered and Threatened Wildlife and Plants; Determination of Endangered and Threatened Status for the Piping Plover; Final Rule." *Federal Register*, Fish and Wildlife Service. TN5502.

59 FR 7629. February 16, 1994. "Executive Order 12898 of February 11, 1994: Federal Actions To Address Environmental Justice in Minority Populations and Low-Income Populations." *Federal Register*, Office of the President. TN1450.

61 FR 28467. June 5, 1996. "Environmental Review for Renewal of Nuclear Power Plant Operating Licenses." *Federal Register*, Nuclear Regulatory Commission. TN4491.

64 FR 6183. February 8, 1999. "Executive Order 13112 of February 3, 1999: Invasive Species." *Federal Register*, Office of the President. TN4477.

65 FR 26858. May 9, 2000. “FirstEnergy Nuclear Operating Company, Perry Nuclear Power Plant, Unit 1; Environmental Assessment and Finding of No Significant Impact.” *Federal Register*, U.S. Nuclear Regulatory Commission. TN9917.

66 FR 22938. May 7, 2001. “Endangered and Threatened Wildlife and Plants; Final Determination of Critical Habitat for the Great Lakes Breeding Population of the Piping Plover.” Federal Register, Fish and Wildlife Service. TN9904.

69 FR 52040. August 24, 2004. “Policy Statement on the Treatment of Environmental Justice Matters in NRC Regulatory and Licensing Actions.” *Federal Register*, Nuclear Regulatory Commission. TN1009.

74 FR 66496. December 15, 2009. “Endangerment and Cause or Contribute Findings for Greenhouse Gases Under Section 202(a) of the Clean Air Act.” *Federal Register*, Environmental Protection Agency. TN245.

79 FR 73706. December 11, 2014. “Endangered and Threatened Wildlife and Plants; Threatened Species Status for the Rufa Red Knot; Final Rule.” *Federal Register*, Fish and Wildlife Service. TN4267.

80 FR 17974. April 2, 2015. “Endangered and Threatened Wildlife and Plants; Threatened Species Status for the Northern Long-Eared Bat With 4(d) Rule—Final Rule and Interim Rule with Request for Comments.” *Federal Register*, Fish and Wildlife Service. TN4216.

81 FR 24707. April 27, 2016. “Endangered and Threatened Wildlife and Plants; Determination that designation of Critical Habitat is not prudent for the Northern Long-Eared Bat.” *Federal Register*, Fish and Wildlife Service. TN8388.

81 FR 88609. December 8, 2016. “Safeguarding the Nation from the Impacts of Invasive Species.” Executive Order 13751. *Federal Register*, Office of the President. TN8375.

85 FR 43609. July 17, 2020. “Energy Harbor Nuclear Corp; Energy Harbor Nuclear Generation LLC; Perry Nuclear Power Plant Unit No. 1.” *Federal Register*, Nuclear Regulatory Commission. TN9977.

85 FR 81813. December 17, 2020. “Endangered and Threatened Wildlife and Plants: 12-Month Finding for the Monarch Butterfly.” *Federal Register,* Fish and Wildlife Service. TN8590.

87 FR 26152. May 3, 2022. “Endangered and Threatened Wildlife and Plants; Review of Species that are Candidates for Listing as Endangered or Threatened; Annual Notification of Findings on Resubmitted Petitions; Annual Description of Progress on Listing Actions.” *Federal Register*, Fish and Wildlife Service. TN8591.

87 FR 56381. September 14, 2022. “Endangered and Threatened Wildlife and Plants; Endangered Species Status for Tricolored Bat.” *Federal Register*, U.S. Fish and Wildlife Service. TN8546.

87 FR 73488. November 30, 2022. “Endangered and Threatened Wildlife and Plants; Endangered Species Status for Northern Long-Eared Bat.” *Federal Register*, U.S. Fish and Wildlife Service. TN8545.

88 FR 22530. April 13, 2023. “Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for Rufa Red Knot.” *Federal Register*, Fish and Wildlife Service, Interior. TN10376.

88 FR 32198. May 19, 2023. “Notice of Intent To Conduct Scoping and To Prepare a Draft Environmental Impact Statement for the Proposed Lake Erie Quadrangle National Marine Sanctuary.” *Federal Register*, National Oceanic and Atmospheric Administration. TN10016.

88 FR 67373. September 29, 2023. “Energy Harbor Corp.; Energy Harbor Generation LLC; Energy Harbor Nuclear Corp.; Perry Nuclear Power Plant, Unit 1.” *Federal Register*, U.S. Nuclear Regulatory Commission. TN9927.

88 FR 69967. Tuesday, October 10, 2023. “Notice of Intent To Conduct Scoping Process and Prepare Environmental Impact Statement; Energy Harbor Corp.; Energy Harbor Generation LLC.; Energy Harbor Nuclear Corp.; Perry Nuclear Power Plant, Unit 1.” *Federal Register*, U.S. Nuclear Regulatory Commission. TN9932.

89 FR 64166. August 6, 2024. “Renewing Nuclear Power Plant Operating Licenses - Environmental Review.” Final rule and guidance; issuance, *Federal Register*, Nuclear Regulatory Commission. TN10321.

16 U.S.C. § 1801 *et seq*. Conservation, Chapter 38, “Fishery Conservation and Management.” TN9966.

42 U.S.C. § 7410. Clean Air Act Section 110, “SIPs for National Primary and Secondary Air Quality Standards.” TN4851.

42 U.S.C. § 7661a. U.S. Code Title The Public Health and Welfare, Section 7661a “Permit programs.” TN5268.

54 U.S.C. § 306108. National Historic Preservation Act Section 106, “Effect of Undertaking on Historic Property.” TN4839.

Abel, T.J. 2012. *The Petersen Site A Prehistoric To Historic Occupation In Northeastern Ohio*. 2nd Edition, Copetown Press, St. John’s, Newfoundland and Labrador, Canada. TN9871.

Abrams, E.M. 2009. “Hopewell Archaeology: A View from the Northern Woodlands.” *Journal of Archaeological Research* 17:169-204, New York, New York. TN9873.

Aller, L., and K. Ballou. 1991. Ground Water Pollution Potential of Lake County, Ohio. Ground Water Pollution Potential Report No. 8, Ohio Department of Natural Resources, Columbus, Ohio. Accessed May 17, 2024, at https://dam.assets.ohio.gov/image/upload/ohiodnr.gov/documents/geology/GWPP8_Aller_1991_Lake.pdf. TN9946.

Allison, T.D., J.E. Diffendorfer, E.F. Baerwald, J.A. Beston, D. Drake, A.M. Hale, C.D. Hein, M.M. Huso, S.R. Loss, J.E. Lovich, M.D. Strickland, K.A. Williams, and V.L. Winder. 2019. “Impacts to Wildlife of Wind Energy Siting and Operation in the United States.” Ecological Society of America, *Issues in Ecology*, Report No. 21, Washington, D.C. TN8847.

Army (U.S. Army). 2014. Biological Assessment on the Proposed Activities on Fort Drum Military Installation, Fort Drum, New York (2015-2017) for the Indiana Bat (Myotis sodalis) and Northern Long-Eared Bat (Myotis septentrionalis). Fort Drum, New York. TN8512.

Atomic Energy Act of 1954. 42 U.S.C. § 2011 *et seq*. Public Law 112-239, as amended. TN663.

Bagar, T.A., M.L. Hladik, and J.C. Daniels. 2020. “Uptake and toxicity of clothianidin to monarch butterflies from milkweed consumption.” *Peer J* 8:e8669, Bethesda, Maryland. TN8594.

Bald and Golden Eagle Protection Act. 16 U.S.C. § 668-668d *et seq.* TN1447.

Benson, A.J., D. Raikow, J. Larson, A. Fusaro, A.K. Bogdanoff, and A. Elgin. 2023. Dreissena polymorpha *(Pallas, 1771*). U.S. Geological Survey, Reston, Virginia. Accessed on February 15, 2024, at https://nas.er.usgs.gov/queries/FactSheet.aspx?speciesID=5. TN9754.

Bland, J.K., and P.W. Willink. 2018. *Conservation Guidance for Iowa Darter* Etheostoma exile*(Girard, 1859)*. Illinois Department of Natural Resources, Springfield, Illinois. Accessed February 9, 2024, at https://naturalheritage.illinois.gov/content/dam/soi/en/web/naturalheritage/speciesconservation/speciesguidance/documents/iowa-darter-sgd-final.pdf. TN9750.

BLM (Bureau of Land Management). 2010. N*orth Steens 230-kV Transmission Line Project Draft Environmental Impact Statement*. DOI-BLM-OR-B060-2010-0035-EIS, Bureau of Land Management, Hines, Oregon. TN9626.

BLM (Bureau of Land Management). 2013. Final Environmental Impact Statement for the Mohave County Wind Farm Project (Volume 1). BLM/AZ/PL-13/003, Washington, D.C. TN8882.

BLM (Bureau of Land Management). 2019. Gemini Solar Project, Final Resource Management Plan Amendment and Environmental Impact Statement, Volume 1: Chapters 1 – 4. DOI-BLM-NV-S010-2018-0051-EIS, Washington D.C. TN8386.

BOEM (Bureau of Ocean Energy Management). Undated. “Renewable Energy on the Outer Continental Shelf: Ocean Wave Energy.” Washington, D.C. Accessed June 12, 2022, at https://www.boem.gov/Renewable-Energy-Program/Renewable-Energy-Guide/Ocean-Wave-Energy.aspx. TN7696.

Brose, D.S. 2024. “Prehistoric Inhabitants.” Case Western Reserve University, Cleveland, Ohio. Accessed April 8, 2024, at https://case.edu/ech/articles/p/prehistoric-inhabitants. TN9880.

Brose, D.S., and A.M. Lee. 1973. A Summery Report on the Archaeological Survey and-Testing of the Perry Nuclear Power Plant Area , Lake Co., Ohio. Rockville, Maryland. TN9907.

Carter, T.C., and G.A. Feldhamer. 2005. “Roost tree use by maternity colonies of Indiana bats and northern long-eared bats in southern Illinois.” *Forest Ecology and Management* 219(2-3):259-268. TN8501.

CE (Centerior Energy Corporation). 1992. Letter from M.D. Lyster, Vice President, Nuclear, to NRC Document Control Desk, dated July 15, 1992, regarding “Perry Nuclear Power Plant, Docket No. 50-440, PNPP Level 2 PRA Submittal.” Perry, Ohio. ADAMS Accession No. ML20102A253. TN10352.

CE (Centerior Energy Corporation). 1996. Letter from D.C. Shelton, Senior Vice President, Nuclear, to NRC Document Control Desk, dated July 22, 1996, regarding “Perry Nuclear Power Plant, Docket No. 50-440, Resubmittal of Individual Plant Examination - External Events.” Perry, Ohio. ADAMS Accession No. ML20115J972. TN10353.

CEQ (Council on Environmental Quality). 1997. *Environmental Justice Guidance under the National Environmental Policy Act*. Washington D.C. ADAMS Accession No. ML103430030. TN452.

Cheng, T.L., J.D. Reichard, J.T.H. Coleman, T.J. Weller, W.E. Thogmartin, B.E. Reichert, A.B. Bennett, H.G. Broders, J. Campbell, K. Etchison, D.J. Feller, R. Geboy, T. Hemberger, C. Herzog, A.C. Hicks, S. Houghton, J. Humber, J.A. Kath, R.A. King, S.C. Loeb, A. Massé, K.M Morris, H. Niederriter, G. Nordquist, R.W. Perry, R.J. Reynolds, D.B. Sasse, M.R. Scafini, R.C. Stark, C.W. Stihler, S.C. Thomas, G.G. Turner, S. Webb, B.J. Westrich, and W.F. Frick. 2021. “The Scope and Severity of White-Nose Syndrome on Hibernating Bats in North America.” *Conservation Biology* 35(5):1586–1586, Hoboken, New Jersey. http://dx.doi.org/10.1111/cobi.13739. TN9903.

City of Ashtabula. 2020. “Port Authority.” Ashtabula, Ohio. Accessed January 25, 2024, at https://www.cityofashtabula.com/port-authority. TN9719.

Clean Air Act. 42 U.S.C. § 7401 *et seq*. TN1141.

Coastal Zone Management Act of 1972. 16 U.S.C. § 1451 *et seq*. TN1243.

Cook, R.A, and Thompson A.D.R. 2023. “Introducing the Serpent Mound’s Fort Ancient Village: A Preliminary Analysis of the Fort Ancient Component at Serpent Mound State Memorial.” *Journal of Ohio Archaeology* 9:15-39, Columbus, Ohio. TN9874.

Crawford, R.L., and W.W. Baker. 1981. “Bats Killed at a North Florida Television Tower: A 25-Year Record.” *Journal of Mammalogy* 62(3):651-652. TN8506.

Crow, W. 2022. The Iroquois Indians in Ohio, 1600–1763. Portland State University, Portland, Oregon. TN9877.

Dahlkemper, K. 2015. *Lake Erie Quadrangle National Marine Sanctuary Proposal*. Erie, Pennsylvania. Accessed April 18, 2024, at https://nmsnominate.blob.core.windows.net/nominate-prod/media/documents/lake-erie-proposal.pdf. TN9906.

Dodds, J.S. 2022. *Crataegus pennsylvanica Rare Plant Profile*. New Jersey Department of Environmental Protection, State Parks, Forests & Historic Sites, State Forests Fire Service & Forestry, Office of Natural Lands Management, New Jersey Natural Heritage Program, Trenton, NJ. TN9994.

DOE (U.S. Department of Energy). 2011. Final Environmental Impact Statement: Volume 1 Department of Energy Loan Guarantee to Royal Bank of Scotland for Construction and Startup of the Topaz Solar Farm, San Luis Obispo County, California. DOE/EIS-0458, Washington, D.C. TN8387.

DOE (U.S. Department of Energy). 2015. *Wind Vision: A New Era for Wind Power in the United States*. Washington, D.C. TN8757.

DOE (U.S. Department of Energy). 2019. "Solar-Plus-Storage 101." Office of Energy Efficiency & Renewable Energy, Washington, D.C. Accessed January 25, 2024, at https://www.energy.gov/eere/solar/articles/solar-plus-storage-101. TN9717.

DOE (U.S. Department of Energy). 2021. *Hydrogen Shot: An Introduction.* Office of Energy Efficiency and Renewable Energy, Hydrogen and Fuel Cells Technology Office. Washington, D.C. Accessed June 12, 2022, at https://www.energy.gov/eere/fuelcells/articles/hydrogen-shot-introduction. TN7693.

DOE (U.S. Department of Energy). 2021. *Land-Based Wind Market Report: 2021 Edition*. Washington, D.C. Accessed December 12, 2023, at https://www.energy.gov/sites/default/files/2021-08/Land-Based%20Wind%20Market%20Report%202021%20Edition_Full%20Report_FINAL.pdf. TN9562.

DOE (U.S. Department of Energy). Undated. "Fuel Cell Basics: Hydrogen and Fuel Cell Technologies Office." Washington, D.C. Accessed June 12, 2022, at https://www.energy.gov/eere/fuelcells/fuel-cell-basics.TN7695.

DOE (U.S. Department of Energy). Undated. "Geothermal Basics: Geothermal." Washington, D.C. Accessed June 12, 2022, at https://www.energy.gov/eere/geothermal/geothermal-basics. TN7698.

DOE (U.S. Department of Energy). Undated. "Wind Energy State Information." Washington, D.C. Available at https://windexchange.energy.gov/states. TN8431.

DOE/EIA (U.S. Department of Energy/Energy Information Administration). 2013. *Annual Energy Outlook 2013 with Projections to 2040.* DOE/EIA-0383(2013), Washington, D.C. ADAMS Accession No. ML13253A313. TN2590.

DOE/EIA (U.S. Department of Energy/Energy Information Administration). 2015. *Annual Energy Outlook 2015 with Projections to 2040*. DOE/EIA-0383(2015), Washington, D.C. ADAMS Accession No. ML16172A121. TN4585.

DOE/EIA (U.S. Department of Energy/Energy Information Administration). 2021. "Today in Energy: Less Electricity Was Generated by Coal than Nuclear in the United States in 2020." Washington, D.C. Accessed June 12, 2022, at https://www.eia.gov/todayinenergy/detail.php?id=47196. TN7718.

DOE/EIA (U.S. Department of Energy/Energy Information Administration). 2022. *Cost and Performance Characteristics of New Generating Technologies, Annual Energy Outlook 2021*. Washington, D.C. Accessed June 12, 2022, at https://www.eia.gov/outlooks/aeo/assumptions/pdf/table_8.2.pdf. TN7694.

DOE/EIA (U.S. Department of Energy/Energy Information Administration). 2022. "North Carolina State Energy Profile*."* Washington, D.C. Available at https://www.eia.gov/state/analysis.php?sid=VA. TN8955.

DOE/EIA (U.S. Department of Energy/Energy Information Administration). 2023. Electric Power Monthly with Data for August 2023, Table 6.07.B: Capacity Factors for Utility Scale Generators Primarily Using Non-Fossil Fuels. Washington, D.C. TN8821.

Duke Energy. 2021. Letter from S.M. Snider, Vice President, Oconee Nuclear Station, to NRC Document Control Desk, dated June 7, 2021, regarding "Duke Energy Carolinas, LLC (Duke Energy) Oconee Nuclear Station (ONS), Units 1, 2, and 3 Docket Numbers 50-269, 50-270, 50-287 Renewed License Numbers DPR-38, DPR-47, DPR-55 Application for Subsequent Renewed Operating Licenses." Seneca, South Carolina. ADAMS Accession No. ML21158A193. TN8897.

ECCC/NOAA (Environment and Climate Change Canada and the U.S. National Oceanic and Atmospheric Administration). 2023. *2022 Annual Climate Trends and Impacts Summary for the Great Lakes Basin*. Ottawa, Ontario and Silver Spring, Maryland. Available at https://glisa.umich.edu/summary-climate-information/annual-climate-trends/. TN10049.

EH (Energy Harbor). 2021. Letter from R.L. Penfield, Site Vice President, Perry Nuclear, to NRC Document Control Desk, dated April 26, 2021, regarding "Perry Nuclear Power Plant Docket No.50-440 Annual Environmental and Effluent Release Report." Perry, Ohio. ADAMS Accession No. ML21119A030. TN9954.

EH (Energy Harbor). 2022. Letter from R.L. Penfield, Site Vice President, Perry Nuclear, to NRC Document Control Desk, dated April 27, 2022, regarding "Perry Nuclear Power Plant Docket No.50-440 Annual Radiological Effluent Release Report." Perry, Ohio. ADAMS Accession No. ML22118A159. TN9955.

EH (Energy Harbor). 2022. Letter from R.L. Penfield, Site Vice President, Perry Nuclear, to NRC Document Control Desk, dated April 28, 2022, regarding "Perry Nuclear Power Plant Docket No.50-440 Annual Radiological Environmental Operating Report." Perry, Ohio. ADAMS Accession No. ML22118A320. TN9969.

EH (Energy Harbor). 2023. Appendix E, Applicant's Environmental Report, License Renewal Stage, Perry Nuclear Power Plant Unit 1. Perry, Ohio. May. TN9536.

EH (Energy Harbor). 2023. Letter from R.L. Penfield, Site Vice President, Perry Nuclear, to NRC Document Control Desk, dated April 26, 2023, regarding “Perry Nuclear Power Plant Docket No.50-440 Annual Radiological Effluent Release Report.” Perry, Ohio. ADAMS Accession No. ML23117A196. TN9956.

EH (Energy Harbor). 2023. Letter from R.L. Penfield, Site Vice President, Perry Nuclear, to NRC Document Control Desk, dated April 26, 2023, regarding “Perry Nuclear Power Plant Docket No.50-440 Annual Radiological Environmental Operating Report.” Perry, Ohio. ADAMS Accession No. ML23117A201. TN9970.

EH (Energy Harbor). 2023. Letter from R.L. Penfield, Site Vice President, Perry Nuclear, to NRC Document Control Desk, dated September 12, 2023, regarding “Perry Nuclear Power Plant Docket No.50-440, License No. NPF-58 Ohio National Pollutant Discharge Elimination System (NPDES) Permit 3IB00016*MD for the Perry Nuclear Power Plant.” Perry, Ohio. ADAMS Accession No. ML23255A098. TN9746.

EH (Energy Harbor). 2023. Letter from R.L. Penfield, Site Vice President, Perry Nuclear, to NRC Document Control Desk, dated October 27, 2023, regarding “Perry Nuclear Power Plant Docket No.50-440, License No. NPF-58, Submittal of the Updated Safety Analysis Report, Revision 23.” Perry, Ohio. ADAMS Accession No. ML23303A132. TN9979.

EH (Energy Harbor). 2023. Letter from R.L. Penfield, Site Vice President, Perry Nuclear, to NRC Document Control Desk, dated July 3, 2023, regarding “Perry Nuclear Power Plant, Unit No. 1 Docket No. 50-440, License No. NPF-58 License Renewal Application for the Perry Nuclear Power Plant.” Perry, Ohio. ADAMS Accession No. ML23184A081. TN9533.

EIA (U.S. Energy Information Administration). 2021. “State Electricity Profiles. Table 5. Electric Power Industry Generation by Primary Energy Source, 1990 through 2019.” Washington, D.C. Available at https://www.eia.gov/electricity/state. TN8353.

EIA (U.S. Energy Information Administration). 2022. “Virginia State Profile and Energy Estimates -Analysis*.”* Washington, D.C. Available at https://www.eia.gov/state/analysis.php?sid=VA. TN8352.

EIA (U.S. Energy Information Administration). 2023. “Ohio State Energy Profile.” Washington, D.C. Accessed December 12, 2023, at https://www.eia.gov/state/print.php?sid=OH. TN9563.

Endangered Species Act of 1973. 16 U.S.C. § 1531 *et seq.* TN1010.

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. Washington, D.C. ADAMS Accession No. ML12241A393. TN3941.

EPA (U.S. Environmental Protection Agency). 1981. *Noise Effects Handbook: A Desk Reference to Health and Welfare, Effects of Noise*. EPA 350/9-82-106. Washington, D.C. TN7412.

EPA (U.S. Environmental Protection Agency). 2009. Assessment of the Impacts of Global Change on Regional U.S. Air Quality: A Synthesis of Climate Change Impacts on Ground-Level Ozone (An Interim Report of the U.S. EPA Global Change Research Program). EPA/600/R-07/094F. Washington, D.C. TN9068.

EPA (U.S. Environmental Protection Agency). 2013. *Level III Ecoregions of the Continental United States*. National Health and Environmental Effects Research Laboratory, Corvallis, Oregon. TN9981.

EPA (U.S. Environmental Protection Agency). 2015. "US_Eco_L4.zip." Washington, D.C. Accessed on May 22, 2024, at https://gaftp.epa.gov/EPADataCommons/ORD/Ecoregions/us/. TN9982.

EPA (U.S. Environmental Protection Agency). 2016. *Climate Change Indicators in the United States 2016*. Fourth Edition, EPA 430-R-16-004, Washington D.C. Accessed June 7, 2022, at https://www.epa.gov/sites/default/files/2016-08/documents/climate_indicators_2016.pdf. TN7561.

EPA (U.S. Environmental Protection Agency). 2020. *2020 County-Level Process Data for Mobile and Nonpoint Emissions (Does Not Include Point Emissions), Lake County, Ohio*. Washington, D.C. Accessed May 20, 2024, at https://awsedap.epa.gov/public/single/?appid=20230c40-026d-494e-903f-3f112761a208&sheet=5d3fdda7-14bc-4284-a9bb-cfd856b9348d&opt=ctxmenu,currsel. TN9962.

EPA (U.S. Environmental Protection Agency). 2020. "Mercury and Air Toxics Standards (MATS)." Washington D.C. Available at https://www.epa.gov/mats. TN8379.

EPA (U.S. Environmental Protection Agency). 2022. "Climate Change Indicators: U.S. and Global Precipitation." Washington, D.C. Available at https://www.epa.gov/climate-indicators/climate-change-indicators-us-and-global-precipitation. TN9163.

EPA (U.S. Environmental Protection Agency). 2022. "How's My Waterway? - Waterbody Report, Grand River Mainstem (Mill Creek to mouth)." Washington, D.C. Accessed April 17, 2024, at https://mywaterway.epa.gov/waterbody-report/21OHIO/OHLR041100049001/2022. TN9897.

EPA (U.S. Environmental Protection Agency). 2022. "How's My Waterway? - Waterbody Report, Lake Erie Central Basin Open Water (>3m)." Washington, D.C. Accessed April 17, 2024, at https://mywaterway.epa.gov/waterbody-report/21OHIO/OHLE041202000303/2022. TN9895.

EPA (U.S. Environmental Protection Agency). 2022. "How's My Waterway? - Waterbody Report, McKinley Creek-Frontal Lake Erie." Washington, D.C. Accessed April 17, 2024, at https://mywaterway.epa.gov/waterbody-report/21OHIO/OH041100030204/2022. TN9896.

EPA (U.S. Environmental Protection Agency). 2023. "Climate Change Indicators: U.S. and Global Temperature." Washington, D.C. Accessed May 1, 2024, at https://www.epa.gov/climate-indicators/climate-change-indicators-us-and-global-temperature. TN10021.

EPA (U.S. Environmental Protection Agency). 2023. "Energy Recovery from the Combustion of Municipal Solid Waste (MSW)." Washington, D.C. Available at https://www.epa.gov/smm/energy-recovery-combustion-municipal-solid-waste-msw#EnergyRecovery. TN8443.

EPA (U.S. Environmental Protection Agency). 2023. "Great Lakes CWMP Results and Major Findings." Washington, D.C. Accessed January 26, 2024, at https://www.epa.gov/great-lakes-monitoring/great-lakes-cwmp-results-and-major-findings. TN9721.

EPA (U.S. Environmental Protection Agency). 2023. "Minnesota Nonattainment/Maintenance Status for Each County by Year for All Criteria Pollutants." Chicago, Illinois. Available at https://www3.epa.gov/airquality/greenbook/anayo_mn.html. TN9567.

EPA (U.S. Environmental Protection Agency). 2024. "Climate Change and Freshwater Harmful Algal Blooms." Washington, D.C. Accessed May 1, 2024, at https://www.epa.gov/habs/climate-change-and-freshwater-harmful-algal-blooms. TN10042.

EPA (U.S. Environmental Protection Agency). 2024. "Climate Change Indicators: Great Lakes Water Levels and Temperatures." Washington, D.C. Accessed May 1, 2024, at https://www.epa.gov/climate-indicators/great-lakes#:~:text=In%20recent%20years%2C%20warmer%20surface,extends%20the%20season%20for%20evaporation. TN10022.

EPA (U.S. Environmental Protection Agency). 2024. "Diamond Shamrock Corp. (Painesville Works), Painesville, Ohio, Cleanup Activities." Washington, D.C. Accessed May 16, 2024, at https://cumulis.epa.gov/supercpad/SiteProfiles/index.cfm?fuseaction=second.cleanup&id=0504696. TN9937.

EPA (U.S. Environmental Protection Agency). 2024. "Final Rule - National Emission Standards for Hazardous Air Pollutants: Coal- and Oil-Fired Electric Utility Steam Generating Units Review of the Residual Risk and Technology Review." Washington, D.C. Accessed August 27, 2024, at https://www.epa.gov/stationary-sources-air-pollution/final-rule-national-emission-standards-hazardous-air-pollutants-0. TN10375.

EPA (U.S. Environmental Protection Agency). 2024. *Sole Source Aquifers Near to Perry, Ohio*. Washington, D.C. Accessed April 29, 2024, at https://epa.maps.arcgis.com/apps/webappviewer/index.html?id=9ebb047ba3ec41ada1877155fe31356b. TN9950.

EPRI (Electric Power Research Institute). 2011. *Mapping and Assessment of the United States Ocean Wave Energy Resource*. 1024637, EPRI, Palto Alto, California. TN8442.

FD (Farm and Dairy). 2021. "Three more utility-scale solar farms get approval in Ohio." Salem, Ohio. Accessed on December 11, 2023, at https://www.farmanddairy.com/news/three-more-utility-scale-solar-farms-get-approval-in-ohio/685054.html. TN9549.

Federal Water Pollution Control Act of 1972 (commonly referred to as the Clean Water Act). 33 U.S.C. § 1251 *et seq.* TN662.

FENOC (FirstEnergy Nuclear Operating Company). 2014. Letter from E.J. Harkness, Vice President, to R. Queen, Ohio Environmental Protection Agency, dated December 19, 2014, regarding "Application for Section 401 Water Quality Certification - Perry Nuclear Power Plant." L-14-402, Perry, Ohio. ADAMS Accession Package No. ML24215A372. TN10373.

FENOC (FirstEnergy Nuclear Operating Company). 2019. Letter from D.B. Hamilton, Vice President, to NRC Document Control Desk, dated April 29, 2019, regarding "Perry Nuclear Power Plant Docket No.50-440 Annual Environmental and Effluent Release Report." Perry, Ohio. ADAMS Accession No. ML19120A328. TN9952.

FENOC (FirstEnergy Nuclear Operating Company). 2020. Letter from F. Payne, to NRC Document Control Desk, dated April 29, 2019, regarding "Perry Nuclear Power Plant Docket No.50-440 Annual Environmental and Effluent Release Report." Perry, Ohio. ADAMS Accession No. ML20119A519. TN9953.

FH (Fairport Harbor). 2022. "Port Authority." Fairport Harbor, Ohio. Accessed January 25, 2024, at https://www.exploretheport.com/. TN9718.

Foster, R.W., and A. Kurta. 1999. "Roosting Ecology of the Northern Bat (*Myotis septentrionalis*) and Comparisons with the Endangered Indiana Bat (*Myotis sodalist*)." *Journal of Mammalogy* 80(2):659-672. TN8499.

Francy, D.S., A.M.G. Brady, E.A. Stelzer, J.R. Cicale, C. Hackney, H.D. Dalby, P. Struffolino, and D.F. Dwyer. 2020. "Predicting Microcystin Concentration Action-Level Exceedances Resulting from Cyanobacterial Blooms in Selected Lake Sites in Ohio." *Environmental Monitoring Assessment* 192:513, New York, New York. Accessed January 26, 2024, at https://doi.org/10.1007/s10661-020-08407-x. TN9729.

Fuller, P., J. Larson, T.H. Makled, and A. Fusaro. 2019. Lepisosteus platostomus *Rafinesque, 1820*. U.S. Geological Survey, Reston, Virginia. Accessed on February 23, 2024, at https://nas.er.usgs.gov/queries/greatlakes/FactSheet.aspx?Species_ID=757&Potential=N&Type=0&HUCNumber=DGreatLakes. TN9765.

Fuller, P., L. Nico, M. Neilson, K. Dettloff, and R. Sturtevant. 2024. Anguilla rostrata *(Lesueur, 1817)*. U.S. Geological Survey, Reston, Virginia. Accessed on February 9, 2024, at https://nas.er.usgs.gov/queries/greatlakes/FactSheet.aspx?Species_ID=310. TN9749.

FWS (U.S. Fish and Wildlife Service). 2003. *Recovery Plan for the Great Lakes Piping Plover (*Charadrius melodus*)*. FWS Region 3, Fort Snelling, Minnesota. TN8841.

FWS (U.S. Fish and Wildlife Service). 2007. *Indiana Bat (*Myotis sodalis*) Draft Recovery Plan: First Revision*. Great Lakes-Big Rivers Region, Fort Snelling, Minnesota. ADAMS Accession No. ML14302A612. TN934.

FWS (U.S. Fish and Wildlife Service). 2010. Letter from S.E. Pruitt, Field Supervisor, to COL M.J. Bennett, NGB Chief, Environmental Programs Division, dated October 21, 2010, regarding "Programmatic Biological Opinion on the Effects of Ongoing and Future Military and Land Management Activities at the Camp Atterbury Joint Maneuver Training Center in Bartholomew, Brown, and Johnson Counties in Indiana on the Federally Endangered Indiana Bat (Myotis sodalist)." Bloomington, Indiana. TN8537.

FWS (U.S. Fish and Wildlife Service). 2014. *Rufa Red Knot Background Information and Threats Assessment*. Northeast Region New Jersey Field Office, Pleasantville, New Jersey. TN8851.

FWS (U.S. Fish and Wildlife Service). 2014. Letter from F. Clark, Acting Field Supervisor to D.J. Wrona, NRC, dated September 30, 2014, regarding "Threatened and endangered species within the vicinity of the Davis-Besse Nuclear Power Station." Columbus, Ohio. ADAMS Accession No. ML14296A559. TN7605.

FWS (U.S. Fish and Wildlife Service). 2015. Letter from D.A. Stilwell, Field Supervisor, to D.J. Wrona, Chief Environmental Review and Guidance Update Branch Division of License Renewal Office of Nuclear Reactor Regulation, dated July 14, 2015, regarding "This responds to your July 1,2015, letter regarding the proposed renewal of Facility Operating Licenses DPR-26 and DPR-64 for an additional 20 years at the Indian Point Nuclear Generating Units 2 and 3 located in the Village of Buchanan, Westchester County, New York." Cortland, New York. ADAMS Accession No. ML15196A013. TN7612.

FWS (U.S. Fish and Wildlife Service). 2016. Programmatic Biological Opinion on Final 4(d) Rule for the Northern Long-Eared Bat and Activities Excepted from Take Prohibitions. Midwest Regional Office, Bloomington, Minnesota. TN7400.

FWS (U.S. Fish and Wildlife Service). 2018. Letter from T.R. Chapman, Supervisor, New England Field Office, to B. Beasley, Office of Nuclear Reactor Regulation Division of Materials and License Renewal, dated September 20, 2018, regarding "Seabrook Station Unit 1 License Renewal, Seabrook NH, TAILS: 2018-I-2970." Concord, New Hampshire. ADAMS Accession No. ML18263A200. TN7610.

FWS (U.S. Fish and Wildlife Service). 2019. *Peach Bottom Atomic Power Station Units 2 and 3 Subsequent License Renewal.* Project number 2017-0333, State College, Pennsylvania. ADAMS Accession No. ML19247D287. TN9742.

FWS (U.S. Fish and Wildlife Service). 2019. Letter from Virginia Ecological Services Field Office, dated June 6, 2019, regarding "Updated list of threatened and endangered species that may occur in your proposed project location, and/or may be affected by your proposed project." Gloucester, Virginia. ADAMS Accession No. ML19157A113. TN7609.

FWS (U.S. Fish and Wildlife Service). 2020. *Monarch (*Danaus plexippus*) Species Status Assessment (SSA) Version 2.1*. Washington, D.C. TN8593.

FWS (U.S. Fish and Wildlife Service). 2020. *Species Status Assessment Report for the Rufa Red Knot (*Calidris canutus rufa*), Version 1.1*. Ecological Services New Jersey Field Office, Galloway, New Jersey. TN8850.

FWS (U.S. Fish and Wildlife Service). 2021. *Birds of Conservation Concern 2021, Migratory Bird Program*. Washington, D.C. TN8740.

FWS (Fish and Wildlife Service). 2021. *Species Status Assessment (SSA) for Tricolored Bat (*Perimyotis subflavus*) Version 1.1*. Fish and Wildlife Service Northeast Region, Hadley, Massachusetts. TN8589.

FWS (U.S. Fish and Wildlife Service). 2021. Letter from Green Bay Ecological Services Field Office to B. Grange, dated February 9, 2021, regarding "Verification letter for the 'Point Beach Nuclear Plant, Units 1 and 2, Subsequent License Renewal' project under the January 5, 2016, Programmatic Biological Opinion on Final 4(d) Rule for the Northern Long-eared Bat and Activities Excepted from Take Prohibitions." New Franken, Wisconsin. ADAMS Accession No. ML21040A485. TN9740.

FWS (U.S. Fish and Wildlife Service). 2023. Letter from Fish and Wildlife Service, Virginia Ecological Services Field Office, dated July 10, 2023, regarding "Federal agency coordination under the Endangered Species Act, Section 7 for 'North Anna Power Station, Units 1 and 2, Subsequent License Renewal'." Gloucester, Virginia. ADAMS Accession No. ML23191A537. TN9093.

FWS (U.S. Fish and Wildlife Service). 2023. Letter from Fish and Wildlife Service, Ohio Ecological Services Field Office, October 19, 2023, regarding "List of threatened and endangered species that may occur in your proposed project location or may be affected by your proposed project." Columbus, Ohio. ADAMS Accession No. ML23292A247. TN9767.

FWS (U.S. Fish and Wildlife Service). 2023. Letter from Ohio Ecological Services Field Office to B. Arlene, dated October 19, 2023, regarding "Federal agency coordination under the Endangered Species Act, Section 7 for 'Perry Nuclear Power Plant, Unit 1, License Renewal'." Columbus, Ohio. ADAMS Accession No. ML23292A248. TN9741.

FWS (U.S. Fish and Wildlife Service). 2024. "Indiana Bat, Overview." Washington, D.C. Accessed March 18, 2024, at https://www.fws.gov/species/indiana-bat-myotis-sodalis. TN9810.

FWS (U.S. Fish and Wildlife Service). Undated. "Little Brown Bat." Washington, D.C. Accessed on May 22,2024, at https://www.fws.gov/species/little-brown-bat-myotis-lucifugus. TN9987.

FWS and NMFS (U.S. Fish and Wildlife Service and National Marine Fisheries Service). 1998. *Endangered Species Act Consultation Handbook, Procedures for Conducting Section 7 Consultation and Conference*. Washington, D.C. ADAMS Accession No. ML14171A801. TN1031.

GLFC (Great Lakes Fishery Commission). 2017. *Impediments to the Rehabilitation of* Cisco (Coregonus artedi) *in Lake Erie*. Ann Arbor, Michigan. Accessed February 15, 2024, at http://www.glfc.org/pubs/lake_committees/erie/LEC_docs/position_statements/Cisco%20Restoration%20Impediments%20-%20FINAL_APRIL2017.pdf. T9756.

GLFC (Great Lakes Fishery Commission). 2020. *Lake Erie Yellow Perch Management Plan 2020-2024*. Ann Arbor, Michigan. Accessed February 1, 2024, at http://www.glfc.org/pubs/lake_committees/erie/YPTG_docs/other_reports_and_docs/YPMP_withAppendix_July%202021_FINAL.pdf. TN9732.

GLISA (Great Lakes CAP/RISA Team). Undated. "Algal Blooms." Ann Arbor, Michigan. Accessed May 1, 2024, at https://glisa.umich.edu/resources-tools/climate-impacts/algal-blooms/. TN10040.

Good Company. 2011. Health and Safety Concerns of Photovoltaic Solar Panels. Eugene, Oregon. TN8599.

Griffin, J.B. 1967. "Eastern North American Archaeology: A Summary: Prehistoric Cultures Changed from Small Hunting Bands to Well-Organized Agricultural Towns and Tribes." *Science*, 156(3722):175-191, Washington, D.C. TN9876.

Hansen, M.C., and M. Fakhari. 2023. *Geofacts, Ohio Shale Concretions*. Geofacts No. 4, Ohio Department of Natural Resources, Columbus, Ohio. Accessed May 1, 2024, at https://dam.assets.ohio.gov/image/upload/ohiodnr.gov/documents/geology/GF4_Fakhari_2023.pdf. TN9948.

Hansen, M.C., and J.L. Fox. 2020. Earthquakes in Ohio. Ohio Department of Natural Resources, Columbus, Ohio. Accessed May 16, 2024, at https://dam.assets.ohio.gov/image/upload/ohiodnr.gov/documents/geology/EL9_Hansen_2020.pdf. TN9938.

Harrington, B.R. 2008. *Coastal Inlets as Strategic Habitat for Shorebirds in the Southeastern United States*. U.S. Army Engineering Research and Development Center, TN-DOER-E25, Vicksburg, Mississippi. TN8852.

Hathcock, C. 2019. Literature review on impacts to avian species from solar energy collection and suggested mitigations. Department of Energy. TN8470.

Haudenosaunee Confederacy. 2024. "About the Haudenosaunee Confederacy." Ohsweken, Ontario, Canada. Accessed 8, 2024, at https://www.haudenosauneeconfederacy.com/who-we-are/. TN9881.

Horvath, G., G. Kriska, and B. Robertson. 2009. "Polarized Light Pollution: A New Kind of Ecological Photopollution." *Frontiers in Ecology and the Environment* 7(6):317–325, Washington, D.C. TN897.

ICNIRP (International Commission on Non-Ionizing Radiation Protection). 1998. "Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields (up to 300 GHz)." *Health Physics* 74 (4): 494-522, Philadelphia, Pennsylvania. Accessed October 7, 2020, at https://www.icnirp.org/cms/upload/publications/ICNIRPemfgdl.pdf. TN6591.

IDNR (Illinois Department of Natural Resources). 2024. "Longnose Dace." Springfield, Illinois. Accessed February 15, 2024, at https://dnr.illinois.gov/education/wildaboutpages/wildaboutfishes/wafminnows/waflongnosedace.html. TN9759.

IEA (International Energy Agency). 2007. *Biomass for Power Generation and CHP*. ETE03, IEA Energy Technology Essentials, License CC BY 4.0. Paris, France. TN8436.

iNaturalist. 2023. "Species, Lake County, U.S., OH, County." Oakland, California. Accessed April 23, 2024, at https://www.inaturalist.org/places/lake-county-oh-us. TN9913.

iNaturalist. 2024. "American Marram Grass (*Ammophila breviligulata*)." Oakland, California. Accessed May 21, 2024, at https://www.inaturalist.org/taxa/130755-Ammophila-breviligulata. TN9968.

iNaturalist. 2024. "Piping Plover (*Charadrius melodus*), Monarch Butterfly (*Danaus plexippus*), and Milkweed (*Ascelpias spp.*) observations within vicinity of Perry Plant." Oakland, California. Accessed May 24, 2024, at https://www.inaturalist.org/home. TN10048.

iNaturalist. 2024. "Seaside Pea (*Lathyrus japonicus*)." Oakland, California. Accessed May 21, 2024, at https://www.inaturalist.org/taxa/77638-Lathyrus-japonicus. TN9967.

iNaturalist. Undated. "Bailey's Sedge (*Carex baileyi*)." Oakland, California. Accessed on May 22, 2024, at https://www.inaturalist.org/taxa/136606-Carex-baileyi. TN9989.

iNaturalist. Undated. "Forked Rush (*Juncus dichotomus*)." Oakland, California. Accessed on May 22, 2024, at https://inaturalist.ca/taxa/164260-Juncus-dichotomus. TN9991.

IPCC (Intergovernmental Panel on Climate Change). 2000. *Summary for Policymakers, Emissions Scenarios, A Special Report of IPCC Working Group III*. Intergovernmental Panel on Climate Change, Geneva, Switzerland. Accessed June 11, 2022, at https://www.ipcc.ch/site/assets/uploads/2018/03/sres-en.pdf. TN7652.

IPCC (Intergovernmental Panel on Climate Change). 2007. Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. ADAMS No. ML112710385. Accessed May 23, 2022, at https://www.ipcc.ch/site/assets/uploads/2018/05/ar4_wg1_full_report-1.pdf. TN7421.

IPCC (Intergovernmental Panel on Climate Change). 2013. Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. T.F. Stocker, 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. Accessed May 25, 2022, at https://www.ipcc.ch/report/ar5/wg1/. TN7434.

IPCC (Intergovernmental Panel on Climate Change). 2014. *Climate Change 2014, Synthesis Report*. Geneva, Switzerland. Accessed June 11, 2022, at https://ar5-syr.ipcc.ch/ipcc/ipcc/resources/pdf/IPCC_SynthesisReport.pdf. TN7651.

IPCC (Intergovernmental Panel on Climate Change). 2021. “Climate Change 2021: The Physical Science Basis.” Accessed May 24, 2022, at https://www.ipcc.ch/report/ar6/wg1/. TN7435.

IPCC (Intergovernmental Panel on Climate Change). 2023. *AR6 Synthesis Report: Climate Change 2023.* Intergovernmental Panel on Climate Change, Geneva, Switzerland. TN8557.

James, D.G. 2019. “A Neonicotinoid Insecticide at a Rate Found in Nectar Reduces Longevity but not Oogenesis in Monarch Butterflies, *Danaus plexippus* (L.). (Lepidoptera: Nymphalidae).” *Insects* 10(9):276, Bethesda, Maryland. TN8595.

James, D.G., M.C. Schaefer, K.K. Easton, and A. Carl. 2021. “First Population Study on Winter Breeding Monarch Butterflies, *Danaus plexippus* (Lepidoptera: Nymphalidae) in the Urban South Bay of San Francisco, California.” *Insects* 12(10):946, Basel, Switzerland. https://doi.org/10.3390/insects12100946. TN9973.

Johnson, G.D., and Strickland, MD. 2003. Biological Assessment for the Federally Endangered Indiana Bat (Myotis sodalis) and Virginia Big-eared Bat (Corynorhinus townsendii virginianus) NedPower Mount Storm Wind Project, Grant County, West Virginia. West, Inc., Cheyenne, Wyoming. TN8509.

Johnson,G.D., W.P. Erickson, M.D. Strickland, M.F. Shepard, D.A. Shepard, and S.A. Sarappo. 2003. “Mortality of Bats at a Large-scale Wind Power Development at Buffalo Ridge, Minnesota.” *The American Midland Naturalist* 15(2):332-342. TN8511.

Karatayev, A. Y., L. E. Burlakova, K. Mehler, S. A. Bocaniov, P. D. Collingsworth, G. Warren, R. T. Kraus, and E. K. Hinchey. 2018. “Biomonitoring Using Invasive Species in a Large Lake: *Dreissena* Distribution Maps Hypoxic Zones.” *Journal of Great Lakes Research* 44(4):639-649, Ann Arbor, Michigan. TN9755.

Kayastha, M.B., X. Ye, C. Huang, P. Xue. 2022. “Future Rise of the Great Lakes Water Levels Under Climate Change.” *Journal of Hydrology* 612(B), Amsterdam, Netherlands. https://doi.org/10.1016/j.jhydrol.2022.128205. TN10037.

Kayle, K., K. Oldenburg, C. Murray, J. Francis, and J. Markham. 2015. *Lake Erie Walleye Management Plan 2015-2019*. Great Lakes Fishery Commission, Ann Arbor, Michigan. Accessed February 1, 2024, at http://www.glfc.org/pubs/lake_committees/erie/LEC_docs/position_statements/walleye_managment_plan.pdf. TN9731.

Keener C.S. 2005. Phase I Cultural Resource Management Survey of a Proposed Cell Tower (OH1094/North Perry Site) in Perry Township, Lake County, Ohio. West Alexandria, Ohio. TN9908.

Keener, C.S., and C. Nelson. 2019. Phase I Cultural Resource Management Survey of a Proposed Tillman Infrastructure Cell Tower (Perry/GL544618) in Perry Township, Lake County, Ohio. West Alexandria, Ohio. TN9909.

Krischik, V., M. Rogers, G. Gupta, and A. Varshney. 2015. "Soil-Applied Imidacloprid Translocates to Ornamental Flowers and Reduces Survival of Adult *Coleomegilla maculata*, *Harmonia axyridis*, and *Hippodamia convergens Lady Beetles, and Larval Danaus plexippus* and *Vanessa cardui* Butterflies." *PLoS One* 10(3):e0119133, San Francisco, California. TN8596.

Krishnan, N., Y. Zhang, K.G. Bidne, R.L. Hellmich, J.R. Coats, and S.P. Bradbury. 2020. "Assessing Field-Scale Risks of Foliar Insecticide Applications to Monarch Butterfly (Danaus plexippus) Larvae." *Environmental Toxicology Chemistry* 39(4):923-941. TN8597.

Larson, A. 2020. "Innovative Byproduct-Hydrogen Fuel Cell Power Plant Completed." *POWER.* Rockville, Maryland. Available at https://www.powermag.com/innovative-byproduct-hydrogen-fuel-cell-power-plant-completed/. TN8401.

LCHC (Lake County History Center). Undated. "Lake County History." Painesville, Ohio. Accessed April 8, 2024, at https://lakehistorycenter.org/lake-county-history/. TN9885.

LCO (Lake County, Ohio). 2024. "Communities." Painesville, Ohio. Accessed April 8, 2024, at https://www.lakecountyohio.gov/communities/. TN9886.

LCO (Lake County, Ohio). 2024. "Water Quality, Consumer Confidence Reports, 2023-2017." Painesville, Ohio. Accessed May 1, 2024, at https://www.lakecountyohio.gov/utilities/water-quality/. TN9964.

LCO (Lake County Ohio). Undated. "Lake Navigator." Painesville, Ohio. Accessed February 5, 2024, at https://gis.lakecountyohio.gov/lakepublicaccess/lcpas.htm. TN9734.

Lee, J.M., V.L. Chartier, D.P. Hartmann, G.E. Lee, K.S. Pierce, F.L. Shon, R.D. Stearns, and M.T. Zeckmeister. 1989. *Electrical and Biological Effects of Transmission Lines: A Review*. DOE/BP-945. U.S. Department of Energy, Bonneville Power Administration, Portland, Oregon. June. Accessed June 1, 2022, at https://doi.org/10.2172/5712107. TN7481

LM (Lake Metroparks). 2024. "Parks and Trails." Concord Township, Ohio. Accessed January 10, 2024, at https://www.lakemetroparks.com/parks-trails/. TN9607.

Loring, P.H., A.K. Lenske, J.D. McLaren, M. Aikens, A.M. Anderson, Y. Aubry, E. Dalton, A. Dey, C. Friis, D. Hamilton, R. Holberton, D. Kriensky, D. Mizrahi, L. Niles, K.L. Parkins, J. Paquet, F. Sanders, A. Smith, Y. Turcotte, A. Vitz, and P.A. Smith. 2021. *Tracking Movements of Migratory Shorebirds in the US Atlantic Outer Continental Shelf Region*. BOEM 2021-008, Bureau of Ocean Energy Management, Washington D.C. TN10018.

Łukasz, B., I. Rybakowska, A. Krakowiak, M. Gregorczyk, And W. Waldman. 2023. "Lithium Batteries Safety, Wider Perspective." *International Journal of Occupational Medicine and Environmental Health* 36(1):3-20, Łódź, Poland. TN9618.

Magnuson-Stevens Fishery Conservation and Management Act, Public Law 94-265, as amended through October 11, 1996. 16 U.S.C. § 1801 *et seq.* TN1061.

Maize, K. 2019. "Waste-to-Energy: A Niche Market in Decline?" *POWER*, Rockville, Maryland. Accessed June 12, 2022, at https://www.powermag.com/waste-to-energy-a-niche-market-in-decline. TN7699.

Michaels T., and K. Krishnan. 2019. *Energy Recovery Council, 2018 Directory of Waste-to-Energy Facilities*. Washington, D.C. Accessed June 12, 2022, at http://energyrecoverycouncil.org/wp-content/uploads/2019/01/ERC-2018-directory.pdf. TN7700.

Mid-Atlantic Herbaria Consortium. Undated. "*Lycopodiella inundata* (L.) Holub." Philadelphia, Pennsylvania. Accessed on May 22, 2024, at https://midatlanticherbaria.org/portal/taxa/index.php?taxon=90694&clid=3419. TN9993.

MSU (Michigan State University). 2024. *Species and Natural Community Abstracts,* Opsopoeodus emiliae. East Lansing, Michigan. Accessed March 18, 2024, at https://mnfi.anr.msu.edu/abstracts/zoology/Opsopoeodus_emiliae.pdf. TN9809.

National Environmental Policy Act of 1969 (NEPA), as amended. 42 U.S.C. § 4321 *et seq.* TN661.

National Geographic. 2023. "Inside the Secret World of the Hopewell Mounds—Our Newest World Heritage Site." Washington, D.C. Accessed April 8, 2024, at https://www.nationalgeographic.com/travel/article/how-visit-ohio-first-world-heritage-site-hopewell-mounds. TN9878.

National Historic Preservation Act. 54 U.S.C. § 300101 *et seq*. TN4157.

National Marine Sanctuaries Act, as amended. 16 U.S.C. § 1431 *et seq*. TN4482.

NatureServe Explorer. 2024. "*Buxbaumia aphylla* Bug-on-a-Stick Moss." Arlington, Virginia. Accessed on May 22, 2024, at https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.126502/Buxbaumia_aphylla. TN9996.

NC State Extension (North Carolina State Extension). Undated. "Rubus canadensis." Raleigh, North Carolina. Accessed on May 22, 2024, at https://plants.ces.ncsu.edu/plants/rubus-canadensis/. TN9995.

NCES (National Center for Education Statistics). 2022. "Ashtabula County Public School Districts." Washington, D.C. Accessed March 18, 2024, at https://nces.ed.gov/ccd/districtsearch/district_list.asp?Search=1&details=1&InstName=&DistrictID=&Address=&City=&State=39&Zip=&Miles=&County=Ashtabula+County&PhoneAreaCode=&Phone=&DistrictType=1&DistrictType=2&DistrictType=3&DistrictType=4&DistrictType=5. TN9814.

NCES (National Center for Education Statistics). 2022. "Geauga County Public School Districts." Washington, D.C. Accessed March 18, 2024, at https://nces.ed.gov/ccd/districtsearch/district_list.asp?Search=1&details=1&InstName=&DistrictID=&Address=&City=&State=39&Zip=&Miles=&County=Geauga+County&PhoneAreaCode=&Phone=&DistrictType=1&DistrictType=2&DistrictType=3&DistrictType=4&DistrictType=5&DistrictType=6&DistrictType=7&DistrictType=8&DistrictType=9&NumOfStudents=&NumOfStudentsRange=more&NumOfSchools=&NumOfSchoolsRange=more. TN9815.

NCES (National Center for Education Statistics). 2022. "Lake County Public School Districts." Washington, D.C. Accessed March 18, 2024, at https://nces.ed.gov/ccd/districtsearch/district_list.asp?Search=1&details=1&InstName=&DistrictID=&Address=&City=&State=39&Zip=&Miles=&County=Lake+County&PhoneAreaCode=&Phone=&DistrictType=1&DistrictType=2&DistrictType=3&DistrictType=4&DistrictType=5&DistrictType=6&DistrictType=7&DistrictType=8&DistrictType=9&NumOfStudents=&NumOfStudentsRange=more&NumOfSchools=&NumOfSchoolsRange=more. TN9813.

NEI (Nuclear Energy Institute). 2005. *Severe Accident Mitigation Alternatives (SAMA) Analysis Guidance Document*. NEI-05-01, Revision A, Washington, D.C. ADAMS Accession No. ML060530203. TN1978.

NEI (Nuclear Energy Institute). 2007. *Industry Ground Water Protection Initiative—Final Guidance Document.* NEI 07–07, Washington, D.C. ADAMS Accession No. ML091170588. TN1913.

NEI (Nuclear Energy Institute). 2019. *Industry Groundwater Protection Initiative – Final Guidance Document, Rev. 1.* NEI-07-07, Revision 1, Washington, D.C. ADAMS Accession No. ML19142A071. TN6775.

NETL (National Energy Technology Laboratory). 2012. *Life Cycle Analysis: Natural Gas Combined Cycle (NGCC) Power Plant*. DOE/NETL-403-110509, Pittsburgh, Pennsylvania. Accessed January 8, 2023, at https://www.netl.doe.gov/projects/files/FY13_LifeCycleAnalysisNaturalGasCombinedCycle(NGCC)PowerPlantFinal_060113.pdf. TN9604.

NETL (National Energy Technology Laboratory). 2019. Cost and Performance Baselined for Fossil Energy Plants Volume 1: Bituminous Coal and Natural Gas to Electricity. NETL-PUB-22638, Pittsburgh, Pennsylvania. TN7484.

NETL (National Energy Technology Laboratory). 2022. *Cost and Performance Baseline for Fossil Energy Plants, Volume 1: Bituminous Coal and Natural Gas to Electricity*. DOE/NETL-2023/4320, Pittsburgh, Pennsylvania. Available at https://netl.doe.gov/projects/files/CostAndPerformanceBaselineForFossilEnergyPlantsVolume1BituminousCoalAndNaturalGasToElectricity_101422.pdf. TN8820.

Newstead, D.J., S.J. Dinsmore, B..M Ballard, L.J. Niles, and J. Burger. 2024. “Survival of red knots in the northern Gulf of Mexico.” *Frontiers in Ecology and Evolution*12(1375412), Lausanne, Switzerland. http://dx.doi.org/10.3389/fevo.2024.1375412. TN9974.

Newstead, D.J., L.J. Niles, R.R. Porter, A.D. Dey, J. Burger, and O.N. Fitzsimmons. 2013. “Geolocation Reveals Mid-Continent Migratory Routes and Texas Wintering Areas of Red Knots Calidris Canutus Rufa.” *Wader Study Group Bull*, 120(1): 53-59. Coastal Bend Bays & Estuaries Program, Corpus Christi, Texas. TN8853.

NIEHS (National Institute of Environmental Health Sciences). 1999. *NIEHS Report on Health Effects from Exposure to Power-Line Frequency Electric and Magnetic Fields*. NIH Publication No 99–4493, National Institutes of Health, Research Triangle Park, North Carolina. ADAMS Accession No. ML093240277. TN78.

NIEHS (National Institute of Environmental Health Sciences). 2002. *Electric and Magnetic Fields Associated with the Use of Electric Power: Questions and Answers*. National Institutes of Health, Research Triangle Park, North Carolina. ADAMS Accession No. ML112660024. TN6560.

NIOSH (National Institute for Occupational Safety and Health). 1996. *EMFs In The Workplace*. Washington, D.C. ADAMS Accession No. ML21145A339. TN6766.

NOAA (National Oceanic and Atmospheric Administration). 2016. Letter from J. Armor, Acting Director, to Honorable K. Dahlkemper, Erie County Executive, dated February 22, 2016, regarding “Nomination for the Proposed Lake Erie Quadrangle National Marine Sanctuary.” Silver Spring, Maryland. TN9905.

NOAA (National Oceanic and Atmospheric Administration). 2022. *Local Climatological Data Annual Summary with Comparative Data, Cleveland, Ohio (KCLE*). National Centers for Environmental Protection Information, Silver Spring, Maryland. Accessed April 18, 2024, at https://www.ncdc.noaa.gov/IPS/lcd/lcd.html. TN9965.

NOAA (National Oceanic and Atmospheric Administration). 2023. “Potential Impacts of Asian Carp in Lake Erie.” National Centers for Coastal Ocean Science, Silver Spring, Maryland. Accessed on February 15, 2024, at https://coastalscience.noaa.gov/news/lake-erie-food-web-balance/. TN9752.

NOAA (National Oceanic and Atmospheric Administration). 2024. "Average Lake Erie Water Temperatures, Average Temperatures off of Cleveland (1981-2010)." National Weather Service, Silver Spring, Maryland. Accessed January 23, 2024, at https://www.weather.gov/cle/avg_lake_erie_water_temps. TN9726.

NOAA (National Oceanic and Atmospheric Administration). 2024. "Great Lakes Ice Coverage Reaches Historic Low." Silver Spring, Maryland. Accessed May 1, 2024, at https://research.noaa.gov/2024/02/13/great-lakes-ice-coverage-reaches-historic-low/. TN10027.

NOAA (National Oceanic and Atmospheric Administration). 2024. "Ice Coverage Nearly Nonexistent Across the Great Lakes, as the Historical Peak Approaches." Silver Spring, Maryland. Accessed May 1, 2024, at https://www.climate.gov/news-features/event-tracker/ice-coverage-nearly-nonexistent-across-great-lakes-historical-peak. TN10026.

NOAA (National Oceanic and Atmospheric Administration). 2024. "Lake Erie Climatology, Sustained Assessment of the Great Lakes." Silver Spring, Maryland. Accessed May 1, 2024, at https://glisa.umich.edu/sustained-assessment/erie-climatology/. TN10024.

NOAA (National Oceanic and Atmospheric Administration). 2024. "No Sign of Greenhouse Gases Increases Slowing in 2023." Key West, Florida. Accessed May 24, 2024, at https://research.noaa.gov/2024/04/05/no-sign-of-greenhouse-gases-increases-slowing-in-2023/. TN10000.

NOAA (National Oceanic and Atmospheric Administration). 2024. *Observed Water Levels at 9063063, Cleveland OH*. Silver Spring, Maryland. Accessed May 22, 2024, at https://tidesandcurrents.noaa.gov/waterlevels.html?id=9063063. TN10013.

NOAA (National Oceanic and Atmospheric Administration). 2024. "Storm Events Database Search Results for Lake County, Ohio." National Centers for Environmental Protection Information, Silver Spring, Maryland. Accessed April 30, 2024, at https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=1950&endDate_mm=01&endDate_dd=31&endDate_yyyy=2024&county=LAKE%3A85&hailfilter=0.00&tornfilter=0&windfilter=000&sort=D. TN9936.

NOAA (National Oceanic and Atmospheric Administration). 2024. "The Great Lakes Water Level Dashboard." Silver Spring, Maryland. Accessed May 1, 2024, at https://www.glerl.noaa.gov/data/wlevels/dashboard/. TN10023.

NOAA (National Oceanic and Atmospheric Administration). 2024. "Why Low Ice Coverage on the Great Lakes Matters." Silver Spring, Maryland. Accessed May 1, 2024, at https://research.noaa.gov/2024/01/18/why-low-ice-coverage-on-the-great-lakes-matters/. TN10025.

NOAA NCEI (National Oceanic and Atmospheric Administration National Centers for Environmental information). 2024. "Climate at a Glance: Divisional Time Series for Ohio." Silver Spring, Maryland. Accessed May 1, 2024, at https://www.ncei.noaa.gov/access/monitoring/climate-at-a-glance/divisional/time-series/3303/pcp/12/1/1895-2024?base_prd=true&begbaseyear=1901&endbaseyear=2000&trend=true&trend_base=10&begtrendyear=1895&endtrendyear=2024. TN10028.

Nolte, C.G., T.L. Spero, J.H. Bowden, M.S. Mallard, and P.D. Dolwick. 2018. "The potential effects of climate change on air quality across the conterminous US at 2030 under three Representative Concentration Pathways." *Atmos Chem Phys.* 18(20):15471-15489. TN8571.

NPS (National Park Service). 2015. "Summer 1795: The Treaty of Greenville creates an uneasy peace." Washington, D.C. Accessed April 8, 2024, at https://www.nps.gov/articles/a-long-legacy.htm#:~:text=In%20response%20to%20these%20tensions,expansion%20quickly%20nullified%20the%20agreement. TN9884.

NPS (National Park Service). 2021. "Ohio's Prehistoric Past, Hopewell Culture National Historical Park." Washington, D.C. Accessed April 5, 2024, at https://www.nps.gov/articles/000/ohio-s-prehistoric-past.htm. TN9875.

NPS (National Park Service). 2023. "The Six Nations Confederacy During the American Revolution." Washington, D.C. Accessed April 8, 2024, at https://www.nps.gov/articles/000/the-six-nations-confederacy-during-the-american-revolution.htm#:~:text=The%20Five%20Nations%2C%20comprised%20of,other%20members%20of%20the%20confederation. TN9882.

NPS (National Park Service). 2024. "Hopewell Culture, Hopewell Mound Group." Washington, D.C. Accessed April 8, 2024, at https://www.nps.gov/hocu/learn/historyculture/hopewell-mound-group.htm. TN9879.

NPV (North Perry Village). 2021. "Zoning." North Perry, Ohio. Accessed January 10, 2024, at https://northperry.org/departments/zoning/. TN9605.

NRC (U.S. Nuclear Regulatory Commission). 1982. Final Environmental Statement related to the operation of Perry Nuclear Power Plant, Units 1 and 2, Docket Nos. 50-440 and 50-441, Cleveland Electric Illuminating Company. NUREG-0884, Washington, D.C. ADAMS Accession No. ML15134A060. TN9606.

NRC (U.S. Nuclear Regulatory Commission). 1996. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*. Volumes 1 and 2, NUREG-1437, Washington, D.C. ADAMS Accession Nos. ML040690705, ML040690738. TN288.

NRC (U.S. Nuclear Regulatory Commission). 1997. *Regulatory Analysis Technical Evaluation Handbook.* NUREG/BR–0184, Washington, D.C. ADAMS Accession No. ML050190193. TN676.

NRC (U.S. Nuclear Regulatory Commission). 2002. “Final Generic Environmental Impact Statement of Decommissioning of Nuclear Facilities (NUREG-0586).” NUREG–0586, Supplement 1, Volumes 1 and 2, Washington, D.C. ADAMS Accession Nos. ML023470327, ML023500228. TN665.

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, Main Report - Final Report. NUREG-0586, Supplement 1, Volume 1 and 2, Washington, D.C. ADAMS Accession Nos. ML023470304, ML023470323, ML023500187, ML023500211, ML023500223. TN7254.

NRC (U.S. Nuclear Regulatory Commission). 2006. *Liquid Radioactive Release Lessons Learned Task Force Final Report*. Washington, D.C. ADAMS Accession No. ML083220312. TN1000.

NRC (U.S. Nuclear Regulatory Commission). 2011. Memorandum from Chairman Jaczko to Commissioners Svinicki, Apostolakis, Magwood, and Ostendorff, dated March 21, 2011, regarding “NRC Actions Following the Events in Japan.” COMGBJ-11-0002, Washington, D.C. TN7448.

NRC (U.S. Nuclear Regulatory Commission). 2012. “In the Matter of All Power Reactor Licensees and Holders of Construction Permits in the Active or Deferred Status. Order Modifying Licenses with Regard to Requirements For Mitigation Strategies For Beyond-Design-Basis External Events (Effective Immediately).” 7590-01-P, EA-12-049, NRC-2012-0068, Washington, D.C. ADAMS Accession No. ML12056A045. TN7947.

NRC (U.S. Nuclear Regulatory Commission). 2012. Letter from E. Leeds to All Power Reactor Licensees and Holders of Construction Permits in Active or Deferred Status, dated March 12, 2012, regarding “Request for Information Pursuant to Title 10 of the *Code of Federal Regulations* 50.54(f) Regarding Recommendations 2.1, 2.3, and 9.3, of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident.” Washington, D.C. ADAMS Accession No. ML12053A340. TN2198.

NRC (U.S. Nuclear Regulatory Commission). 2013. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*. NUREG-1437, Revision 1, Washington, D.C. ADAMS Package Accession No. ML13107A023. TN2654.

NRC (U.S. Nuclear Regulatory Commission). 2013. Letter from R.K. Johnson, Chief Fuel Manufacturing Branch Division of Fuel Cycle Safety and Safeguards, Office of Nuclear Materials Safety and Safeguards, to D.W. Johnson, Director, Office of Technical Programs and Coordination Activities, Department of Labor Occupational Safety and Health Administration, dated July 29, 2013, regarding "Memorandum of Understanding Between the U.S. Nuclear Regulatory Commission and the Occupational Safety and Health Administration." Washington, D.C. ADAMS Accession No. ML11354A411. TN10165.

NRC (U.S. Nuclear Regulatory Commission). 2013. *Preparation of Environmental Reports for Nuclear Power Plant License Renewal Applications*. Regulatory Guide 4.2, Supplement 1, Revision 1, Washington, D.C. ADAMS Accession No. ML13067A354. TN4791.

NRC (U.S. Nuclear Regulatory Commission). 2013. *Standard Review Plans for Environmental Reviews of Nuclear Power Plants, Supplement 1: Operating License Renewal.* Final Report, NUREG-1555, Supplement 1, Revision 1, Washington, D.C. ADAMS Accession No. ML13106A246. TN3547.

NRC (U.S. Nuclear Regulatory Commission). 2014. Email from B.A. Grange to U.S. Fish and Wildlife Service, dated June 17, 2014, regarding "Davis Besse Operating License Renewal." Washington, D.C. ADAMS Accession No. ML14168A616. TN7385.

NRC (U.S. Nuclear Regulatory Commission). 2014. *Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel.* Final Report, NUREG–2157, Washington, D.C. ADAMS Package Accession No. ML14198A440. TN4117.

NRC (U.S. Nuclear Regulatory Commission). 2014. *Probabilistic Seismic Hazard Analysis: Background Information*. Washington, D.C. ADAMS Accession No. ML14140A648. TN8997.

NRC (U.S. Nuclear Regulatory Commission). 2015. Biological Assessment on the Northern Long-Eared Bat (Myotis septentrionalis) and Indiana Bat (Myotis sodalis), Indian Point Nuclear Generating Units 2 and 3, Proposed License Renewal. Docket Numbers 50-247 and 50-286, Rockville, Maryland. ADAMS Accession No. ML15161A086. TN7382.

NRC (U.S. Nuclear Regulatory Commission). 2015. Generic Environmental Impact Statement for License Renewal of Nuclear Plants; Supplement 53 Regarding Sequoyah Nuclear Plant, Units 1 and 2, Final Report. NUREG-1437, Supplement 53, Washington, D.C. ADAMS Accession No. ML15075A438. TN5842.

NRC (U.S. Nuclear Regulatory Commission). 2018. Biological Evaluation of Impacts to Northern Long-Eared Bat, Rufa Red Knot, Piping Plover, and Roseate Tern, Seabrook Station, Unit 1, Proposed License Renewal to Operating License No. NPF-86. Docket No. 50-443, Rockville, Maryland. ADAMS Accession No. ML18186A692. TN7381.

NRC (U.S. Nuclear Regulatory Commission). 2018. Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Supplement 58: Regarding River Bend Station, Unit 1 Final. NUREG-1437, Supplement 58, Washington, D.C. ADAMS Accession No. ML18310A072. TN7313.

NRC (U.S. Nuclear Regulatory Commission). 2018. "Seismic Reviews at U.S. Nuclear Power Plants." Backgrounder, June 2018, Washington, D.C. ADAMS Accession No. ML081620327. TN8998.

NRC (U.S. Nuclear Regulatory Commission). 2019. Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Supplement 5, Second Renewal, Regarding Subsequent License Renewal for Turkey Point Nuclear Generating Unit Nos. 3 and 4. NUREG-1437, Supplement 5, Second Renewal, Washington, D.C. ADAMS Accession No. ML19290H346. TN6824.

NRC (U.S. Nuclear Regulatory Commission). 2020. Letter from R.J. Bernardo, Project Manager, Integrated Program Management and BDB Branch, Division of Operating Reactor Licensing, Office of Nuclear Reactor Regulation, to Mr. F.R. Payne, Site Vice President, dated August, 17, 2020, regarding “Perry Nuclear Power Plant, Unit No. 1 - Documentation of the Completion of Required Actions Taken in Response to the Lessons Learned from the Fukushima Dai-Ichi Accident.” Washington, D.C. ADAMS Accession No. ML20219A129. TN9941.

NRC (U.S. Nuclear Regulatory Commission). 2020. *Procedural Guidance for Preparing Categorical Exclusions, Environmental Assessments, and Considering Environmental Issues*. LIC-203, Revision 4, Washington, D.C. ADAMS Accession No. ML20016A379. TN6399.

NRC (U.S. Nuclear Regulatory Commission). 2023. “Event Notification Report for June 26, 2023, Event Numbers 56581, 56584, 56585, 56586, and 56588.” Washington, D.C. Accessed May 6, 2024, at https://www.nrc.gov/reading-rm/doc-collections/event-status/event/2023/20230626en.html. TN9961.

NRC (U.S. Nuclear Regulatory Commission). 2023. Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Main Report, Chapters 1–8, Draft Report for Comment, and Appendices. NUREG-1437, Volume 1 and 2, Revision 2, Washington, D.C. ADAMS Accession No. ML23011A063. TN10070.

NRC (U.S. Nuclear Regulatory Commission). 2023. *List of Leaks and Spills at Operating U.S. Commercial Nuclear Power Plants October 11, 2023*. Washington, D.C. ADAMS Accession No. ML23284A164. TN9980.

NRC (U.S. Nuclear Regulatory Commission). 2023. Memorandum from L.J. Rakovan, Sr. Project Manager Environmental Review License Renewal Branch Division of Rulemaking, Environmental, and Financial Support Office of Nuclear Material Safety and Safeguards, to T.B. Smith, Chief Environmental Review License Renewal Branch Division of Rulemaking, Environmental, and Financial Support Office of Nuclear Material Safety and Safeguards, dated November 6, 2023, regarding “Meeting Summary: Public Scoping Meeting for the Environmental Review of the License Renewal Application for Perry Nuclear.” Washington, D.C. ADAMS Accession No. ML23303A064. TN9934.

NRC (U.S. Nuclear Regulatory Commission). 2023. Letter from T.B. Smith, Chief Environmental Review License Renewal Branch Division of Rulemaking, Environment, and Financial Support Office of Nuclear Material Safety and Safeguards, to Mary Beth Hirsch, Director State Historic Preservation Office, dated October 18, 2023, regarding “Request for Scoping Comments Concerning the Environmental Review of Perry Nuclear Power Plant, Unit 1 License Renewal Application (Docket Number: 50-440).” Washington, D.C. ADAMS Accession No. ML23276B122. TN10054.

NRC (U.S. Nuclear Regulatory Commission). 2023. Letter from T.B. Smith, Chief Environmental Review License Renewal Branch Division of Rulemaking, Environment, and Financial Support Office of Nuclear Material Safety and Safeguards, to P. Barton, Tribal Historic Preservation Officer; E. Meshigaud, Hannahville Indian Community, Michigan; M. Wiatrolik, Tribal Historic Preservation Officer; Logan York, Tribal Historic Preservation Officer; J. Stahlman, Tribal Historic Preservation Officer; and W. Tarrant, Tribal Historic Preservation Officer, dated October 18, 2023, regarding "Request for Scoping Comments Concerning the Environmental Review of Perry Nuclear Power Plant, Unit 1 License Renewal Application (Docket Number: 50-440)." Washington, D.C. ADAMS Accession No. ML23277A082. TN10053.

NRC (U.S. Nuclear Regulatory Commission). 2023. Letter from T.B. Smith, Chief Environmental Review License Renewal Branch Division of Rulemaking, Environment, and Financial Support Office of Nuclear Material Safety and Safeguards, to R. Nelson, Executive Director Advisory Council on Historic Preservation, dated October 18, 2023, regarding "Request for Scoping Comments Concerning the Environmental Review of Perry Nuclear Power Plant, Unit 1 License Renewal Application (Docket Number: 50-440)." Washington, D.C. ADAMS Accession No. ML23276B401. TN10052.

NRC (U.S. Nuclear Regulatory Commission). 2024. "Event Notification Report for January 08, 2024, Event Numbers 56833, 56911, 56913, 56914, and 56915." Washington, D.C. Accessed May 6, 2024, at https://www.nrc.gov/reading-rm/doc-collections/event-status/event/2024/20240108en.html. TN9963.

NRC (U.S. Nuclear Regulatory Commission). 2024. Letter from S.S. Koenick, Chief Environmental Project Management Branch 1 Division of Rulemaking, Environmental, and Financial Support Office of Nuclear Material Safety and Safeguards, to R.L. Penfield, Site Vice President, Perry Nuclear Power Plant, dated July 25, 2024, regarding "Issuance of Environmental Scoping Summary Report Associated with the U.S. Nuclear Regulatory Commission Staff's Review of the Perry Nuclear Power Plant Unit 1, Subsequent License Renewal Application (EPID NO. L-2023-LNE- 0002) (DOCKET NO. 50-440)." Washington, D.C. ADAMS Accession No. ML24150A200. TN10327.

NRC (U.S. Nuclear Regulatory Commission). 2024. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*. NUREG-1437, Volume 1-3, Revision 2, Washington, D.C. ADAMS Accession No. ML24087A133. TN10161.

NRC (U.S. Nuclear Regulatory Commission). 2024. *Occupational Radiation Exposure at Commercial Nuclear Power Reactors and Other Facilities 2021, Fifty-Fourth Annual Report*. NUREG-0713, Volume 43, Washington, D.C. ADAMS Accession No. ML24060A017. TN9915.

NRC (U.S. Nuclear Regulatory Commission). 2024. Letter from L.J. Rakovan, Sr. Project Manager Environmental Review License Renewal Branch Division of Rulemaking, Environmental, and Financial Support Office of Nuclear Material Safety and Safeguards, to R.L. Penfield, Site Vice President, dated March 14, 2024, regarding "Perry Nuclear Power Plant Unit 1 - Summary of the January-February 2024 Environmental Audit Related to the Review of the License Renewal Application Environmental Report (EPID Number: L-2023-LNE-002)." Washington, D.C. ADAMS Accession No. ML24064A217. TN9935.

NRC (U.S. Nuclear Regulatory Commission). 2024. Second Round Request for Additional Information - Perry Nuclear Power Plant Unit 1 License Renewal Environmental Review. Washington, D.C. ADAMS Accession No. ML24190A080. TN10378.

NREL (National Renewable Energy Laboratory). Undated. “Concentrating Solar Power.” Golden, Colorado. Accessed June 12, 2022, at https://www.nrel.gov/csp/index.html. TN7710.

Oh. Admin. Code (OAC) 37-3750. Title 37, Health-Safety-Morals, Chapter 3750, “Emergency Planning.” Ohio Laws and Administrative Rules, Columbus, Ohio. TN10020.

Oh. Admin. Code (OAC) 15-1531. 1988. Title 15, *Conservation of Natural Resources,* Chapter 1531,”Protection of species threatened with statewide extinction.” Ohio Laws and Administrative Rules, Columbus, Ohio. TN9736.

Oh. Admin. Code (OAC) Title 15. 1988. Title 15, *Conservation of Natural Resources.* Ohio Laws and Administrative Rules, Columbus, Ohio. TN9748.

Occupational Safety and Health Act of 1970, as amended. 29 U.S.C. § 651 *et seq*. TN4453.

OCPI (Ohio City Productions, Inc.). 2024. “Lake County.” Upper Arlington, Ohio. Accessed April 9, 2024, at http://touringohio.com/northeast/lake/lake-county-ohio.html. TN9888.

ODNR (Ohio Department of Natural Resources). 2018. “Ohio Coastal Atlas.” Columbus, Ohio. Accessed January 10, 2024 at https://ohiodnr.gov/discover-and-learn/safety-conservation/about-ODNR/coastal-management/ohio-coastal-mgmt-program/ohio-coastal-atlas-documents. TN9608.

ODNR (Ohio Department of Natural Resources). 2018. *Raptors of Ohio, Field Guide*. Publication 5386 (0118), Columbus, Ohio. Accessed April 17, 2024, at https://ohiodnr.gov/static/documents/wildlife/backyard-wildlife/Pub%205386%20Raptors%20of%20Ohio%20FIeld%20Guide.pdf. TN9893.

ODNR (Ohio Department of Natural Resources). 2020. *2020 Ohio Bald Eagle Nests*. Columbus, Ohio. Accessed April 17, 2024, at https://ohiodnr.gov/static/documents/wildlife/wildlife-management/WEB_2020EagleNestMap.pdf. TN9892.

ODNR (Ohio Department of Natural Resources). 2020. “Bachman’s Jelly Lichen.” Columbus, Ohio. Accessed on May 22, 2024, at https://ohiodnr.gov/discover-and-learn/plants-trees/fungi/bachmans-jelly-lichen. TN9986.

ODNR (Ohio Department of Natural Resources). 2020. “Clinton’s Wood Fern.” Columbus, Ohio. Accessed on May 22, 2024, at https://ohiodnr.gov/discover-and-learn/plants-trees/non-flowering-plants/Clintons-Wood-Fern. TN9990.

ODNR (Ohio Department of Natural Resources). 2020. “Ohio DNR 2020 Rare Plants.” Columbus, Ohio. Accessed May 21, 2024, at https://ohiodnr.gov/discover-and-learn/animals/search-for-species/search-for-species?plant=Rare%20Plants. TN9978.

ODNR (Ohio Department of Natural Resources). 2020. "Variegated Scouring-Rush." Columbus, Ohio. Accessed on May 22, 2024, at https://ohiodnr.gov/discover-and-learn/plants-trees/non-flowering-plants/Variegated-Scouring-rush. TN9992.

ODNR (Ohio Department of Natural Resources). 2021. *Invasive Carp Tactical Plan 2021-2030*. Columbus, Ohio. Accessed February 15, 2024, at https://ohiodnr.gov/static/documents/wildlife/fish-management/Invasive+Carp+Tactical+Plan.pdf. TN9753.

ODNR (Ohio Department of Natural Resources). 2022. *Freshwater Mussels of Ohio Field Guide*. Publication 5517, Columbus, Ohio. Accessed February 15, 2024, at https://ohiodnr.gov/static/documents/wildlife/backyard-wildlife/Pub+5517+-+Freshwater+Mussels+of+Ohio+R1022.pdf. TN9757.

ODNR (Ohio Department of Natural Resources). 2022. Ohio's Listed Species - Wildlife That Are Considered to be Endangered, Threatened, Species of Concern, Special Interest, Extirpated, or Extinct in Ohio. Publication 5356 (R0722), Columbus, Ohio. Accessed February 23, 2024, at https://ohiodnr.gov/static/documents/wildlife/state-listed-species/Pub+5356+Ohio+Listed+Species_R0722.pdf. TN9766.

ODNR (Ohio Department of Natural Resources). 2023. *Lake County State Listed Animal Species.* Columbus, Ohio. Accessed on May 22, 2024, at https://ohiodnr.gov/discover-and-learn/safety-conservation/about-odnr/wildlife/documents-publications/wildlife-species-county. TN9983.

ODNR (Ohio Department of Natural Resources). 2023. *Lake County State Listed Plant Species.* Columbus, Ohio. TN9984.

ODNR (Ohio Department of Natural Resources). 2023. *Status of the Lake Erie Yellow Perch Fishery 2023*. Columbus, Ohio. Accessed February 1, 2024 at https://ohiodnr.gov/static/documents/wildlife/fish-management/Yellow%20Perch%20Status%20Pamphlet.pdf. TN9730.

ODNR (Ohio Department of Natural Resources). 2024. "Invasive Species." Columbus, Ohio. Accessed April 23, 2024, at https://ohiodnr.gov/discover-and-learn/animals/invasive-species. TN9914.

ODNR (Ohio Department of Natural Resources). 2024. "List of Ohio's Aquatic Invasive Species." Columbus, Ohio. Accessed February 16, 2024, at https://ohiodnr.gov/discover-and-learn/safety-conservation/fish-management/aquatic-invasive-species/aquatic-invasive-species. TN9760.

ODNR (Ohio Department of Natural Resources). 2024. *Mines of Ohio*. Columbus, Ohio. Accessed March 8, 2024, at https://gis.ohiodnr.gov/MapViewer/?config=OhioMines. TN9918.

ODNR (Ohio Department of Natural Resources). 2024. Email from C. Nelson, Groundwater Program Supervisor, to R.L. Bence, Groundwater Hydrologist, dated May 3, 2024, regarding "ODNR Water Wells Records Request." Columbus, Ohio. TN10046.

ODNR (Ohio Department of Natural Resources). 2024. *Ohio's Lake Erie Fisheries 2023 Annual Data Report*. Columbus, Ohio. Accessed February 5, 2024 at https://dam.assets.ohio.gov/image/upload/ohiodnr.gov/documents/wildlife/fish-management/LakeErieStatus.pdf. TN9737.

ODNR (Ohio Department of Natural Resources). 2024. "State Listed Species." Columbus, Ohio. Accessed February 5, 2024, at https://ohiodnr.gov/discover-and-learn/safety-conservation/about-ODNR/wildlife/state-listed-species. TN9738.

ODOD (Ohio Department of Development). 2022. "Population." Columbus, Ohio. Accessed February 22, 2024, at https://development.ohio.gov/about-us/research/population/population. TN9764.

O'Donnell, D.R., R. Briland, R.R. Budnik, S.A. Ludsin, and J.M. Hood. 2023. "Trends in Lake Erie Phytoplankton Biomass and Community Structure During a 20-year Period of Rapid Environmental Change." *Journal of Great Lakes Research* 49(3): 672-684, Ann Arbor, Michigan. TN9758.

ODOT (Ohio Department of Transportation). 2022. *Statewide Transportation Improvement Program*. Columbus, Ohio. Accessed May 10, 2024, at http://www.dot.state.oh.us/Divisions/Planning/STIP/20212024/2021-2024%20STIP.pdf. TN9922.

ODOT (Ohio Department of Transportation). 2023. "Traffic Monitoring Management System (TMMS)." Columbus, Ohio. Accessed March 17, 2024, at https://www.transportation.ohio.gov/programs/technical-services/tech-services-card-catalog/tmms. TN9807.

OEPA (Ohio Environmental Protection Agency). 2023. Letter from R. Hodanbosi, Chief, Division of Air Pollution Control, to A. Inman, EHNOC - Perry Nuclear Power Plant, dated August 24, 2023, regarding "Final Air Pollution Permit-To-Install and Operate Facility ID: 0243120922 Permit Number: P0134322 Permit Type: Initial Installation County: Lake." Columbus, Ohio. Accessed January 18, 2024, at https://edocpub.epa.ohio.gov/publicportal/ViewDocument.aspx?docid=2536956. TN10051.

OEPA (Ohio Environmental Protection Agency). 2023. Letter from R. Hodanbosi, Chief, Division of Air Pollution Control, to A. Inman, EHNOC - Perry Nuclear Power Plant, dated September 27, 2023, regarding "Final Air Pollution Permit-To-Install and Operate Facility ID: 0243120922 Permit Number: P0134521 Permit Type: Administrative Modification County: Lake." Columbus, Ohio. Accessed October 31, 2023, at https://edocpub.epa.ohio.gov/publicportal/ViewDocument.aspx?docid=2560401. TN10050.

OEPA (Ohio Environmental Protection Agency). 2024. "Harmful Algal Blooms." Columbus, Ohio. Accessed April 13, 2024, at https://epa.ohio.gov/monitor-pollution/pollution-issues/harmful-algae-blooms. TN9916.

OEPA (Ohio Environmental Protection Agency). 2024. “NPDES General Permits.” Columbus, Ohio. Accessed January 18, 2024, at https://epa.ohio.gov/divisions-and-offices/surface-water/permitting/npdes-general-permits. TN9944.

OEPA (Ohio Environmental Protection Agency). 2024. “Ohio Integrated Water Quality Monitoring and Assessment Report, 2024-1975.” Columbus, Ohio. Accessed April 17, 2024, at https://epa.ohio.gov/divisions-and-offices/surface-water/reports-data/ohio-integrated-water-quality-monitoring-and-assessment-report. TN9894.

OHC (Ohio History Connection). 2023. Email from K. Horrocks, Interim Department Head and Deputy State Historic Preservation Officer for Resource Protection & Review, Ohio History Connection, to PerryEnvironmental, dated November 13, 2023, regarding “Perry Nuclear Power Plant, Unit 1 License Renewal Application (Docket ID: NRC-2023-0136((2014-LAK-29621, RPR Serial No. 1100250).” Columbus, Ohio. ADAMS Accession No. ML23317A370. TN10073.

OLEC (Ohio Lake Erie Commission). 2022. *Lake Erie Quality Index 2022 Report*. Sandusky, Ohio. Accessed January 23, 2024, at https://lakeerie.ohio.gov/static/OLEC_Reports/LEQI%202022%20FINAL%20PDF.pdf. TN9707.

ONW (Oneida Nation of Wisconsin). 2024. “Federal Treaties.” Oneida, Wisconsin. Accessed April 8, 2024, at https://oneida-nsn.gov/our-ways/our-story/historic-timeline/federal-treaties/. TN9883.

OSU (Ohio State University). 2024. “Plankton and Algae Common to Lake Erie.” Columbus, Ohio. Accessed January 26, 2024, at https://ohioseagrant.osu.edu/research/plankton. TN9727.

Owen, S.F., Menzel, M.A., Ford, W.M., Edwards, J.W., Chapman, B.R., Miller, K.V., Wood, P.B. 2022. *Roost Tree Selection by Maternal Colonies of Northern Long-eared Myotis on an Intensively Managed Forest*. Technical Report NE-22, United States Forest Service Northeastern Research Station, Newton Square, Pennsylvania. TN8500.

Peskin, L. 2011. “The Forgotten Indian Earthworks of Cleveland, Ohio.” *Ohio Archaeologist*, 61(2):33-37, Fairborn, Ohio. TN9872.

Petersen, M.D., A.M. Shumway, P.M. Powers, C.S. Mueller, M.P. Moschetti, A.D. Frankel, S. Rezaeian, D.E. McNamara, N. Luco, O.S. Boyd, K.S. Rukstales, K.S. Jaiswal, E.M. Thompson, S.M. Hoover, B.S. Clayton, E.H. Field, and Y. Zeng. 2020. “The 2018 update of the US National Seismic Hazard Model: Overview of model and implications.” *Earthquake Spectra* 36(1):5-41, Los Angeles, California. TN7281.

Petersen, M.D., A.M. Shumway, P.M. Powers, E.H. Field, M.P. Moschetti, K.S. Jaiswal, K.R. Milner, S. Rezaeian, A.D. Frankel, A.L. Llenos, A.J. Michael, J.M. Altekruse, S.K. Ahdi, K.B. Withers, C.S. Mueller, Y. Zeng, R.E. Chase, L.M. Salditch, N. Luco, K.S. Rukstales, J.A. Herrick, D.L. Girot, B.T. Aagaard, A.M. Bender, M.L. Blanpied, R.W. Briggs, O.S. Boyd, B.S. Clayton, C.B. DuRoss, E.L. Evans, P.J. Haeussler, A.E. Hatem, K.L. Haynie, E.H. Hearn, K.M. Johnson, Z.A. Kortum, N.S. Kwong, A.J. Makdisi, H.B. Mason, D.E. McNamara, D.F. McPhillips, P.G. Okubo, M.T. Page, F.F. Pollitz, J.L. Rubinstein, B.E. Shaw, Z.-K. Shen, B.R. Shiro, J.A. Smith, W.J. Stephenson, E.M. Thompson, J.A.T. Jobe, E.A. Wirth, and R.C. Witter. 2024. "The 2023 US 50-State National Seismic Hazard Model: Overview and Implications." *Earthquake Spectra* 40(1):5-88, Thousand Oaks, California. http://dx.doi.org/10.1177/87552930231215428. TN9940.

Pollution Prevention Act of 1990. 42 U.S.C. § 13101 *et seq*. TN6607.

PT (Perry Township). 2022. "Zoning Department." Perry, Ohio. Accessed February 1, 2024, at https://www.perrytownship-lake.com/zoning. TN9728.

Redmond, B.G. 2006. *Before the Western Reserve: An Archaeological History of Northeast Ohio*. The Cleveland Museum of Natural History, Cleveland, Ohio. Accessed April 5, 2024 at https://www.cmnh.org/CMNH/media/CMNH_Media/C-R%20Docs/BeforeWR.pdf. TN9867.

Resource Conservation and Recovery Act of 1976. 42 U.S.C § 6901 *et seq*. Public Law 94-580, 90 Stat. 2795. TN1281.

Saunders, W.E. 1930. "Bats in Migration." *Journal of Mammalogy* 11(2):255. TN8504.

Schaub, A., J. Ostwald, and B.M. Siemers. 2008. "Foraging Bats Avoid Noise." *The Journal of Experimental Biology*, 211:3174-3180. Cambridge, United Kingdom. TN8867.

Shmidt, J.J. 1994. *Ground Water Resources of Lake County*. Ohio Department of Natural Resources, Columbus, Ohio. Accessed May 17, 2024, at https://dam.assets.ohio.gov/image/upload/ohiodnr.gov/documents/geology/Lake_GWR_29x24_EOGS04749.pdf. TN9947.

Slagle, Z., H. Luken, P. Jenkins, M. Thorn, A. Bonsall, T. MacDougall, J. Holden, J. Hessenauer, J. Markham, M. Hosack, M. DuFour, and K. Towne. 2023. *Report of the Lake Erie Forage Task Group*. Great Lakes Fishery Commission, Ann Arbor, Michigan. Accessed February 9, 2024, at http://www.glfc.org/pubs/lake_committees/erie/FTG_docs/annual_reports/FTG_report_2023.pdf. TN9747.

Smith, A.D., F.J. Sanders, K.L. Lefevre, J.M. Thibault, K.S. Kalasz, M.C. Handmaker, F.M. Smith, and T.S. Keyes. 2023. "Spring Migration Patterns of Red Knots in the Southeast United States Disentangled Using Automated Telemetry." Scientific Reports 13(11138), New York, New York. https://doi.org/10.1038/s41598-023-37517-y. TN9975.

Stantial, M.L. 2014. *Flight Behavior of Breeding Piping Plovers: Implications for Risk of Collision with Wind Turbines*. Master of Science Thesis, State University of New York. Syracuse, New York. Accessed June 10, 2022, at https://www.njfishandwildlife.org/ensp/pdf/plover-turbine_stantialthesis14.pdf. TN7614.

Stantial, M.L., and J.B. Cohen. 2015. "Estimating Flight Height and Flight Speed of Breeding Piping Plover." *Journal of Field Ornithology* 86(4)369-377. Hoboken, New Jersey. DOI: 10.1111/jofo.12120. Accessed May 12, 2022, at https://doi.org/10.1111/jofo.12120. TN7348.

Taylor, W.K., and B.H. Anderson. 1973. "Nocturnal migrants killed at a central Florida TV tower; Autumns 1969-1971." *The Wilson bulletin* 85(1):42-51. TN8508.

Tegen, S. 2016. "Wind Energy Workforce Development & Jobs." *Nebraska Wind and Solar Conference*, Lincoln, Nebraska. TN8826.

Thompson, M., J.A. Beston, M. Etterson, J.E. Diffendorfer, and S.R. Loss. 2017. "Factors Associated with Bat Mortality at Wind Energy Facilities in the United States." *Biological Conservation*, 215:241-254, *Elsevier*, Amsterdam, Netherlands. TN8746.

TVA (Tennessee Valley Authority). 2013. Sequoyah Nuclear Plant, Units 1 and 2, License Renewal Application, Appendix E, Applicant's Environmental Report, Operating License Renewal Stage. Chattanooga, Tennessee: TVA. January 7, 2013. ADAMS Nos. ML13024A012, ML13024A013, ML13024A006, ML13024A007, ML13024A008, ML13024A009, and ML13024A010. TN7899.

USACE (U.S. Army Corp of Engineers). 2012. *Molluscides*. Washington, D.C. Accessed February 15, 2024, at https://glmris.anl.gov/documents/docs/anscontrol/Molluscicides.pdf. TN9751.

USCB (U.S. Census Bureau). 2000. "Decennial Census, DEC Summary File 4 Demographic Profile, Table DP1, Profile of General Demographic Characteristics: 2000 for Ashtabula County, Lake County, and Geauga County, Ohio." Washington, D.C. Accessed March 17, 2024, at https://data.census.gov/table/DECENNIALDPSF42000.DP1?q=DP1&g=050XX00US39007,39055,39085. TN9802.

USCB (U.S. Census Bureau). 2010. "Decennial Census, DEC Redistricting Data (PL 94-171), Table P2, Hispanic or Latino, and not Hispanic or Latino by Race for Ashtabula County, Lake County, and Geauga County, Ohio." Washington, D.C. Accessed March 17, 2024, at https://data.census.gov/table/DECENNIALPL2010.P2?q=P2&g=050XX00US39007,39055,39085. TN9804.

USCB (U.S. Census Bureau). 2020. "Decennial Census, DEC Redistricting Data (PL 94-171), Table P2, Hispanic or Latino, and not Hispanic or Latino by Race for Ashtabula County, Lake County, and Geauga County, Ohio." Washington, D.C. Accessed March 17, 2024, at https://data.census.gov/table/DECENNIALPL2020.P2?q=P2&g=050XX00US39007,39055,39085. TN9803.

USCB (U.S. Census Bureau). 2020. “Decennial Census, DEC Redistricting Data (PL 94-171), Table P2, Hispanic or Latino, and not Hispanic or Latino by Race for Ohio and Erie County, Mercer County, and Crawford County, Pennsylvania.” Washington, D.C. Accessed March 18, 2024, at https://data.census.gov/table/DECENNIALPL2020.P2?q=P2&g=040XX00US39$1500000_050XX00US42039$1500000,42049$1500000,42085$1500000. TN9816.

USCB (U.S. Census Bureau). 2021. “American Community Survey, ACS 5-Year Estimates Data Profiles, Table DP03, Selected Economic Characteristics for Ashtabula County, Lake County, and Geauga County, Ohio.” Washington, D.C. Accessed February 23, 2024, at https://data.census.gov/table/ACSDP5Y2021.DP03?q=DP03&g=040XX00US39_050XX00US39007,39055,39085. TN9769.

USCB (U.S. Census Bureau). 2021. “American Community Survey, ACS 5-Year Estimates Data Profiles, Table DP04, Selected Housing Characteristics for Ashtabula County, Lake County, and Geauga County, Ohio.” Washington, D.C. Accessed March 17, 2024, at https://data.census.gov/table/ACSDP5Y2021.DP04?q=DP04&g=050XX00US39007,39055,39085. TN9806.

USCB (U.S. Census Bureau). 2021. “American Community Survey, ACS 5-Year Estimates Detailed Tables, Table B25004, Vacancy Status for Ashtabula County, Lake County, and Geauga County, Ohio.” Washington, D.C. Accessed March 17, 2024, at https://data.census.gov/table/ACSDT5Y2021.B25004?q=B25004&g=050XX00US39007,39055,39085. TN9805.

USCB (U.S. Census Bureau). 2021. “American Community Survey, ACS 5-Year Estimates Detailed Tables, Table C17002, Ratio of Income to Poverty Level in the Past 12 Months for Ohio and Erie County, Mercer County, and Crawford County, Pennsylvania.” Washington, D.C. Accessed May 30, 2024, at https://data.census.gov/table/ACSDT5Y2021.C17002?q=C17002&g=040XX00US39$1500000_050XX00US42039$1500000,42049$1500000,42085$1500000. TN10019.

USCB (U.S. Census Bureau). 2021. “Poverty Thresholds by Size of Family and Number of Children.” Washington, D.C. Accessed September 5, 2023, at https://www.census.gov/data/tables/time-series/demo/income-poverty/historical-poverty-thresholds.html. TN8833.

USDA (U.S. Department of Agriculture). 2019. *2017 Census of Agriculture - County Data, Table 7, Hired Farm Labor - Workers and Payroll:* 2017. Washington, D.C. Accessed February 23, 2024, at https://www.nass.usda.gov/Publications/AgCensus/2017/Full_Report/Volume_1,_Chapter_2_County_Level/Ohio/st39_2_0007_0007.pdf. TN9770.

USDA (U.S. Department of Agriculture). 2024. *Custom Soil Resource Report for Lake County, Ohio*. Washington, D.C. Accessed March 11, 2024, at https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx. TN9887.

USGCRP (U.S. Global Change Research Program). 2014. *Climate Change Impacts in the United States: The Third National Climate Assessment*. J.M. Melillo, T.C. Richmond, and G.W. Yohe (eds.). U.S. Government Printing Office, Washington, D.C. ADAMS Accession No. ML14129A233. TN3472.

USGCRP (U.S. Global Change Research Program). 2017. *Climate Science Special Report: Fourth National Climate Assessment*. Volume I. Wuebbles, D.J., D.W. Fahey, K.A. Hibbard, D.J. Dokken, B.C. Stewart, and T.K. Maycock (eds.). Washington, D.C. ADAMS Accession No. ML19008A410. doi: 10.7930/J0J964J6. TN5848.

USGCRP (U.S. Global Change Research Program). 2018. *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment*. Volume II. D.R. Reidmiller, C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.). Washington, D.C. ADAMS Accession No. ML19008A414. doi: 10.7930/NCA4.2018. TN5847.

USGCRP (U.S. Global Change Research Program). 2023. *The Fifth National Climate Assessment*. A.R. Crimmins, C.W. Avery, D.R. Easterling, K.E. Kunkel, B.C. Stewart, and T.K. Maycock, Eds. Washington, D.C. Available at https://doi.org/10.7930/NCA5.2023. TN9762.

USGS (U.S. Geological Survey). 2008. *Assessment of Moderate- and High-Temperature Geothermal Resources of the United States*. Fact Sheet 2008–3082, Menlo Park, California. Accessed June 12, 2022, at https://pubs.usgs.gov/fs/2008/3082/pdf/fs2008-3082.pdf. TN7697.

USGS (U.S. Geological Survey). 2016. “Bat Fatalities at Wind Turbines- Investigating the Causes and Consequences.” Reston, Virginia. Available at https://www.usgs.gov/centers/fort-collins-science-center/science/bat-fatalities-wind-turbines-investigating-causes-and?qt-science_center_objects=0#qt-science_center_objects . TN8510.

USGS (U.S. Geological Survey). 2018. “Lake Erie Collaborative Science and Monitoring Initiative 2014.” Reston, Virginia. Accessed January 26, 2024, on https://www.sciencebase.gov/catalog/item/59c319e7e4b091459a61d63d. TN9720.

USGS (U.S. Geological Survey). 2024. “The Mineral Industry of Ohio, Statistics and Information on the Nonfuel Mineral Commodities Produced in Ohio.” Reston, Virginia. Accessed on March 7, 2024, at https://www.usgs.gov/centers/national-minerals-information-center/mineral-industry-ohio. TN9808.

USGS (U.S. Geological Survey). 2024. “U.S. Geological Survey - Earthquake Hazard Program, Search Earthquake Catalog.” Reston, Virginia. Accessed April 5, 2024, at https://earthquake.usgs.gov/earthquakes/search/. TN9939.

USGS (U.S. Geological Survey). 2024. “Watershed Boundary Dataset.” Reston, Virginia. Accessed May 17, 2024, at https://www.usgs.gov/national-hydrography/watershed-boundary-dataset?qt-science_support_page_related_con=4#qt-science_support_page_related_con. TN9942.

Van Gelder, R.G. 1956. “Echo-Location Failure in Migratory Bats.” *Transactions of the Kansas Academy of Science* 59(2):220-222. TN8505.

Vistra. 2024. Letter from R. Penfield, Site Vice President, to NRC Document Control Desk, dated April 22, 2024, regarding “Perry Nuclear Power Plant, Docket No. 5000-440, Annual Radiological Effluent Release Report.” Perry, Ohio. ADAMS Accession No. ML24121A276. TN10193.

Vistra. 2024. Letter from R.L. Penfield, Site Vice President, to NRC Document Control Desk, dated April 15, 2024, regarding “Perry Nuclear Power Plant, Unit No. 1 Docket No. 50-440, License No. NPF-58 Perry Nuclear Power Plant Rod L. Penfield Site Vice President 1 0 Center Road Perry, Ohio 44081 10 CFR 54 Response to Perry Nuclear Power Plant License Renewal Environmental Report Requests for Additional Information and Request for Clarification (EPID No. L-2023-LNE-0002).” Perry, Ohio. ADAMS Accession No. ML24107B080. TN9925.

Vistra. 2024. Letter from R.L. Penfield, Site Vice President, to NRC Document Control Desk, dated May 16, 2024, regarding “Perry Nuclear Power Plant, Unit No. 1, Docket No. 50-440, License No. NPF-58, Response to Perry Nuclear Power Plant License Renewal Environmental Report Requests for Accident Mitigation Alternatives Requests for Additional Information and Request for Clarification (EPID No. L-2023-LNE-0002).” Perry, Ohio. ADAMS Accession No. ML24137A283. TN10350.

Vistra. 2024. Letter from R.L. Penfield, Site Vice President, to NRC Document Control Desk, dated August 15, 2024, regarding “Perry Nuclear Power Plant, Unit No. 1, Docket No. 50-440, License No. NPF-58, Response to Perry Nuclear Power Plant License Renewal Environmental Report Severe Accident Mitigation Alternatives 2nd Round Requests for Additional Information.” Perry, Ohio. ADAMS Accession No. ML24137A283. TN10351.

WAPA/FWS (Western Area Power Administration, U.S. Fish and Wildlife Service). 2015. *Upper Great Plains Wind Energy Programmatic Environmental Impact Statement, Final*. DOE/EIS-0408, Billings, Montana and Lakewood, Colorado. TN8725.

Waterbury, B., A. Potter, and L.K. Svancara. 2019. “Monarch Butterfly Distribution and Breeding Ecology in Idaho and Washington.” *Frontiers in Ecology and Evolution* 7(172), Lausanne, Switzerland. http://dx.doi.org/10.3389/fevo.2019.00172. TN9972.

Wisconsin Odonata Survey. Undated. “*Boyeria grafiana*Ocellated Darner.” Madison, Wisconsin. Accessed on May 22, 2024, at https://wiatri.net/inventory/odonata/speciesaccounts/SpeciesDetail.cfm?TaxaID=15#:~:text=Description%20of%20Habitat%2FRange%3A,lakes%20with%20rocky%2C%20windswept%20shorelines. TN9988.

Woods, A.J., J.M. Omernik, C.S. Brockman, T.D. Gerber, W.D. Hosteter, and S.H. Azevedo. 1998. *Ecoregions of Indiana and Ohio*. U.S. Geological Survey, Reston, Viginia. Accessed May 21, 2024, at https://gaftp.epa.gov/EPADataCommons/ORD/Ecoregions/oh/ohin_eco_lg.pdf. TN9971.

Xue, P., X. Ye, J.S. Pal, P.Y. Chu, M.B. Kayastha, C. Huan. 2022. "Climate Projections Over the Great Lakes Region: Using Two-Way Coupling of a Regional Climate Model with a 3-D Lake Model." Geoscientific Model Development 15:4425–4446, Göttingen, Germany. https://doi.org/10.5194/gmd-15-4425-2022. TN10039.

Zinn, T.L., and W.W. Baker. 1979. "Seasonal Migration of the Hoary Bat, *Lasiurus cinereus*, through Florida." *Journal of Mammalogy* 60(3):634-635. TN8507.

6 LIST OF PREPARERS

Members of the U.S. Nuclear Regulatory Commission's (NRC's) Office of Nuclear Materials Safety and Safeguards prepared this draft supplemental environmental impact statement with assistance from other NRC's organizations and Pacific Northwest National Laboratory (PNNL). Table 6-1 identifies each contributor's name, affiliation, and function or expertise.

Table 6-1 List of Preparers

Name	Education and Experience	Function or Expertise
Beth Alferink, NRC	MS Environmental Engineering; MS Nuclear Engineering; BS Nuclear Engineering; 26 years of national laboratory, industry, and government experience including radiation detection and measurements, nuclear power plant emergency response, operations, health physics, decommissioning, shielding and criticality	Human Health, Radiological and Nonradiological Waste Management, Spent Nuclear Fuel, Uranium Fuel Cycle, Termination & Decommissioning
Briana Arlene, NRC	Master's Certification, National Environmental Policy Act; BS Conservation Biology; 18 years of experience in ecological impact analysis, Endangered Species Act Section 7 consultations, and Essential Fish Habitat consultations	Aquatic Resources, Special Status Species and Habitats, Endangered Species Act Section 7 Consultation, Essential Fish Habitat Consultation
Lloyd Desotell, NRC	MS Civil Engineering; MS Water Resources Management; BA Environmental Studies; Over 20 years of experience conducting surface and subsurface hydrologic analyses	Geologic Environment, Surface Water Resources, Groundwater Resources
Elijah Dickson, NRC	PhD Health Physics; Masters of Health Physics; BS Health Physics; 18 years of conducting radiation protection, probabilistic risk assessment, and radiological consequence analyses	Severe Accident Mitigation Alternative (SAMA), Postulated Accidents
Jerry Dozier, NRC	MS Reliability Engineering; MBA Business Administration; BS Mechanical Engineering; 31 years of experience including operations, reliability engineering, technical reviews, and NRC branch management	Severe Accident Mitigation Alternative (SAMA), Postulated Accidents
Caroline Hsu, NRC	BS Molecular Biology; BA English Literature; 13 years of government experience	Terrestrial Ecology, Land Use, and Visual Resources
Stephen Koenick, NRC	MS Environmental Engineering; BS Mechanical Engineering; Over 30 years of government experience	Management Oversight

Table 6-1 List of Preparers (Continued)

Name	Education and Experience	Function or Expertise
Leah Parks, NRC	PhD Environmental Management; MS Environmental Engineering; BS Systems and Information Engineering; 17 years of academic and government experience including nuclear power plant operations, health physics, decommissioning, waste management, environmental impact analysis, and performance assessment	Socioeconomics, Radiological and Nonradiological Waste Management, Spent Nuclear Fuel
Lance Rakovan, NRC	MS Nuclear Engineering; BS Engineering Physics; Project Management Professional (PMP); Nearly 30 years project management experience; over 20 years of experience facilitating public NEPA interactions	Environmental Project Manager
Jeffrey Rikhoff, NRC	MRP Regional Environmental Planning; MS Development Economics; BA English; 44 years of combined industry and government experience in NEPA compliance for DOE Defense Programs/NNSA and Nuclear Energy, DoD, and DOI; project management; socioeconomics and environmental justice impact analysis, historic and cultural resource impact assessments, consultation with American Indian Tribes, and comprehensive land use and development planning studies	Replacement Power Alternatives, Cumulative Effects
Ted Smith, NRC	MS Environmental Engineering; BS Electrical Engineering; 38 years of experience, including DOE Power Administration support of site environmental management programs and spent fuel management; oversight of U.S. Navy nuclear ships design, construction, and operation; and NRC project management	Management Oversight
Gerry Stirewalt, NRC	PhD Structural Geology; Registered Professional Geologist (PG); Certified Engineering Geologist (CEG); 50+ years of experience including geologic site characterization for nuclear energy facilities and high level nuclear waste disposal facilities, 3-D geospatial modeling of subsurface geology, tectonic faults, and contaminated groundwater plumes, environmental geology, and assessment of groundwater	Geologic Resources, Groundwater
Jean Trefethen, NRC	BA Biology and Chemistry; Duke NEPA Certificate; 15 years of professional experience	Historic and Cultural Resources
Caitlin Condon, PNNL	PhD Radiation Health Physics BS Environmental Health 6 years of experience in health physics, NEPA environmental impact assessments, waste management, radionuclide dispersion and dosimetry modeling.	Project Management

Table 6-1 List of Preparers (Continued)

Name	Education and Experience	Function or Expertise
Stephen Ferencz, PNNL	PhD Geosciences (Hydrogeology/Hydrology); MA Earth Sciences; BA Geology; 7 years of experience in hydrologic, groundwater, and water systems modeling; 3 years of experience in environmental remediation and site characterization	Surface Water Resources
Tracy Fuentes, PNNL	PhD Urban Design and Planning; MS Plant Biology; BS Botany; Over 15 years of experience, including NEPA planning; environmental impact analysis, environmental resource monitoring, data analysis, and research	Terrestrial Resources, Federally Protected Resources
Dave Goodman, PNNL	JD Law; BS Economics; 12 years of experience including NEPA environmental impact assessments, ecological restoration, Endangered Species Act, land use and visual resources, and environmental law and policy	Land Use, Visual Resources, Cumulative Impacts, NEPA Regulatory Analyst
Leah Hare, PNNL	MS Geographic Information Science; BS Environmental Studies; 12 years of experience in environmental monitoring, regulatory compliance, project management, and environmental assessment	Deputy Project Management
Tristan Hay, PNNL	PhD Radiation Health Physics; MS Radiation Health Physics; BS Physics; B.S. Math; 12 years of experience in health physics, medical health physics, environmental impact analyses, radiological emergency preparedness, nuclear materials inspections and licensing, radiation safety	Radiological Human Health, Radiological Waste, Spent Nuclear Fuel
Philip Meyer, PNNL	PhD Civil Engineering; MS Civil Engineering; BA Physics; 30 years relevant experience in subsurface hydrology and contaminant transport, including 15 years of experience in groundwater resource assessment and environmental impacts analysis	Groundwater Resources, Geologic Environment
Ann Miracle, PNNL	PhD Molecular Immunology; MS Molecular Genetics; BA Biology; Over 15 years of experience in ecological impact analysis, Endangered Species Act Section 7 consultations, and Essential Fish Habitat consultations	Aquatic Resources, Terrestrial Resources

Table 6-1 List of Preparers (Continued)

Name	Education and Experience	Function or Expertise
Dan Nally, PNNL	MA Urban and Environmental Policy and Planning; BS Biology; 11 years of experience in preparation and review of NEPA documents, related regulatory compliance, and conducting public outreach and engagement	Project Management, Ecological Resources
Jon Napier, PNNL	PhD Radiation Health Physics; MS Health Physics; BS Environmental Science; Certified Health Physicist with 7 years of experience in health physics, nuclear materials inspections and licensing, and radiation safety.	Radiological Human Health, Radiological Waste, Spent Nuclear Fuel
Mike Parker, PNNL	BA English Literature; 25 years of experience copyediting, document design, and formatting and 20 years of experience in technical editing	Production
Rajiv Prasad, PNNL	PhD Civil and Environmental Engineering; MTech Civil Engineering; BE Civil Engineering; 25 years of experience in applying hydrologic principles to water resources engineering, hydrologic design, flooding assessments, environmental engineering, and impacts assessment including 15 years of experience in NEPA environmental assessments of surface water resources	Surface Water Resources
Lindsey Renaud, PNNL	MA Anthropology; BA Anthropology; 12 years in cultural resource management, NEPA environmental impact assessments and Section 106 and 110 compliance. Secretary of the Interior-qualified registered professional archaeologist. Experience in Tribal engagement and Native American Graves Protection and Repatriation Act compliance	Historic and Cultural Resources
Kacoli Sen, PNNL	PhD Cancer Biology; MS Zoology (Specialization Ecology); BS Zoology; Diploma in Environmental Law; Over 6 years of document editing and production experience	Production Editor
Kazi Tamaddun, PNNL	PhD Civil and Environmental Engineering; MS Civil Engineering; 8 years of experience in hydrologic, hydraulic, ecosystem, and water systems modeling; hydro-climatology; climate change modeling and analysis	Surface Water Resources

Table 6-1 List of Preparers (Continued)

Name	Education and Experience	Function or Expertise
Steven Short, PNNL	M.S., Nuclear Engineering; M.B.A., Business Administration; B.S., Nuclear Engineering; 40 years of experience including nuclear safety analysis, probabilistic risk assessment, technical reviews of risk-informed license amendment requests and severe accident mitigation alternative analyses	Postulated Accidents, Severe Accident Mitigation Alternative
Caitlin Wessel, PNNL	PhD Marine Science MS Coastal, Marine, and Wetland Science BS Biology 11 years of relevant experience	Aquatic Resources
Lin Zeng, PNNL	PhD Environmental Science and Engineering; BE Civil Engineering; 10 years of experience in socioeconomic analysis and environmental impact assessment	Socioeconomics

AM or MA = Master of Arts; BA = Bachelor of Arts; BS = Bachelor of Science; DoD = U.S. Department of Defense; DOE = U.S. Department of Energy; DOI = U.S. Department of Interior; CEG = Certified Engineering Geologist; MBA = Master of Business Administration; MRP = Master of Regional Planning; MS = Master of Science; NEPA = National Environmental Policy Act of 1969; NNSA = National Nuclear Security Administration; NRC = U.S. Nuclear Regulatory Commission; PG = Professional Geologist; PhD = Doctor of Philosophy; PNNL = Pacific Northwest National Laboratory; SAMA = Severe Accident Mitigation Alternative.

7 LIST OF AGENCIES, ORGANIZATIONS, AND PERSONS TO WHOM COPIES OF THIS SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT ARE SENT

Table 7-1 List of Agencies, Organizations, and Persons to Whom Copies of the Statement are Sent (10 CFR 51, "Appendix A to Subpart A—Format for Presentation of Material in Environmental Impact Statements")

Name	Affiliation
Barton, Paul	Eastern Shawnee Tribe of Oklahoma
Davis, Daryl M.	-
DeMare, Joseph	-
Gunter, Paul	Beyond Nuclear
Lee, M.	Council on Intelligent Energy & Conservation Policy and Promoting Health and Sustainable Energy
Marida, Patricia	-
McClain, Krystle Z.	U.S. Environmental Protection Agency
Meshigaud, Earl	Hannahville Indian Community, Michigan
Ohio Ecological Services Field Office	U.S. Fish and Wildlife Service
Spotts, Richard	-
Stahlman, Joe	Seneca Nation of Indians
Tarrant, William	Seneca-Cayuga Nation
Welling, Diana	Ohio State Historic Preservation Office
Wiatrolik, Melissa	Little Traverse Bay Band of Odaqa Indians, Michigan
Vogel, Anne M.	Ohio Environmental Protection Agency
York, Logan	Miami Tribe of Oklahoma

APPENDIX A

COMMENTS RECEIVED ON THE PERRY NUCLEAR POWER PLANT UNIT 1 ENVIRONMENTAL REVIEW

A.1 Comments Received During the Scoping Period

The scoping process began on October 10, 2023, with the publication of the U.S. Nuclear Regulatory Commission's (NRC's) notice of intent to conduct scoping in the *Federal Register* (88 FR 69967-TN9932). The scoping process included two public meetings: a virtual meeting on October 19, 2023 and an in-person meeting in Perry, Ohio, on October 25, 2023. The meetings consisted of prepared statements by NRC staff and a public comment session. Attendees provided oral statements that were recorded and transcribed by a certified court reporter. Written statements submitted at the public meeting are captured in Agencywide Documents Access and Management System (ADAMS).

The transcript of the meeting is an attachment of the scoping meetings summary, dated March 18, 2024 (NRC 2023-TN9934). In addition to the comments received during the public meeting, comments were also received electronically, via Regulations.gov and email.

At the conclusion of the scoping process, the staff issued a scoping summary report (NRC 2024-TN10204). The report contains a summary of comments received during the public meeting and electronically during the scoping period as well as the NRC staff's consideration of these comments.

A.2 References

88 FR 69967. Tuesday, October 10, 2023. "Notice of Intent To Conduct Scoping Process and Prepare Environmental Impact Statement; Energy Harbor Corp.; Energy Harbor Generation LLC.; Energy Harbor Nuclear Corp.; Perry Nuclear Power Plant, Unit 1." *Federal Register*, U.S. Nuclear Regulatory Commission. TN9932.

NRC (U.S. Nuclear Regulatory Commission). 2023. Memorandum from L.J. Rakovan, Sr. Project Manager Environmental Review License Renewal Branch Division of Rulemaking, Environmental, and Financial Support Office of Nuclear Material Safety and Safeguards, to T.B. Smith, Chief Environmental Review License Renewal Branch Division of Rulemaking, Environmental, and Financial Support Office of Nuclear Material Safety and Safeguards, dated November 6, 2023, regarding "Meeting Summary: Public Scoping Meeting for the Environmental Review of the License Renewal Application for Perry Nuclear." Washington, D.C. ADAMS Accession No. ML23303A064. TN9934.

NRC (U.S. Nuclear Regulatory Commission). 2024. Letter from S.S. Koenick, Chief Environmental Project Management Branch 1 Division of Rulemaking, Environmental, and Financial Support Office of Nuclear Material Safety and Safeguards, to R.L. Penfield, Site Vice President, Perry Nuclear Power Plant, dated July 25, 2024, regarding "Issuance of Environmental Scoping Summary Report Associated with the U.S. Nuclear Regulatory Commission Staff's Review of the Perry Nuclear Power Plant Unit 1, Subsequent License Renewal Application (EPID NO. L-2023-LNE- 0002) (DOCKET NO. 50-440)." Washington, D.C. ADAMS Accession No. ML24150A200. TN10327.

APPENDIX B

APPLICABLE LAWS, REGULATIONS, AND OTHER REQUIREMENTS

Several Federal laws and regulations affect environmental protection, health, safety, compliance, and consultation at every U.S. Nuclear Regulatory Commission (NRC) licensed nuclear power plant. Some of them require permits by or consultation with other Federal agencies or State, Tribal, or local governments. Certain Federal environmental requirements have been delegated to State authorities for enforcement and implementation. Furthermore, States have also enacted laws to protect public health and safety and the environment. It is the NRC's policy to make sure nuclear power plants are operated in a manner that provides adequate protection of public health and safety and protection of the environment through compliance with applicable Federal and State laws, regulations, and other requirements, as appropriate.

The Atomic Energy Act of 1954, as amended (AEA) (TN663), and the Energy Reorganization Act of 1974 (TN4466) give the NRC the licensing and regulatory authority for commercial nuclear energy use. They allow the NRC to establish dose and concentration limits for protection of workers and the public for activities under NRC jurisdiction. The NRC implements its responsibilities under the AEA through regulations set forth in Title 10, "Energy," of the *Code of Federal Regulations* (CFR). The AEA also authorizes the NRC to enter into an agreement with any State that allows the State to assume regulatory authority for certain activities (42 U.S.C. § 2021-TN10029). Ohio has been an NRC Agreement State since 1999, and the Bureau of Environmental Health and Radiation Protection of the Ohio Department of Health Services has regulatory responsibility over certain byproducts, sources, and quantities of special nuclear materials not sufficient to form a critical mass. In addition, the Ohio Emergency Management Agency has the authority for emergency planning and response capabilities to emergencies for Ohio.

In addition to carrying out some Federal programs, State legislatures develop their own laws. State statutes can supplement, as well as implement, Federal laws for the protection of air, surface water, and groundwater. State legislation may address solid waste management programs, locally rare or endangered species, and historic and cultural resources.

The U.S. Environmental Protection Agency (EPA) has the primary responsibility to administer the Clean Water Act (TN662). The National Pollutant Discharge Elimination System program addresses water pollution by regulating the discharge of potential pollutants to waters of the United States. The EPA allows for primary enforcement and administration through State agencies if the State program is at least as stringent as the Federal program.

The EPA has delegated the authority to issue National Pollutant Discharge Elimination System permits to the State of Ohio. The Ohio Environmental Protection Agency (OEPA) provides oversight for public water supplies and issues permits to regulate the discharge of industrial and municipal wastewaters—including discharges to groundwater— and monitors State water resources for water quality. The Agency issues National Pollutant Discharge Elimination System (NPDES) permits for surface water discharges and Injection Well Operating Permits for groundwater to regulate and control water pollutants.

B.1 Federal and State Requirements

Perry Nuclear Power Plant Unit 1 (Perry Plant) is subject to various Federal and State requirements. The applicant may prepare and submit for several regulatory approvals or permits prior to the NRC license renewal (LR) approval. As a convenient source of references of environmental requirements, Table B-1 lists principal Federal, State, and local approvals applicable to LR.

Table B-1 Federal and State Requirements

Topic	Law/Regulation	Requirements
Current operating license and LR	Atomic Energy Act, 42 U.S.C. 2011 et seq.	The AEA of 1954, as amended, and the Energy Reorganization Act of 1974 (42 U.S.C. 5801 et seq.) give the NRC the licensing and regulatory authority for commercial nuclear energy use. They allow the NRC to establish dose and concentration limits for protection of workers and the public for activities under NRC jurisdiction. The NRC implements its responsibilities under the AEA through regulations set forth in Title 10, “Energy,” of CFR.
Current operating license and LR	National Environmental Policy Act of 1969, 42 U.S.C. 4321 et seq.	The NEPA, as amended, requires Federal agencies to integrate environmental values into their process by considering the environmental impacts of proposed Federal actions and reasonable alternatives to those actions. NEPA establishes policy, sets goals (in Section 101), and provides means (in Section 102) for carrying out the policy. NEPA Section 102(2) contains action-forcing provisions to ensure that Federal agencies follow the letter and spirit of the Act. For major Federal actions significantly affecting the quality of the human environment, Section 102(2)(C) of NEPA requires Federal agencies to prepare a detailed statement that includes the environmental impacts of the proposed action and other specified information.
Current operating license and LR	10 CFR Part 20	Regulations in 10 CFR Part 20, “Standards for Protection Against Radiation,” establish standards for protection against ionizing radiation resulting from activities conducted under licenses issued by the NRC. These regulations are issued under the AEA of 1954, as amended, and the Energy Reorganization Act of 1974, as amended. The purpose of these regulations is to control the receipt, possession, use, transfer, and disposal of licensed material by any licensee in such a manner that the total dose to an individual (including doses resulting from licensed and unlicensed radioactive material and from radiation sources other than background radiation) does not exceed the standards for protection against radiation prescribed in the regulations in this Part.
Current operating license and LR	10 CFR Part 51	Regulations in 10 CFR Part 51, “Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions,” contain the NRC’s regulations that implement NEPA.

Table B-1 Federal and State Requirements (Continued)

Topic	Law/Regulation	Requirements
Current operating license and LR	10 CFR Part 50	Regulations in 10 CFR Part 50, “Domestic Licensing of Production and Utilization Facilities,” are NRC regulations issued under the AEA, as amended (68 Stat. 919), and Title II of the Energy Reorganization Act of 1974 (88 Stat. 1242), to provide for the licensing of production and utilization facilities, including power reactors.
Current operating license and LR	10 CFR Part 54	NRC regulations in 10 CFR Part 54, “Requirements for Renewal of Operating Licenses for Nuclear Power Plants,” govern the issuance of renewed operating licenses and renewed combined licenses for nuclear power plants licensed under Sections 103 or 104b of the AEA, as amended, and Title II of the Energy Reorganization Act of 1974 (88 Stat. 1242). The regulations focus on managing adverse effects of aging nuclear power plants. The rule is intended to ensure that important systems, structures, and components will continue to perform their intended functions during the period of extended operation.
Air quality protection	Clean Air Act, 42 U.S.C. 7401 et seq.	The CAA is intended to “protect and enhance the quality of the nation’s air resources so as to promote the public health and welfare and the productive capacity of its population.” The CAA establishes regulations to ensure maintenance of air quality standards and authorizes individual States to manage permits. Section 118 of the CAA requires each Federal agency with jurisdiction over properties or facilities engaged in any activity that might result in the discharge of air pollutants to comply with all Federal, State, inter-State, and local requirements with regard to the control and abatement of air pollution. Section 109 of the CAA directs the EPA to set National Ambient Air Quality Standards for criteria pollutants. The EPA has identified and set National Ambient Air Quality Standards for the following criteria pollutants: particulate matter, sulfur dioxide, carbon monoxide, ozone, nitrogen dioxide, and lead. Section 111 of the CAA requires the establishment of national performance standards for new or modified stationary sources of atmospheric pollutants. Section 160 of the CAA requires that specific emission increases must be evaluated before permit approval to prevent significant deterioration of air quality. Section 112 requires specific standards for release of hazardous air pollutants (including radionuclides). These standards are implemented through plans developed by each State and approved by the EPA. The CAA requires sources to meet standards and obtain permits to satisfy those standards. Nuclear power plants may be required to comply with the CAA Title V, Sections 501–507, for sources subject

Table B-1 Federal and State Requirements (Continued)

Topic	Law/Regulation	Requirements
		to new source performance standards or sources subject to national emission standards for hazardous air pollutants. The EPA regulates the emissions of air pollutants using 40 CFR Parts 50 to 99.
Water resources protection	Clean Water Act, 33 U.S.C. 1251 et seq., and the NPDES (40 CFR 122)	The CWA was enacted to “restore and maintain the chemical, physical, and biological integrity of the Nation’s water.” The Act requires all branches of the Federal Government with jurisdiction over properties or facilities engaged in any activity that might result in a discharge or runoff of pollutants to surface waters, to comply with Federal, State, inter-State, and local requirements. As authorized by the CWA, the NPDES permit program controls water pollution by regulating point sources that discharge pollutants into waters of the United States. The NPDES program requires all facilities that discharge pollutants from any point source into waters of the United States to obtain an NPDES permit. A nuclear power plant may also participate in the NPDES General Permit for Industrial Stormwater due to stormwater runoff from industrial or commercial facilities to waters of the United States. The EPA is authorized under the CWA to directly implement the NPDES program; however, the EPA has authorized many States to implement all or parts of the national program. Section 401 of the CWA requires States to certify that the permitted discharge would comply with all limitations necessary to meet established State water quality standards, treatment standards, or schedule of compliance. The U.S. Army Corps of Engineers is the lead agency for enforcement of CWA wetland requirements (33 CFR Part 320, “General Regulatory Policies”). Under Section 401 of the CWA, the EPA or a delegated State agency has the authority to review and approve, condition, or deny all permits or licenses that might result in a discharge to waters of the State, including wetlands.

Table B-1 Federal and State Requirements (Continued)

Topic	Law/Regulation	Requirements
Water resources protection	Coastal Zone Management Act of 1972, as amended (16 U.S.C. 1451 et seq.)	Congress enacted the CZMA in 1972 to address the increasing pressures of over-development upon the Nation's coastal resources. The National Oceanic and Atmospheric Administration administers the Act. The CZMA encourages States to preserve, protect, develop, and, where possible, restore or enhance valuable natural coastal resources such as wetlands, floodplains, estuaries, beaches, dunes, barrier islands, and coral reefs, as well as the fish and wildlife using those habitats. Participation by States is voluntary. To encourage States to participate, the CZMA makes Federal financial assistance available to any coastal State or territory, including those on the Great Lakes, as long as the State or territory is willing to develop and implement a comprehensive coastal management program.
Water resources protection	Wild and Scenic Rivers Act, 16 U.S.C. 1271 et seq.	The Wild and Scenic River Act created the National Wild and Scenic Rivers System, which was established to protect the environmental values of free-flowing streams from degradation by impacting activities, including water resources projects.
Waste management and pollution prevention	Resource Conservation and Recovery Act, 42 U.S.C. 6901 et seq.	The Resource Conservation and Recovery Act requires the EPA to define and identify hazardous waste; establish standards for its transportation, treatment, storage, and disposal; and require permits for persons engaged in hazardous waste activities. Section 3006, "Authorized State Hazardous Waste Programs" (42 U.S.C. 6926), allows States to establish and administer these permit programs with EPA approval. EPA regulations implementing the Resource Conservation and Recovery Act are found in 40 CFR Parts 260 through 283. Regulations imposed on a generator or on a treatment, storage, and/or disposal facility vary according to the type and quantity of material or waste generated, treated, stored, and/or disposed. The method of treatment, storage, and/or disposal also impacts the extent and complexity of the requirements.
Waste management and pollution prevention	Pollution Prevention Act, 42 U.S.C. 13101 et seq.	The Pollution Prevention Act establishes a national policy for waste management and pollution control that focuses first on source reduction, then on environmental issues, safe recycling, treatment, and disposal.
Waste management and pollution prevention	Ohio Water Pollution Control Act (ORC Section 6111)	Ohio Revised Code Chapter 6111, "Water Pollution Control."
Waste management and pollution prevention	OAC 3745-52	OAC Chapter 3745-52, "Generator Standards."

Table B-1 Federal and State Requirements (Continued)

Topic	Law/Regulation	Requirements
Waste management and pollution prevention	OAC 1301:7-9-04	OAC Chapter 1307:7-9, “Underground Storage Tanks.”
Protected species	Bald and Golden Eagle Protection Act, 16 U.S.C. 668-668d et seq.	The Bald and Golden Eagle Protection Act prohibits anyone, without a permit issued by the Secretary of the Interior, from taking bald or golden eagles, including their parts (including feathers), nests, or eggs. The Act defines “take” as pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest, or disturb. Regulations further define “disturb” as “to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available, 1) injury to an eagle, 2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or 3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior.”
Protected species	Endangered Species Act, 16 U.S.C. 1531 et seq.	The Endangered Species Act was enacted to prevent the further decline of endangered and threatened species and to restore those species and their critical habitats. Section 7, “Interagency Cooperation,” of the Act requires Federal agencies to consult with the U.S. Fish and Wildlife Service or the NMFS on Federal actions that may affect listed species or designated critical habitats.
Protected species	Magnuson–Stevens Fishery Conservation and Management Act, 16 U.S.C. 1801-1884	The Magnuson–Stevens Fishery Conservation and Management Act, as amended, governs marine fisheries management in U.S. Federal waters. The Act created eight regional fishery management councils and includes measures to rebuild overfished fisheries, protect essential fish habitat, and reduce bycatch. Under Section 305 of the Act, Federal agencies are required to consult with the NMFS for any Federal actions that may adversely affect essential fish habitat.
Protected species	Migratory Bird Treaty Act, 16 U.S.C. 703-712 et seq.	The MBTA implements four international conservation treaties that the U.S. entered with Canada (1916), Mexico (1936), Japan (1972), and Russia (1976). The MBTA has been amended with signing of each treaty, as well as when any of the treaties were subsequently amended. To ensure that populations of all protected migratory birds are sustained, the MBTA prohibits the take of protected migratory bird species without prior authorization from U.S. Fish and Wildlife Service. Under the MBTA, “take” includes killing, capturing, selling, trading, and transport of protected migratory bird species.

Table B-1 Federal and State Requirements (Continued)

Topic	Law/Regulation	Requirements
Protected species	OAC 15: Chapter 1518	OAC Title 15, “Conservation of Natural Resources,” Chapter 1518, “Endangered Species.”
Historic preservation and cultural resources	National Historic Preservation Act, 16 U.S.C. 470 et seq.	The National Historic Preservation Act was enacted to create a national historic preservation program, including the National Register of Historic Places and the Advisory Council on Historic Preservation. Section 106 of the Act requires Federal agencies to consider the effects of their undertakings on historic properties. The Advisory Council on Historic Preservation regulations implementing Section 106 of the Act are found in 36 CFR Part 800, “Protection of Historic Properties.” The regulations call for public involvement in the Section 106 consultation process, including involvement from Indian Tribes and other interested members of the public, as applicable.

AEA = Atomic Energy Act of 1954; CAA = Clean Air Act; CFR = *U.S. Code of Federal Regulation*; CWA = Clean Water Act; CZMA = Coastal Zone Management Act; EPA = U.S. Environmental Protection Agency; MBTA = Migratory Bird Treaty Act; NEPA = National Environmental Policy Act; NMFS = National Marine Fisheries Service; NPDES = National Pollutant Discharge Elimination System; NRC = U.S. Nuclear Regulatory Commission; OAC = Ohio Administrative Code; ORC = Ohio Revised Code; LR = license renewal; U.S.C = U.S. Code.

B.2 Operating Permits and Other Requirements

Table B-2 lists the permits and licenses issued by Federal, State, and local authorities for activities at Perry Plant, as identified in Chapter 9 of the environmental report.

Table B-2 Operating Permits and Other Requirements

Agency	Authority	Requirement	Number	Expiration Date	Authorized Activity
NRC	Atomic Energy Act [10 CFR Part 50]	Perry Plant license to operate Unit 1	NPF-58	Issued: 11/13/1986 Expires: 11/7/2026	Operation of Perry Plant Unit 1.
NRC	NRC Regulations 10 CFR Part 72	General license for storage of fuel at power reactor sites	General License	n/a	Storage of power reactor spent fuel and other associated radioactive materials in an ISFSI.
U.S. DOT	49 U.S.C. 5180 [49 CFR Part 107, Subpart G]	Registration	Reg. No: 050421550022D	6/30/2022	Hazardous material shipment
TDEC	TDEC Rule 0400-20-10-.32	License to ship radioactive material	T-OH001-L22	12/31/2022	Shipment of radioactive material to a licensed disposal/processing facility in Tennessee.
EPA and OEPA	40 CFR 262; OAC 3745-52	Hazardous waste generator registration	EPA/OEPA ID No: OHD025673518	n/a	Small to large quantity generator of hazardous and mixed wastes.
OEPA	Clean Water Act Section 401 [33 U.S.C. 1341]	Certification of water quality standards	OEPA ID No: 154766	n/a	Section 401 Water Quality Certification issued by the State for operation of Perry Plant.
OEPA	Federal Clean Water Act (33 U.S.C. 1251 et seq.), Ohio Water Pollution Control Act (ORC Section 6111)	NPDES Permit	3IB00016*LD	2/28/2023	Authorize discharges of Perry Plant wastewaters and industrial stormwaters into Lake Erie.

Table B-2 Operating Permits and Other Requirements (Continued)

Agency	Authority	Requirement	Number	Expiration Date	Authorized Activity
OEPA	OAC Chapter 3745-31	Permit to install and operate air contaminant source(s)	P0111998	6/18/2024	Operation of 2 auxiliary boilers.
Ohio Department of Commerce, Division of State Fire Marshal	OAC 1301:7-9-04	Underground storage tank registration	Facility No: 43007657	Renewed annually	Registration of underground storage tanks T00001 through T00006.
ODNR	ORC Section 1506.11	Lake Erie Halite Non-Extraction Lease	HNL-001-LA	5/14/2072	A mineral rights lease that prevents the extraction of the mineral halite within a 410-ac submerged land area of Lake Erie.
ODNR	ORC Section 1501.01 ORC Section 1506.10 ORC Section 1506.11	Lake Erie Submerged Lands Lease	SUB-0528-LA	5/14/2072	Covers approximately 3,500-ft of shoreline protection and includes the intake and discharge tunnels.

ac = acre(s); CFR = *Code of Federal Regulation*; EPA = U.S. Environmental Protection Agency; ft = foot/feet; ID = identification; ISFSI = independent spent fuel storage installation; n/a = not available; LR = license renewal; NPDES = National Pollutant Discharge Elimination System; NRC = U.S. Nuclear Regulatory Commission; OAC = Ohio Administrative Code; ODNR = Ohio Department of Natural Resources; OEPA = Ohio Environmental Protection Agency; ORC = Ohio Revised Code; Perry Plant = Perry Nuclear Power Plant; U.S. DOT = U.S. Department of Transportation; TDEC = Tennessee Department of Environment and Conservation; U.S.C. = U.S. Code.
Source: Energy Harbor's/VistraOps' Response to Perry Nuclear Power Plant License Renewal Environmental Report Requests for Additional Information and Request for Clarification (Vistra 2024-TN9925).

B.3 References

42 U.S.C. § 2021. U.S. Code Title 42, Public Health and Welfare, Section 2021, "Cooperation with States." TN10029.

Atomic Energy Act of 1954. 42 U.S.C. § 2011 *et seq.* Public Law 112-239, as amended. TN663.

Energy Reorganization Act of 1974, as amended. 42 U.S.C. § 5801 *et seq*. TN4466.

Federal Water Pollution Control Act of 1972 (commonly referred to as the Clean Water Act). 33 U.S.C. § 1251 *et seq.* TN662.

Vistra. 2024. Letter from R.L. Penfield, Site Vice President, to NRC Document Control Desk, dated April 15, 2024, regarding "Perry Nuclear Power Plant, Unit No. 1 Docket No. 50-440, License No. NPF-58 Perry Nuclear Power Plant Rod L. Penfield Site Vice President 1 0 Center Road Perry, Ohio 44081 10 CFR 54 Response to Perry Nuclear Power Plant License Renewal Environmental Report Requests for Additional Information and Request for Clarification (EPID No. L-2023-LNE-0002)." Perry, Ohio. ADAMS Accession No. ML24107B080. TN9925.

APPENDIX C

CONSULTATION CORRESPONDENCE

C.1 Endangered Species Act Section 7 Consultation

As a Federal agency, the U.S. Nuclear Regulatory Commission (NRC) must comply with the Endangered Species Act of 1973 (ESA), as amended (TN1010), as part of any action authorized, funded, or carried out by the agency. In this case, the proposed agency action is whether to issue a renewed facility operating license for the continued operation of Perry Nuclear Generating Plant, Unit 1 (Perry Plant). The proposed action would authorize VistraOps to operate the Perry Plant for an additional 20 years beyond the current renewed operating license term. Under Section 7 of the ESA, the NRC must consult with the U.S. Fish and Wildlife Service (FWS) and the National Marine Fisheries Service (NMFS) ("the Services" [collectively] or "Service" [individually]), as appropriate, to ensure that the proposed action is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of designated critical habitat.

C.2 Federal Agency Obligations under Section 7 of the Endangered Species Act

The ESA and the regulations that implement ESA Section 7 at Title 50 of the *Code of Federal Regulations* (50 CFR Part 402-TN4312) describe the consultation process that Federal agencies must follow in support of agency actions. As part of this process, the Federal agency shall either (1) request that the Services provide a list of any listed or proposed species or designated or proposed critical habitats that may be present in the action area, or (2) request that the Services concur with a list of species and critical habitats that the Federal agency has created (50 CFR 402.12(c)). If any such species or critical habitats may be present, the Federal agency prepares a biological assessment to evaluate the potential effects of the action and determine whether the species or critical habitats are likely to be adversely affected by the action (50 CFR 402.12(a); 16 U.S.C. § 1536-TN4459).

Biological assessments are required for any agency action that is a "major construction activity" (50 CFR 402.12(b)) (TN4312). A major construction activity is a construction project or other undertaking having construction-type impacts that is a major Federal action significantly affecting the quality of the human environment under the National Environmental Policy Act of 1969 (NEPA), as amended (42 U.S.C. § 4321-TN8608; 51 FR 19926-TN7600). Federal agencies may fulfill their obligations to consult with the Services under ESA Section 7 and to prepare a biological assessment, if required, in conjunction with the interagency cooperation procedures required by other statutes, including NEPA (50 CFR 402.06(a)). In such cases, the Federal agency should include the results of ESA Section 7 consultation(s) in the NEPA document (50 CFR 402.06(b)).

C.2.1 Biological Evaluation

License renewal (LR) does not require the preparation of a biological assessment because it is not a major construction activity. Nonetheless, the NRC staff must consider the impacts of its actions on federally listed species and designated critical habitats. In cases where the NRC staff finds that LR "may affect" ESA-protected species or habitats, ESA Section 7 requires the NRC to consult with the relevant Service(s).

To support such consultations, the NRC staff has incorporated its analysis of the potential impacts of the proposed LR into Section 3.8 of this supplemental environmental impact statement (SEIS). The NRC staff refers to its ESA analysis as a "biological evaluation."

The NRC staff structured its evaluation in accordance with the Services' suggested biological assessment contents described at 50 CFR 402.12(f) (TN4312). Section 3.8.1 of this SEIS describes the action area as well as the ESA-protected species and habitats potentially present in the action area. Section 3.8.4 assesses the potential effects of the proposed Perry Plant LR on the ESA-protected species and habitats present in the action area and contains the NRC staff's effect determinations for each of those species and habitat. Finally, Sections 3.8.5 through 3.8.8 address the potential effects of the no-action alternative and power replacement alternatives. The results of the NRC staff's analysis are summarized below in Table C-1.

Table C-1 Effect Determinations for Federally Listed Species under U.S. Fish and Wildlife Service Jurisdiction

Species	Federal Status[(a)]	Potentially Present in the Action Area?	Effect Determination[(b)]	FWS Concurrence Date[(c)]
northern long-eared bat	FE	Yes	NLAA	10/19/2023
Indiana bat	FE	Yes	NLAA	TBD
tricolored bat	FPE	Yes	NLAA	n/a
piping plover (Great Lakes DPS)[(d)]	FE	Yes	NLAA	TBD
red knot	FT	Yes	NLAA	TBD
monarch butterfly	FC	Yes	NLAA	n/a

(a) Indicates protection status under the Endangered Species Act (ESA). FC = candidate for Federal listing; FE = federally endangered; FPE = proposed for Federal listing as endangered; and FT = federally threatened.
(b) The NRC staff makes its effect determinations for federally listed species in accordance with the language and definitions specified in the U.S. Fish and Wildlife Service (FWS) and National Marine Fisheries Service (NMFS) Endangered Species Consultation Handbook (FWS and NMFS 1998-TN1031). NLAA = may affect but is not likely to adversely affect.
(c) The ESA does not require Federal agencies to seek FWS concurrence for "not likely to adversely affect" determinations for proposed species or for conclusions regarding effects on candidate species. n/a = not applicable; and TBD = to be determined.
(d) DPS = Distinct Population Segment.

C.2.2 Chronology of Endangered Species Act Section 7 Consultation

Endangered Species Act Section 7 Consultation with the U.S. Fish and Wildlife Service

On October 19, 2023, the FWS concurred with the NRC's determination that the proposed Perry Plant LR may affect but is not likely to adversely affect the northern long-eared bat and tricolored bat (FWS 2023-TN9082, FWS 2023-TN9081). Following the issuance of this draft SEIS, the NRC staff will seek the FWS's concurrence for its findings concerning the Indiana bat, piping plover, and red knot in accordance with 50 CFR 402.13(c) (TN4312). Because the monarch butterfly is a candidate for Federal listing, the ESA does not require the NRC to consult with or receive concurrence from the FWS regarding this species.

With respect to the tricolored bat, the ESA regulations in 50 CFR 402.10(a) (TN4312) require Federal agencies to confer with the Services any agency action that is likely to jeopardize the continued existence of any proposed species or result in the destruction or adverse modification of proposed critical habitat. Therefore, based on its “not likely to adversely affect” determination, the NRC is not required to confer with the FWS on the tricolored bat.

Table C-2 lists the correspondence between the NRC and the FWS pursuant to ESA Section 7 that has transpired to date.

Table C-2 Endangered Species Act Section 7 Consultation Correspondence with the U.S. Fish and Wildlife Service

Date	Description	ADAMS Accession No.[(a)]
October 19, 2023	Ohio Ecological Services Field Office (FWS) to B. Arlene (NRC), List of threatened and endangered species for proposed Perry Plant LR	ML23292A247
October 19, 2023	Ohio Ecological Services Field Office (FWS) to B. Arlene (NRC), Federal agency coordination under ESA Section 7 and concurrence that the proposed Perry Plant LR is not likely to adversely affect the long-eared bat	ML23292A248

ADAMS = Agencywide Documents Access and Management System; ESA = Endangered Species Act; FWS = U.S. Fish and Wildlife Service; LR = license renewal; NRC = U.S. Nuclear Regulatory Commission.
(a) Access these documents through the NRC’s ADAMS at http://adams.nrc.gov/wba/.
Source: FWS 2023-TN9767, FWS 2023-TN9741

Endangered Species Act Section 7 Consultation with the National Marine Fisheries Service

As discussed in Section 3.8.1.10 and 3.8.4.5 of this SEIS, no federally listed species or critical habitats under NMFS’s jurisdiction occur within the action area. Therefore, the NRC staff did not engage the NMFS pursuant to ESA Section 7 for the proposed Perry Plant LR.

C.3 Magnuson–Stevens Act Essential Fish Habitat Consultation

The NRC must comply with the Magnuson–Stevens Fishery Conservation and Management Act of 1976 (MSA), as amended (16 U.S.C. § 1801-TN9966), for any actions authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken, that may adversely affect any essential fish habitat (EFH) identified under the MSA. In Sections 3.8.3 and 3.8.4.6 of this SEIS, the NRC staff concludes that the NMFS has not designated any EFH under the MSA within the action area and that the proposed Perry Plant LR would have no effect on EFH. Thus, the MSA does not require the NRC to consult with the NMFS for the proposed action.

C.4 National Marine Sanctuaries Act Consultation

The National Marine Sanctuaries Act of 1966, as amended (16 U.S.C. § 1431 et seq.-TN4482), authorizes the Secretary of Commerce to designate and protect areas of the marine environment with special national significance due to their conservation, recreational, ecological, historical, scientific, cultural, archaeological, educational, or aesthetic qualities as national marine sanctuaries. Under Section 304(d) of the Act, Federal agencies must consult with the National Oceanic and Atmospheric Administration’s Office of National Marine Sanctuaries if a Federal action is likely to destroy, cause the loss of, or injure any sanctuary resources.

In Sections 3.8.3 and 3.8.4.7 of this draft environmental impact statement, the NRC staff concludes that no coastal or marine waters occur near the Perry Plant, that the proposed Lake Erie Quadrangle National Marine Sanctuary is 35 mi (56 km) east of the Perry Plant, and that the Perry Plant LR would have no effect on sanctuary resources of the proposed sanctuary. Thus, the NMSA does not require the NRC to consult with the National Oceanic and Atmospheric Administration for the proposed action.

C.5 National Historic Preservation Act of 1966

The National Historic Preservation Act of 1966, as amended (54 U.S.C. 300101 et seq.; TN4157) (NHPA), requires Federal agencies to consider the effects of their undertakings on historic properties and consult with applicable State and Federal agencies, Tribal groups, individuals, and organizations with a demonstrated interest in the undertaking before taking action. Historic properties are defined as resources that are eligible for listing on the National Register of Historic Places. The NHPA Section 106 review process is outlined in regulations issued by the Advisory Council on Historic Preservation in 36 CFR Part 800, “Protection of Historic Properties” (TN513). In accordance with 36 CFR 800.8(c), “Use of the NEPA Process for Section 106 Purposes,” the NRC has elected to use the NEPA process to comply with its obligations under Section 106 of the NHPA.

Table D-1 in Appendix D lists the chronology of correspondence, including correspondence related to the NRC’s NHPA Section 106 review of the Perry Plant LR.

C.6 References

36 CFR Part 800. *Code of Federal Regulations*, Title 36, *Parks, Forests, and Public Property*, Part 800, "Protection of Historic Properties.” TN513.

50 CFR Part 402. *Code of Federal Regulations,* Title 50, *Wildlife and Fisheries*, Part 402, "Interagency Cooperation—Endangered Species Act of 1973, as amended.” TN4312.

51 FR 19926. 1986. “Interagency Cooperation - Endangered Species Act of 1973, as amended.” Final Rule, *Federal Register*, Fish and Wildlife Service, Interior; National Marine Fisheries Service, National Oceanic and Atmospheric Administration, Commerce. TN7600.

16 U.S.C. § 1536. Endangered Species Act, Section 7, "Interagency Cooperation.” TN4459.

16 U.S.C. § 1801 *et seq*. Conservation, Chapter 38, "Fishery Conservation and Management." TN9966.

42 U.S.C. § 4321 *et seq*. U.S. Code Title 41, The Public Health and Welfare, Section 4321 "Congressional Declaration of Purpose.” TN8608.

Endangered Species Act of 1973. 16 U.S.C. § 1531 *et seq.* TN1010.

FWS (U.S. Fish and Wildlife Service). 2023. Letter from Fish and Wildlife Service, Minnesota-Wisconsin Ecological Services Field Office, to B. Arlene, dated June 27, 2023, regarding "Federal agency coordination under the Endangered Species Act, Section 7 for 'Monticello Subsequent License Renewal'.” Bloomington, Minnesota. ADAMS Accession No. ML24016A228. TN9082.

FWS (U.S. Fish and Wildlife Service). 2023. Letter from Ohio Ecological Services Field Office to B. Arlene, dated October 19, 2023, regarding “Federal agency coordination under the Endangered Species Act, Section 7 for 'Perry Nuclear Power Plant, Unit 1, License Renewal'.” Columbus, Ohio. ADAMS Accession No. ML23292A248. TN9741.

FWS (U.S. Fish and Wildlife Service). 2023. Letter from Fish and Wildlife Service, Ohio Ecological Services Field Office, October 19, 2023, regarding "List of threatened and endangered species that may occur in your proposed project location or may be affected by your proposed project.” Columbus, Ohio. ADAMS Accession No. ML23292A247. TN9767.

FWS (U.S. Fish and Wildlife Service). 2023. Letter from Fish and Wildlife Service, Minnesota-Wisconsin Ecological Services Field Office, to B. Arlene, dated June 27, 2023, regarding "Verification letter for 'Monticello Subsequent License Renewal' for specified threatened and endangered species that may occur in your proposed project location consistent with the Minnesota-Wisconsin Endangered Species Determination Key (Minnesota-Wisconsin DKey).” Bloomington, Minnesota. ADAMS Accession No. ML24016A230. TN9081.

FWS and NMFS (U.S. Fish and Wildlife Service and National Marine Fisheries Service). 1998. *Endangered Species Act Consultation Handbook, Procedures for Conducting Section 7 Consultation and Conference*. Washington, D.C. ADAMS Accession No. ML14171A801. TN1031.

National Historic Preservation Act. 54 U.S.C. § 300101 *et seq*. TN4157.

National Marine Sanctuaries Act, as amended. 16 U.S.C. § 1431 *et seq*. TN4482.

APPENDIX D

CHRONOLOGY OF ENVIRONMENTAL REVIEW CORRESPONDENCE

This appendix contains a chronological listing of correspondence between the U.S. Nuclear Regulatory Commission (NRC) and external parties as part of the agency's environmental review of the Perry Nuclear Power Plant Unit 1 (Perry Plant) license renewal application (LRA). This appendix does not include consultation correspondence or comments received during the scoping process. For a list and discussion of consultation correspondence, see Appendix C of this environmental impact statement. For scoping comments, see Appendix A of this supplemental environmental impact statement and the NRC's, "Scoping Summary Report" (Agencywide Documents Access and Management System [ADAMS] Accession No. ML24150A203; NRC 2024-TN10204). All documents are available electronically from the NRC's Public Electronic Reading Room found at: http://www.nrc.gov/reading-rm.html. From this site, the public can gain access to ADAMS, which provides text and image files of the NRC's public documents. The ADAMS accession number for each document is included in the following table.

D.1 Environmental Review Correspondence

Table D-1 lists the environmental review correspondence, by date, beginning with the request by Vistra Operations Company, LLC (VistraOps) to renew the operating license for Perry Plant.

Table D-1 Environmental Review Correspondence

Date	Correspondence Description	ADAMS Accession No. or *Federal Register* Citing
07/03/2023	Perry Nuclear Power Plant Unit 1–Application for Renewed Operating License	ML23184A081
07/28/2023	Letter to Rod L. Penfield – Perry Nuclear Power Plant, Unit No. 1 –Receipt and Availability of the License Renewal Application	ML23198A041
09/03/2023	Letter to Rod L. Penfield – Perry Nuclear Power Plant, Unit No. 1 License Renewal Application Online Reference Portal	ML23261C364
9/22/2023	Letter to Rod L. Penfield – Perry Nuclear Power Plant, Unit No. 1–Notice of Intent to Prepare an Environmental Impact Statement and Conduct Scoping Process	ML23249A103
09/29/2023	Energy Harbor Corp.; Energy Harbor Generation LLC; Energy Harbor Nuclear Corp.; Perry Nuclear Power Plant, Unit 1	88 FR 67373
10/10/2023	Notice of Intent to Conduct Scoping Process and Prepare Environmental Impact Statement; Energy Harbor Corp.; Energy Harbor Generation LLC.; Energy Harbor Nuclear Corp.; Perry Nuclear Power Plant, Unit 1	88 FR 69967
10/18/2023	Letter to Paul Barton, THPO, Eastern Shawnee Tribe of Oklahoma, Re., Request for Scoping Comments Concerning the Environmental Review of Perry Nuclear Power Plant, Units 1, License Renewal	ML23291A363

Table D-1 Environmental Review Correspondence (Continued)

Date	Correspondence Description	ADAMS Accession No. or *Federal Register* Citing
10/18/2023	Letter to Joe Stahlman, THPO, Seneca Nations of Indians, Re., Request for Scoping Comments Concerning the Environmental Review of Perry Nuclear Power Plant, Units 1, License Renewal	ML23291A367
10/18/2023	Letter to Earl Meshigaud, THPO, Hannahville Indian Community, Michigan, Re., Request for Scoping Comments Concerning the Environmental Review of Perry Nuclear Power Plant, Units 1, License Renewal	ML23291A364
10/18/2023	Letter to Logan York, THPO, Miami Tribe of Oklahoma, Re., Request for Scoping Comments Concerning the Environmental Review of Perry Nuclear Power Plant, Units 1, License Renewal	ML23291A366
10/18/2023	Letter to William Tarrant, THPO, Seneca-Cayuga Nation, Re., Request for Scoping Comments Concerning the Environmental Review of Perry Nuclear Power Plant, Units 1, License Renewal	ML23291A368
10/18/2023	Letter to Melissa Wiatrolik, THPO, Little Traverse Bay Bands of Odawa Indians, Re., Request for Scoping Comments Concerning the Environmental Review of Perry Nuclear Power Plant, Units 1, License Renewal	ML23291A365
10/18/2023	Letter to Reed Nelson, Executive Director, Advisory Council on Historic Preservation, Re., Request for Scoping Comments Concerning the Environmental Review of Perry Nuclear Power Plant, Units 1, License Renewal	ML23276B401
10/18/2023	Letter to Mary Beth Hirsch, Director, State Historic Preservation Office, Re., Request for Scoping Comments Concerning the Environmental Review of Perry Nuclear Power Plant, Units 1, License Renewal	ML23276B122
10/18/2023	October 19, 2023, Perry Nuclear Power Plant, Unit 1, License Renewal Application Public Environmental Scoping Meeting Presentation	ML23291A057
10/18/2023	October 25, 2023, Perry Nuclear Power Plant, Unit 1, License Renewal Application Public Environmental Scoping Meeting Presentation	ML23291A070
10/20/2023	Public Meeting Announcement: Environmental Scoping Meeting Related to the Perry Nuclear Power Plant, Unit No. 1, License Renewal Application	ML23279A077
10/24/2023	Public Meeting Announcement: Environmental Scoping Meeting Related to the Perry Nuclear Power Plant, Unit No. 1, License Renewal Application	ML23297A005
10/30/2023	Meeting Summary: Public Scoping Meeting for the Environmental Review of the License Renewal Application for Perry Nuclear Power Plant, Unit 1	ML23303A064
12/20/2023	Letter to Rod L. Penfield – Perry Nuclear Power Plant, Unit No. 1 – License Renewal Regulatory Audit Regarding the Environmental Review of the License Renewal Application	ML23321A047
03/14/2024	Letter to Rod L. Penfield – Perry Nuclear Power Plant, Unit No. 1 – Summary of the January-February 2024 Environmental Audit Related to the Review of the License Renewal Application Environmental Review	ML24064A221

Table D-1 Environmental Review Correspondence (Continued)

Date	Correspondence Description	ADAMS Accession No. or *Federal Register* Citing
04/15/2024	Perry Nuclear Power Plant Unit 1 – Response to Perry Nuclear Power Plant License Renewal Environmental Report Requests for Additional Information and Requests for Clarification	ML24107B080
08/05/2024	Letter to Rod L. Penfield – Perry Nuclear Power Plant Unit 1 – License Renewal Environmental Scoping Report	ML24150A200
07/08/2024	Email from Lance Rakovan to Rod Penfield - Perry LRA - 2nd Round Request for Additional Information	ML24190A077
08/15/2024	Perry Nuclear Power Plant Unit 1 – Response to Perry Nuclear Power Plant License Renewal Environmental Report SAMA Requests for Additional Information and Requests for Clarification	ML24228A016

ADAMS = Agencywide Documents Access and Management System; LRA = license renewal application; SAMA = severe accident mitigation alternative; THPO = tribal historic preservation officer.

D.2 References

NRC (U.S. Nuclear Regulatory Commission). 2024. Letter from S.S. Koenick, Chief Environmental Project Management Branch 1 Division of Rulemaking, Environmental, and Financial Support Office of Nuclear Material Safety and Safeguards, to R.L. Penfield, Site Vice President, Perry Nuclear Power Plant, dated July 25, 2024, regarding "Issuance of Environmental Scoping Summary Report Associated with the U.S. Nuclear Regulatory Commission Staff's Review of the Perry Nuclear Power Plant Unit 1, Subsequent License Renewal Application (EPID No. L-2023-LNE- 0002) (DOCKET No. 50-440)." Washington, D.C. ADAMS Accession No. ML24150A200. TN10327.

APPENDIX E

PROJECTS AND ACTIONS CONSIDERED IN THE CUMULATIVE IMPACTS ANALYSIS

The cumulative impacts analysis has been provided in Section 3.16 of this environmental impact statement (see Section 3.16, Cumulative Effects of the Proposed Action).

APPENDIX F

U.S. NUCLEAR REGULATORY COMMISSION STAFF EVALUATION OF SEVERE ACCIDENT MITIGATION ALTERNATIVES FOR PERRY NUCLEAR POWER PLANT, UNIT 1 IN SUPPORT OF LICENSE RENEWAL APPLICATION REVIEW

F.1 Introduction

Energy Harbor Nuclear Corp. (Energy Harbor) submitted an assessment of severe accident mitigation alternatives (SAMAs) for Perry Nuclear Power Plant Unit 1 (Perry Plant), in Section 4.15 and Attachment G of the environmental report (EH 2023-TN9534). After the submittal of the license renewal application (LRA), the Perry Plant Facility Operating License was transferred from Energy Harbor to Vistra Operations Company LLC (VistraOps or the applicant).

This assessment was based on the most recent revision to the Perry Plant probabilistic risk assessment (PRA), which includes an internal events[1] model, a seismic model, and a plant-specific offsite consequence analysis performed using the MELCOR Accident Consequence Code System (WinMACCS) computer code. This assessment also considered insights from the Perry Plant individual plant examination (IPE) (CE 1992-TN10352) and the Perry Plant individual plant examination of external events (IPEEE) (CE 1996-TN10353). In identifying and evaluating potential SAMAs, VistraOps considered SAMAs that addressed the major contributors to core damage frequency (CDF), population dose at Perry Plant, and offsite economic cost, as well as insights and SAMA candidates found to be potentially cost-beneficial from the analysis of other boiling water reactor (BWR) nuclear power generating stations. VistraOps initially identified a list of 157 potential SAMAs. VistraOps identified an initial set of 157 candidate SAMAs, referred to as Phase I SAMAs. VistraOps explained that the list of SAMA candidates was significantly reduced after application of the first three screening criteria and that the remaining unscreened SAMA candidates were grouped into 12 SAMA candidate groups, which are identified and described in Table G2-1 of the ER. Based on the latter two screening criteria, 10 of the SAMA candidate groups were screened out. The remaining two SAMAs, referred to as Phase II SAMAs, were evaluated in Section G.2.4 of Attachment G to the applicant's ER (EH 2023-TN9534). In response to NRC staff request for additional information (RAIs) (Vistra 2024-TN10350), four other SAMAs were also evaluated as a Phase II SAMAs. In Phase II, a detailed evaluation was performed for each of these six remaining SAMA candidates. This list was reduced to two unique SAMA candidates with the elimination of the SAMAs that (1) were not applicable to Perry Plant, (2) had already been implemented at Perry Plant, (3) were combined with another SAMA candidate, (4) had an excessive implementation cost, or (5) was expected to have a very low benefit. Of the two unique SAMA candidates remaining, VistraOps concluded in the ER that none of the candidate SAMAs are potentially cost beneficial.

As a result of the review of the SAMA assessment, the NRC staff issued RAI and RCI to VistraOps by email dated March 14, 2024 (NRC 2024-TN9935) and July 8, 2024 (NRC 2024-TN10378). Key requests involved: the contributors to internal events and seismic risk, additional

[1] The internal events model includes both the modeling of internal initiating events, such as those due to failure of plant equipment and operator actions, and the modeling of internal flooding initiating events.

details on the Level 2 and Level 3 PRA analysis, the treatment of external events in the SAMA analysis, the use of the results of PRA importance analysis and the Perry Plant IPE and IPEEE to identify Perry Plant-specific SAMA candidates, the contribution of external events in the assessment of SAMA benefits the impact of sensitivity analyses on the SAMA cost-benefit results and conclusions, further information on the cost-benefit analysis of candidate SAMAs, and low-cost alternatives. VistraOps submitted additional information by letters dated May 16, 2024 (Vistra 2024-TN10350), and August 15, 2024 (Vistra 2024-TN10351). VistraOps' responses to the NRC staff's RAIs and RCIs addressed the staff's concerns and did not result in the identification of potentially cost-beneficial SAMAs.

An assessment of the SAMAs for Perry Plant is presented below. Guidance for the SAMA analysis submittal is provided in NEI 05-01, Revision A, "Severe Accident Mitigation Alternatives (SAMA) Guidance Document" (NEI 2005-TN1978) which is endorsed in Regulatory Guide 4.2, Supplement 1 (NRC 2013-TN4791). The NRC staff notes that the licensee for Perry Plant has changed multiple times since it was granted an operating license by the NRC. Licensee's before VistraOps have included Centerior Energy and FirstEnergy Nuclear Operating Company in addition to Energy Harbor. In this assessment of the SAMA analysis, regardless of which of the licensee's submitted the information referenced in this assessment, VistraOps or the applicant is used to represent all current and prior licensees.

F.2 Estimate of Risk for Perry Plant

Section F.2.1 summarizes VistraOps' estimates of offsite risk at Perry Plant. The summary is followed by the NRC staff's review of VistraOps' risk estimates in Section F.2.2.

F.2.1 VistraOps' Risk Estimates

Two distinct analyses are combined to form the basis for the risk estimates used in the Perry Plant SAMA analysis: (1) the Perry Plant Level 1 and 2 PRA model, which is an updated version of the Perry Plant IPE (CE 1992-TN10352), and (2) a supplemental analysis of offsite consequences and economic impacts (essentially a Level 3 PRA model) developed specifically for the Perry Plant SAMA analysis. The scope of the Perry Plant PRA used for the SAMA analysis (Perry Plant PRA-PY1-AL-R01) includes internal events, including internal flooding, and seismic events, but does not include other external events.

The Perry Plant internal events CDF is approximately 1.3×10^{-6} per reactor-year as determined from quantification of the Level 1 PRA model. The Perry Plant seismic CDF is approximately 1.5×10^{-5} per reactor-year as determined from quantification of the Level 1 PRA model. These values were used as the baseline CDFs in the SAMA evaluations (EH 2023-TN9534). In response to an RAI (Vistra 2024-TN10351), VistraOps accounted for the potential risk reduction benefits associated with external events by explicitly including an estimate of the benefit in the assessment of each SAMA candidate. This is discussed further in Sections F.2.2 and F.6.2.

In response to an RAI (Vistra 2024-TN10350), VistraOps provided the breakdown of CDF by initiating internal events, including internal flooding, which is provided in Table F-1 and by initiating seismic events, which is provided in Table F-2. As shown in Table F-1, pipe breaks in the Control Complex that result in flooding and open phase conditions on the startup transformers are the dominant contributors to the CDF. While not listed explicitly in Table F-1 because they can occur as a result of multiple initiators, VistraOps stated that station blackouts (SBO) contribute about 21 percent (2.8×10^{-7} per reactor-year) of the total CDF and anticipated transients without scram (ATWS) contribute about 2.5 percent (3.3×10^{-8} per reactor-year) to the total internal events, including internal flooding, CDF (Vistra 2024-TN10350).

Table F-1 Perry Nuclear Power Plant Core Damage Frequency for Internal Events (Including Internal Flooding)

Initiating Event	Core Damage Frequency (CDF) (per reactor-year)	% CDF Contribution
Pipe Breaks (Flood) in Control Complex that Propagates to Switchgear Rooms	4.3×10^{-7}	32
Open Phase Condition on Startup Transformers	1.8×10^{-7}	14
Pipe Breaks (Flood) in Control Complex that Propagates to Auxiliary Building and/or Fuel Handling Building	1.7×10^{-7}	13
Loss of Offsite Power	1.2×10^{-7}	9
Pipe Breaks (Nominal Flood) in Control Complex	1.1×10^{-7}	8
Loss of Power Conversion System	7.5×10^{-8}	6
Pipe Breaks (Major Flood) in Control Complex	7.2×10^{-8}	6
Pipe Breaks (Flood) in Auxiliary Building	4.7×10^{-8}	4
Loss of Bus	3.9×10^{-8}	3
Loss of Feedwater	1.9×10^{-8}	1
Loss of Coolant Accident	1.9×10^{-8}	1
Other Pipe Breaks (Flood) in Control Complex	1.3×10^{-8}	1
Other Initiating Events[a]	2.7×10^{-8}	2
Total CDF (Internal Events)	$\mathbf{1.3 \times 10^{-6}}$	**100**

CDF = cord damage frequency.
(a) Multiple initiating events with each contributing less than 1 percent.

Table F-2 Perry Nuclear Power Plant Core Damage Frequency for Seismic Events

Initiating Event	Core Damage Frequency (CDF) (per reactor-year)	% CDF Contribution
%G05 (0.5 to 0.6g)	3.5×10^{-6}	24
%G04 (0.4 to 0.5g)	3.0×10^{-6}	20
%G06 (0.6 to 0.7g)	2.2×10^{-6}	15
%G09 (1.0 to 4.0g)	1.9×10^{-6}	13
%G08 (0.8 to 1.0g)	1.6×10^{-6}	11
%G07 (0.7 to 0.8g)	1.4×10^{-6}	10
%G03 (0.25 to 0.4g)	9.9×10^{-7}	7
Other Initiating Events[1]	6.5×10^{-8}	<1
Total CDF (Seismic Events)	$\mathbf{1.5 \times 10^{-5}}$	**100**

CDF = core damage frequency.
(a) Multiple initiating events with each contributing less than 1 percent.

In response to an RAI (Vistra 2024-TN10350), VistraOps explained that the full Level 2 Perry Plant PRA model that forms the basis for the SAMA evaluation is directly linked to the Level 1 Perry Plant PRA model. This linkage is accomplished by first mapping the Level 1 PRA model core damage accident sequences to one of nine plant damage states (PDSs), each of which are described in the RAI response. PDS-specific containment event trees (CETs) are then used to assess accident phenomenological events while system failures are directly tracked through the linked fault tree modeling.

The CET considers the influence of physical and chemical processes on the integrity of the containment and on the release of fission products once core damage has occurred. The quantified CET sequences are binned into one of 32 source term categories (or STCs). Source terms were developed for each of the STCs using the results of Modular Accident Analysis Program Version 5.0.1 computer code calculations (Vistra 2024-TN10350). The results of this analysis for Perry Plant are provided in Table G.1.4-5 of ER Attachment G (EH 2023-TN9534). The STCs are subsequently binned into release categories that provide the input to the Level 3 consequence analysis. The binned STCs are reviewed by VistraOps to identify the more risk significant contributors. The STC with the more limiting radionuclide release characteristics in magnitude and timing are selected to represent the release category (Vistra 2024-TN10350).

VistraOps computed offsite consequences for potential releases of radiological material using the MACCS, Version 3.10.0, code and analyzed exposure and economic impacts from its determination of offsite and onsite risks. Inputs for these analyses include plant-specific and site-specific input values for core radionuclide inventory, source term and release characteristics, site meteorological data, projected population distribution and growth within a 50 mi (80 km) radius, emergency response evacuation modeling, and local economic data. Radionuclide inventory in the reactor core is based on a plant-specific evaluation and corresponds to 3,758 megawatts thermal (MWt), (EH 2023-TN9534: Attachment G). The estimation of onsite impacts, in terms of clean-up and decontamination costs and occupational dose, is based on guidance in NUREG/BR–0184, *Regulatory Analysis Technical Evaluation Handbook* (NRC 1997-TN676). Additional details on the input parameter assumptions are discussed below.

In Tables G1.4-10 and G1.4-11 of the ER, the applicant estimated the dose risk to the population within 50 mi (80 km) of the Perry Plant site to be 0.171 person-Sv per year (17.1 person-rem per year) for internal events, including internal flooding, and 2.78 person-SV per year (278 person-rem per year) for seismic events (EH 2023-TN9534). The population dose risk (PDR) and offsite economic cost risk (OECR) contributions by containment release mode are summarized in Table F-3 for internal events, including internal flooding, and in Table F-4 for seismic events. Large, early (L/E) and L/I releases provide the greatest contribution for internal events, including internal flooding, totaling approximately 90 percent of the PDR and 97 percent of the OECR. L/E releases provide the greatest contribution for seismic events, contributing approximately 92 percent of the PDR and 97 percent of the OECR. For both internal events, including internal flooding, and seismic events the predominant contributing source term categories are containment penetration failures in which the containment fails prior to core damage and the release is unmitigated.

Table F-3 Base Case Mean Population Dose Risk and Offsite Economic Cost Risk for Internal Events, Including Internal Flooding at Perry Nuclear Power Plant

Release Category		Population Dose Risk[a]		Offsite Economic Cost Risk	
ID[b]	Frequency (per year)	person-rem/yr	% Contribution	$/yr	% Contribution
BOC	0	0	0	0	0
L/E	1.9×10^{-7}	9.3	54	4.2×10^{4}	55
L/I	3.7×10^{-7}	6.1	35	3.2×10^{4}	42
M/I	6.8×10^{-8}	0.35	2	9.6×10^{2}	1
M/L	0	0	0	0	0
S/E	6.4×10^{-7}	1.3	8	7.2×10^{2}	1
S/I	4.5×10^{-9}	0.013	<1	1.2×10^{1}	<<1
Intact	6.0×10^{-8}	0.11	1	3.7×10^{2}	<1
Total	**1.3×10^{-6}[c]**	**17.1[c]**	**100[d]**	**7.6×10^{4}[c]**	**100[d]**

BOC = break outside containment; ID = identification; L/E = large/early; L/I = large/intermediate; M/I = medium/intermediate; M/L = medium/late; S/E = small/early; S/I = small/intermediate.
(a) Unit Conversion Factor: 1 Sv = 100 rem.
(b) Release Category descriptions provided in response to an RAI (Vistra 2024-TN10350).
(c) Sum of contributors may not add up to Total due to round off error.
(d) Sum of contributors may not add up to 100 percent due to round off error.

Table F-4 Base Case Mean Population Dose Risk and Offsite Economic Cost Risk for Seismic Events at Perry Nuclear Power Plant

Release Category		Population Dose Risk[a]		Offsite Economic Cost Risk	
ID[b]	Frequency (per year)	person-rem/yr	% Contribution	$/yr	% Contribution
BOC	0	0	0	0	0
L/E	5.2×10^{-6}	256	92	1.2×10^{6}	97
L/I	2.2×10^{-7}	3.6	1	1.9×10^{4}	2
M/I	6.4×10^{-8}	0.33	<1	9.0×10^{2}	<1
M/L	0	0	0	0	0
S/E	9.0×10^{-6}	18.6	7	1.0×10^{4}	1
S/I	4.6×10^{-10}	0.0013	<<1	1.0×10^{0}	<<1
Intact	6.4×10^{-8}	0.12	<<1	4.0×10^{2}	<<1
Total	**1.5×10^{-5}[c]**	**278[c]**	**100[d]**	**1.2×10^{6}[c]**	**100[d]**

BOC = break outside containment; ID = identification; L/E = large/early; L/I = large/intermediate; M/I = medium/intermediate; M/L = medium/late; S/E = small/early; S/I = small/intermediate.
(a) Unit Conversion Factor: 1 Sv = 100 rem.
(b) Release Category descriptions provided in response to an RAI (Vistra 2024-TN10350).
(c) Sum of contributors may not add up to Total due to round off error.
(d) Sum of contributors may not add up to 100 percent due to round off error.

F.2.2 Review of VistraOps' Risk Estimates

VistraOps' determination of offsite risk at Perry Plant is based on four major elements of analysis:

- Level 1 risk models that supersede the 1992 IPE submittal (CE 1992-TN10352) and the seismic margins assessment in the 1996 IPEEE submittal (CE 1996-TN10353)
- other external event analyses of the 1996 IPEEE submittal
- a new full Level 2 risk model
- the combination of offsite consequence measures from MACCS analyses with release frequencies and radionuclide source terms from the Level 2 PRA model

Each analysis element was reviewed to determine the acceptability of VistraOps' risk estimates for the SAMA analysis, as summarized further in this section.

F.2.2.1 Internal Events CDF Model

Section 11.2.3.1 of NUREG–-1560, Volume 2, "Individual Plant Examination Program: Perspectives on Reactor Safety and Plant Performance Parts 2–5, Final Report" (NRC 1997-TN7812) shows that the IPE-based total internal events CDF for BWR 5 and BWR 6 plants ranges from 1×10^{-5} per year to 4×10^{-5} per year, with an average CDF for the group of 2×10^{-5} per year. The internal events, including internal flooding, CDF value from the 1992 Perry Plant IPE (1.3×10^{-5} per reactor-year) is consistent with the values reported at that time for other BWR 5 and BWR 6 units. Other nuclear power plants have updated the values for CDF subsequent to the IPE submittals to reflect modeling and hardware changes, which in many cases, has resulted in substantially reduced CDFs compared to those reported in the IPE. The internal events, including internal flooding, CDF result for Perry Plant used for the SAMA analysis (1.3×10^{-6} per year) is in the range reported in previous SAMA analyses for other similar plants.

There have been numerous revisions to the Perry Plant IPE Level 1 model since the 1992 IPE submittal leading up to PRA model Perry Plant PRA-PY1-AL-R01 utilized for the SAMA analysis. A listing of the changes made to the Perry Plant PRA since the original IPE submittal, with corresponding CDF and Large Early Release Frequency (LERF) results, is summarized in Table G1.3–1 of the ER (EH 2023-TN9534). A comparison of internal events, including internal flooding, CDF between the 1992 IPE and the 2022 PRA-PY1-AL-R01 model indicates a significant decrease in the total CDF (from 1.3×10^{-5} per reactor-year to 1.3×10^{-6} per reactor-year).

The ER indicates that the PRA model used for the SAMA analysis reflects the Perry Plant as-built, as-operated configuration as of February 10, 2022, and that no other planned major plant modifications which could adversely impact the SAMA analysis results have been identified.

The NRC staff considered the peer reviews, Facts and Observations (F&Os) closure reviews, and other assessments performed to provide assurance of the quality of the Perry Plant PRA, as well as the potential impact of the review findings on the SAMA evaluation. The following summarizes the most relevant PRA peer reviews and other assessments:

- In May 1997, the Boiling Water Reactors Owners Group conducted a peer review certification of the internal events, including internal flooding, PRA model.
- In May 2008, the applicant conducted a gap analysis self-assessment of the internal events, including internal flooding, PRA model to the American Society of Mechanical Engineers (ASME) PRA Standard RA-Sb-2005 (ASME 2005-TN10374).
- In November 2011, a focused scope peer review of the Level 2/LERF model was conducted using the ASME/American Nuclear Society (ANS) PRA Standard RA-Sa-2009 (ASME/ANS 2009-TN6220) and NRC Regulatory Guide 1.200, Revision 2 (NRC 2009-TN6211).
- In July 2012, a focused scope peer review of the internal flooding PRA model was conducted using the ASME/ANS PRA Standard RA-Sa-2009 (ASME/ANS 2009-TN6220) and NRC Regulatory Guide 1.200, Revision 2 (NRC 2009-TN6211).
- In October 2014, a peer review of the seismic PRA model was conducted using the ASME/ANS PRA Standard RA-Sb-2013 (ASME/ANS 2013-TN10372).
- In July 2015, a focused scope peer review of the PRA modeling of offsite power recovery was conducted using the ASME/ANS PRA Standard RA-Sb-2013 (ASME/ANS 2013-TN10372).
- In October 2017, a focused scope peer review of all F&O resolutions determined to be PRA upgrades was conducted using the ASME/ANS PRA Standard RA-Sb-2013 (ASME/ANS 2013-TN10372).
- In June 2019, an F&O closure review was conducted on all open F&O resolutions determined to be PRA updates. In response to an RCI (Vistra 2024-TN10350), VistraOps confirmed that: (1) the closure review was conducted using Nuclear Energy Institute (NEI) Appendix X guidance for closeout of F&Os (NEI 2017-TN10358) and in accordance with NRC expectations and conditions of its use (NRC 2017-TN10368, NRC 2017-TN10369); (2) the closure review scope included all finding-level F&Os for the internal events, including internal flooding, and seismic PRAs; and (3) the closure review team was provided with a written assessment and justification of whether the resolution of each F&O, within the scope of the closure review, constitutes a PRA upgrade or maintenance update in accordance with the PRA standard.

The ER explains that all but one F&O from the peer reviews and focused-scope peer reviews was formally closed using the F&O closure review process. The PRA model of record PRA-PY1-AL-R01 used in the SAMA analysis incorporates the dispositions to all the formally closed F&Os. The one F&O that remains open is concerned with the conservative treatment of recovery actions for relay chatter events during seismic events. VistraOps addressed this concern for the SAMA analysis by removing recovery of relay chatter events from the PRA model and evaluating these recovery events as a SAMA: SAMA-17, “Increase Capacity of Relays.”

In response to an NRC staff RAI (Vistra 2024-TN10350), VistraOps explained that the SAMA analysis utilizes a full scope Level 2 analysis. This is discussed further in Section F.2.2.3.

The ER provides a brief discussion of the Perry Plant maintenance process that ensures that the applicable PRA model is an accurate reflection of the as-built and as-operated plant. This process includes procedures for the PRA maintenance and update process, use of self-assessments and independent peer reviews, and routine PRA model updates to reflect the current plant configuration and additional plant operating history and component data.

Given that the Perry Plant internal events, including internal flooding, Level 1 PRA model has been peer-reviewed and the peer review findings were either all closed using a process acceptable to the NRC or were addressed, that VistraOps has in place procedures to assure the technical quality of the PRA, and that VistraOps has satisfactorily addressed NRC staff questions regarding the PRA, the NRC staff concludes that the internal events Level 1 PRA model is of sufficient quality to support the SAMA evaluation.

F.2.2.2 External Events

As indicated above, the Perry Plant PRA used for the SAMA analysis does not include external events other than seismic events. In the absence of such an analysis, VistraOps used the Perry Plant IPEEE and other analyses to identify the highest risk accident sequences and the potential means of reducing the risk posed by those sequences and to estimate the benefit of potential SAMAs, as discussed below and in Section F.3.2.

The final Perry Plant IPEEE was submitted in 1996 (CE 1996-TN10353), in response to Supplement 4 of GL 88–20 (NRC 1991-TN10360). No fundamental weaknesses or vulnerabilities to severe accident risk regarding external events were identified in the Perry Plant IPEEE. In the NRC staff’s safety evaluation of the Perry Plant IPEEE (NRC 2001-TN10381), the staff stated, “On the basis of the IPEEE review, the staff concludes that the licensee’s IPEEE process is capable of identifying the most likely severe accidents and severe accident vulnerabilities and, therefore, that Perry Plant has met the intent of Supplement 4 to Generic Letter 88-20.”

<u>Seismic Events</u>

As discussed in the Perry Plant IPEEE, the Perry Plant IPEEE seismic analysis was a 0.3 *g* focused-scope seismic margins assessment (SMA) following NRC guidance (NRC 1991-TN10360, NRC 1991-TN10361). The SMA approach is deterministic in nature and does not result in probabilistic risk information. VistraOps estimated the plant’s high confidence low probability of failure for all components, structures, and systems reviewed to be at least 0.3 g, which is equivalent to the review level earthquake.

Following the accident at the Fukushima Dai-ichi nuclear power plant resulting from the March 11, 2011, Great Tohoku Earthquake and subsequent tsunami, the NRC established the Near-Term Task Force to review regulatory insights from the Fukushima Dai-ichi accident as directed by the Commission on March 23, 2011 in COMGBJ-11-0002 (NRC 2011-TN7448). The Near-Term Task Force assessment resulted in the NRC issuing Order EA-12-049 (NRC 2012-TN7947) on March 12, 2012, to nuclear power plant licensees requiring them to mitigate beyond-design-basis external events, and issuing 10 CFR 50.54(f) (TN249) letters directing licensees to conduct seismic and flooding reevaluations (NRC 2012-TN2198).

In response to the 10 CFR 50.54(f) (TN249) letters directing licensees to conduct seismic and flooding reevaluations, VistraOps conducted additional seismic walkdowns at Perry Plant. The NRC staff concluded that the licensee, through the implementation of the walkdown guidance activities and, in accordance with plant processes and procedures, verified the plant configuration with the current seismic licensing basis; addressed degraded, nonconforming, or unanalyzed seismic conditions; and verified the adequacy of monitoring and maintenance programs for protective features. Furthermore, the NRC staff noted that no immediate safety concerns were identified (NRC 2014-TN10363).

The NRC staff notes that VistraOps' response to the Fukushima Near Term Task Force Recommendation 2.1 for a Seismic Hazard and Screening Report confirmed the licensee's conclusion that the Ground Motion Response Spectrum for the Perry Plant site exceeds the Safe Shutdown Earthquake in the 1 to 10 hertz (Hz) range and above 10 Hz. As such, a seismic risk evaluation, spent fuel pool evaluation, and high frequency confirmation were merited (NRC 2015-TN10365). In addition, the Seismic Hazard and Screening Report led to a spent fuel pool evaluation and high frequency exceedance confirmation which were subsequently resolved, and no necessary plant modifications were identified (NRC 2016-TN10367, NRC 2017-TN10370).

The NRC staff also notes that VistraOps submitted its Seismic Mitigating Strategies Assessment Report in August 2017, concluding that the flexible coping strategies for Perry Plant can be implemented as designed and that no further seismic evaluations were necessary (FENOC 2017-TN10355). In its review, the NRC staff concluded that sufficient information was provided to demonstrate that the licensee's plans for the development and implementation of guidance and strategies under Order EA-12-049 appropriately address the reevaluated seismic hazard information stemming from the 50.54(f) letter (NRC 2017-TN10371).

Since Perry Plant was a focused-scope SMA plant, the method to address seismic risk for the IPEEE focused on walk downs of success path equipment and systems and evaluation of equipment capacities against a review level earthquake defined by ground motion with a peak ground acceleration of 0.3 g. Thus, no seismic CDF estimate was developed. However, a Perry Plant-specific seismic PRA has since been developed by VistraOps and is used to assess the impact of SAMAs on seismic risk. As discussed in Section F.2.2.1, this seismic PRA has been independently peer reviewed and all F&Os but one from this peer review have been closed out using a process acceptable to the NRC. The one F&O that remains open is concerned with the conservative treatment of recovery actions for relay chatter events during seismic events. VistraOps addressed this concern for the SAMA analysis by removing recovery of relay chatter events from the PRA model and evaluating these recovery events as a SAMA (SAMA-17, "Increase Capacity of Relays").

In response to an RAI (Vistra 2024-TN10350), VistraOps clarified that the seismic PRA used for the SAMA analysis uses the seismic hazard curves developed in response to NRC information requests to address Fukushima Near Term Task Force recommendations following the accident at the Fukushima Daiichi Nuclear Power Plant and in response to GI-199 "Implications of Updated Probabilistic Seismic Hazard Estimates in Central and Eastern United States on Existing Plants" (NRC 2011-TN10386).

Apart from SAMA-17 discussed previously, VistraOps did not use the seismic PRA to directly assess the impact of SAMA candidates in the ER. In response to an NRC staff RAI (Vistra 2024-TN10351), VistraOps revised the SAMA analysis to explicitly account for the potential benefit due to the reduction in the seismic risk, based on the seismic PRA, from SAMA candidates that are identified to reduce the risk of internal events.

Considering that the seismic PRA has been peer reviewed and all F&Os either closed out or resolved for the SAMA analysis, that the seismic PRA uses the most current seismic hazard curves, and that the spent fuel pool evaluation and high frequency exceedance issues have been resolved, the NRC staff concludes that the seismic PRA, as discussed above, is acceptable for identifying and evaluating the benefits of SAMAs.

Fire Events

The Perry Plant IPEEE (CE 1996-TN10353) included an internal fire analysis in which a fire probabilistic safety assessment was performed based on the methodology of the Electric Power Research Institute Fire-Induced Vulnerability Evaluation (FIVE) methodology (EPRI 1992-TN10380). The FIVE methodology approach is a progressive screening analysis. Fire compartments of potential risk significance were identified using the initial qualitative and quantitative screening steps defined in the FIVE methodology. Areas were qualitatively screened from further analysis when they could be shown to be of low-risk significance. For each fire zone not qualitatively screened, the estimated fire ignition frequency was multiplied by the conditional core damage probability (CCDP) to determine a screening CDF for each zone. The models and methods used in the internal events IPE served as the basis for quantification of the CCDPs. The quantitative screening process screened out fire area/compartments when (1) the total fire area/compartment fire ignition frequency was less than 1×10^{-6} per year or (2) the fire ignition frequency multiplied by the CCDP, given loss of all equipment/cable in the compartment, was less than 1×10^{-6} per year. The fire CDF of the areas that did not screen totaled 3.13×10^{-5} per year in the IPEEE submittal (CE 1996-TN10353).

In response to an RAI (Vistra 2024-TN10350), VistraOps provided a listing of the fire areas and their contribution to the fire CDF for the seven fire areas not screened out in the IPEEE. These fire areas and their contribution to the fire CDF are provided in Table F-5. The dominant areas contributing to the fire CDF are the Unit 1 Control Room and the Unit 1 Division 2 Switchgear Room.

Table F-5 Fire Areas Not Screened in the Individual Plant Examination of External Events for Perry Nuclear Power Plant

Fire Compartment	Description	CDF (per reactor-yr)
1CC-5a	Unit 1 Control Room	1.06×10^{-5}
1CC-3a	Unit 1, Division 2 Switchgear Room	1.05×10^{-5}
1TPC/1	Unit 1 Turbine Power Complex Switchgear Room	3.38×10^{-6}
CC1	Control Area (elevation 574 ft)	2.03×10^{-6}
1CC-3c	Unit 1, Division 1 Switchgear Room	1.98×10^{-6}
FH3	Fuel Handling Building (elevation 620 ft)	1.63×10^{-6}
1TB	Unit 1 Turbine Building	1.30×10^{-6}
AB1f	High Pressure Core Spray Pump Room	8.56×10^{-7}
1CC-4b	Unit 1 Division 2 Cable Chase	8.55×10^{-7}
IB-2	Intermediate Building (Elevation 599 ft)	8.04×10^{-7}
ESW1a	ESW System Pumphouse – ESW Pump Room	7.92×10^{-7}
Other Compartments	-	1.96×10^{-6}
-	**Total Fire CDF**	$\mathbf{3.67 \times 10^{-5}}$

CDF = core damage frequency; ESW = emergency service water.

No vulnerabilities nor improvements with respect to fire were identified in the Perry Plant IPEEE. The Perry Plant IPEEE fire analysis was reviewed by the NRC staff as part of the IPEEE review (NRC 2001-TN10381). The NRC staff concluded that, based on the information in the IPEEE submittal, the licensee’s process is capable of identifying potential vulnerabilities associated with fires and that no potential vulnerabilities were identified.

VistraOps did not consider fire risk in the assessment of SAMAs in the ER. In response to an RAI (Vistra 2024-TN10351), VistraOps revised the SAMA analysis to explicitly account for the potential reduction in fire risk from identified SAMA candidates. For this assessment VistraOps reduced the fire CDFs reported in Table F-5 by a factor of three (approximately 1.2×10^{-5} per reactor-year), which is based on the guidance in NEI 05-01 (NEI 2005-TN1978) that the FIVE methodology is conservative because it is a screening analysis. The NRC staff finds the factor of three reduction is reasonable because the PRA-PY1-AL-R01 PRA model internal events CDF used for the SAMA analysis (1.3×10^{-6} per year) is approximately a factor of 10 less than the IPE CDF (1.3×10^{-5} per year) on which the IPEEE fire CDF is based. This reduction would account for updated modeling of the internal events portion of the model that was used in the fire analysis but does not necessarily address all the conservatisms inherent to the FIVE methodologies.

Considering that the Perry Plant fire risk assessment has been reviewed by the NRC staff as part of the IPEEE program, and that reductions in the internal events CDF due to plant improvements was done conservatively, the NRC staff concludes that the fire risk assessment, as discussed above, provides an acceptable basis for identifying and evaluating the benefits of SAMAs.

<u>High Winds, Floods, and Other External Events</u>

In the ER, VistraOps explained that other external events such as high winds, floods, aircraft accidents, hazardous materials, and turbine missiles were assessed in the Perry Plant IPEEE and that the conclusion from the IPEEE assessment is that there are no significant events of concern. In response to an RAI (Vistra 2024-TN10350), VistraOps further clarified that Perry Plant continues to meet the applicable NRC Standard Review Plan (NRC 1975-TN10359) requirements for high winds, external floods, and other external events.

The NRC staff noted in an RAI that NRC Regulatory Issue Summary 2015-06 (NRC 2015-TN10366) identified several instances in which nuclear power plants were determined to not conform with their tornado-generated missile licensing basis and asked VistraOps to discuss any changes to Perry Plant, the Perry Plant site, or the surrounding environment that would change the conclusions of the IPEEE regarding tornado-generated missiles and which could impact the SAMA analysis (NRC 2024-TN9935). VistraOps responded that the IPEEE analysis with respect to high winds remains bounding, and that Perry Plant is in conformance with its tornado-generated missile licensing basis, with no new missile hazards being located near the Perry Plant site since the IPEEE (Vistra 2024-TN10350).

As part of implementing lessons-learned from the accident at the Fukushima Dai-ichi Nuclear Power plant, the NRC issued a 10 CFR 50.54(f) letter request for information (NRC 2012-TN2198: Enclosure 2) to the letter requested licensees to re-evaluate flood-causing mechanisms using present-day methodologies and guidance. Concurrently with the re-evaluation of flooding hazards, licensees were required to develop and implement mitigating strategies in accordance with NRC Order EA-12-049, “Requirements for Mitigation Strategies for Beyond-Design-Basis External Events” (NRC 2012-TN3237).

Following the accident at the Fukushima Daiichi Nuclear Power Plant, VistraOps conducted additional external flood walkdowns as requested by NRC's 10 CFR 50.54(f) letter request for information (NRC 2012-TN2198). Based on its review of VistraOps’ submittal, the NRC staff concluded that the licensee’s implementation of the flooding walkdown methodology meets the intent of the walkdown guidance and that the licensee, through the implementation of the walkdown guidance activities and, in accordance with plant processes and procedures, verified the plant configuration with the current flooding licensing basis; addressed degraded, nonconforming, or unanalyzed flooding conditions; and verified the adequacy of monitoring and maintenance. Furthermore, the NRC staff noted that the licensee's walkdown results, which were verified by the NRC staff's inspection, identified no immediate safety concerns (NRC 2014-TN10364).

VistraOps submitted the Perry Plant reevaluated flood hazard assessment on March 24, 2016, (FENOC 2016-TN10354) and the NRC staff provided its assessment of the reevaluation on January 24, 2018 (NRC 2018-TN10384). In its assessment, the NRC staff confirmed the licensee's determination that (1) the reevaluated flood hazard results for local intense precipitation (LIP), streams and rivers, and storm surge are not bounded by the current design basis flood hazards, and (2) additional assessments of plant response need to be performed for LIP, streams and rivers, and storm surge flood-causing mechanisms.

VistraOps submitted the flooding mitigating strategies assessment for Perry Plant on July 24, 2017 (FENOC 2017-TN10356) and the NRC staff provided its assessment of the VistraOps submittal on May 3, 2018 (NRC 2018-TN10385). The NRC staff assessment confirmed that the licensee's flood hazard mitigating strategies assessment was performed consistent with applicable guidance. Further, based on the licensee's appropriate hazard characterization, the methodology used in the mitigating strategies assessment evaluation, and the description of its strategies (i.e., existing flexible coping strategies and changes and modifications to the site), the NRC staff concluded that the licensee has demonstrated that the mitigation strategies, if appropriately implemented, are reasonably protected from reevaluated flood hazard conditions for beyond-design-basis external events.

On November 18, 2019, VistraOps submitted its focused evaluation of the external flooding mechanisms for which the reevaluated flooding hazards are not bounded by the current design basis (FENOC 2019-TN10357). VistraOps' evaluation concluded that unbounded external flooding events do not impact any key systems, structures, and components or challenge key safety functions at Perry Plant after implementation of various actions and physical modifications to the site. These actions and modifications involve development of a flooding protection scheme utilizing a combination of permanently installed passive protection (in the form of incorporated barriers) and temporary/removeable barriers deployed per operator action. The NRC staff evaluation of this submittal concluded that the Perry Plant site has effective flood protection measures (if implemented as described) for the reevaluated LIP, streams and rivers, storm surge, and combined events flood hazard mechanisms during beyond-design-basis external flooding events (NRC 2020-TN10383). In response to an RAI (Vistra 2024-TN10350), VistraOps clarified that the plant/site changes identified in the focused evaluation have been implemented and that no additional mitigation strategies are required.

Considering that the NRC staff concluded that the flooding protection measures implemented at Perry Plant provide effective measures for protection against beyond-design-basis external flooding events, that the NRC staff concluded that flooding mitigation strategies implemented at Perry Plant are reasonably protected from reevaluated flood hazard conditions, that the reevaluated flood hazard conditions were conservatively assessed, and that the contribution to CDF from high winds and other external events is negligible because Perry Plant meets the Standard Review Plan, the NRC staff concludes that not explicitly including the risk contribution from these other external hazards in the SAMA analysis is acceptable. Furthermore, the NRC staff concludes that no additional external flooding SAMAs need to be considered because VistraOps has implemented the NRC-mandated safety enhancements from the lessons learned from the Fukushima Dai-ichi accident and that has completed its response to the subsequent letter requesting additional information for Perry Plant (NRC 2020-TN9941).

F.2.2.3 Level 2 Fission Product Release Analysis

The NRC staff reviewed the general process used by VistraOps to translate the results of the Level 1 PRA into containment releases, as well as the results of the Level 2 analysis, as described in the ER and in responses to NRC staff RAIs (Vistra 2024-TN10350).

In response to an RAI (Vistra 2024-TN10350), VistraOps explained that the Level 2 analysis is linked to the Level 1 model by extending the model to include the CETs which characterizes the post core melt accident response. This linkage was accomplished by first mapping the Level 1 PRA model core damage accident sequences to one of nine PDSs, each of which are described in the RAI response. PDS-specific CETs were then used to assess accident phenomenological events while system failures were directly tracked through the linked fault tree modeling. The CET considers the influence of physical and chemical processes on the integrity of the containment and on the release of fission products once core damage has occurred. The quantified CET sequences were binned into one of 32 STCs for use in the Level 2 analysis.

The top events of the CETs represent phenomenological events that impact the ability of the containment to remain intact and contain fission products released from the core by a core damage accident or that result in containment bypass. System failures are passed from the Level 1 analysis through the linked fault tree modeling to the CETs. Additional fault tree logic was developed to ensure complete linking of all system-related interactions. A list of the CET functional events used for the Level 2 analysis is provided in the RAI response (Vistra 2024-TN10350).

The CET end points or STCs represent the outcomes of possible containment accident progression sequences with each end point representing a complete sequence from initiator to release to the environment (EH 2023-TN9534). Associated with each STC is an atmospheric radionuclide source term including the timing, magnitude, and other conditions associated with the release. Because of the large number of STCs, they are grouped into release categories. VistraOps defined 10 release categories: break outside containment, L/E, L/I, large/late (L/L), medium/early (M/E), medium/intermediate, medium/late (M/L), small/early, small/intermediate, and containment intact. The containment intact release category is for accident sequences in which there is no containment failure. In response to an RAI (Vistra 2024-TN10350), VistraOps defined each of these release categories in terms of the characteristics (i.e., timing and magnitude of release) that are used to perform the binning of STCs into the categories. Three release categories (L/L), M/E, and M/L are not used. The L/L release category is not used because, at the Level 2 PRA truncation level (3×10^{-13} per year) assumed for the analysis, no accident sequences were mapped into this category. The M/E and M/L categories were not used because STCs or accident sequences initially binned into these categories, after further review, were rebinned into categories that had either high release (i.e., M/E moved to L/E) or early containment failure (i.e., M/L moved to M/E). Based on the results of a sensitivity study by VistraOps which showed that the rebinning resulted in a small increase in population dose, the NRC staff finds that this rebinning is conservative for the SAMA analysis.

Source terms were developed for each of the STCs using the results of Modular Accident Analysis Program (MAAP) Version 5.0.1 computer code calculations (Vistra 2024-TN10350). The results of this analysis for Perry Plant are provided in Table G.1.4-5 of ER Attachment G. Representative MAAP cases were developed for each STC based on a review of the accident sequences binned into the STC and selecting the accident sequence having the highest release frequency. The STCs are subsequently binned into release categories that provide the input to the Level 3 consequence analysis. The binned STCs are reviewed by VistraOps to identify the more risk significant contributors. The STC having the highest source term based on radionuclide release magnitude and timing was selected to represent the release category (Vistra 2024-TN10350).

The release categories and their frequency are provided in Tables G1.4-10 and G1.4-11 of ER Attachment G. The frequency of each release category is the sum of the frequencies of the various STCs assigned to that release category.

In response to an RAI (Vistra 2024-TN10350), VistraOps explained that the representative MAAP cases for all the STCs were run for 72 hours from accident initiation. VistraOps also explained that in all cases the dominant plume segment is either Plume No. 1 or Plume No. 2 (from ER Table G1.4-7) and that the only instance where one of these plume segments was truncated or stopped prior to its full release duration was STC-3 (i.e., Plume No. 1 in which the plume release duration was stopped after 24 hours). For this case, VistraOps showed that assuming continuation of the release for up to 72 hours would have insignificant impact on the SAMA analysis because radionuclide release would only be increased by 0.1 percent. The information in ER Table G1.4-7 confirms that running the MAAP cases for 72 hours is, for all STCs, more than 48 hours after declaration of a general emergency.

As indicated in ER Table G1.3-1, the LERF-only model for the PRA-PY1-AL-R01 PRA model resulted in total LERF of 9.73×10^{-6} per year for internal events, including internal flooding, and seismic events while Table G2-2 reports the LERF (L/E release category) from the Level 2 analysis used for the SAMA analysis to be 1.88×10^{-7} per year for internal events, including internal flooding, and 5.19×10^{-6} per year for seismic events for a total LERF of 5.38×10^{-6} per year. The NRC staff asked VistraOps to address the impact of this difference on the SAMA analysis (NRC 2024-TN9935). In response to an RAI (Vistra 2024-TN10350), VistraOps stated that the LERF portion of the PRA-PY1-AL-R01 PRA model was independently peer reviewed in accordance with the PRA standard as described in Section F.2.2.1 above. Several of the PRA standard supporting requirements were assessed by the peer review to not be met or to not meet Capability Category II. VistraOps dispositioned each of these to not be significant to the SAMA analysis. VistraOps also explained that the full Level 2 model used for the SAMA analysis was subject to an internal peer review. Additionally, the quantification results (CDF and LERF) were reviewed by Perry Plant PRA staff and PRA vendor staff to confirm that they are reflective of the current plant. The NRC staff performed its own calculation to assess the potential impact of this difference in the reported LERF values. Based on this calculation the NRC staff concludes that the difference is bounded by the 95th percentile uncertainty analysis (see Section F.6.2).

Based on its review of the Level 2 methodology that is in accordance with the NEI 05-01A guidance, VistraOps' responses to NRC staff RAIs, the results of MAAP runs that extended the run time to more than 48 hours after declaration of general emergency for all STCs, the bases for determining that the resolution to independent peer reviews of the LERF model would not impact the SAMA results, and that the Level 2 model was internally reviewed and determined to produce quantification results reflective of the current plant, the NRC staff concludes that the Level 2 PRA, as used in the SAMA analysis, provides an acceptable basis for evaluating the benefits associated with various SAMAs.

F.2.2.4 Level 3 Consequence Analysis

VistraOps used the WinMACCS code, Version 3.10.0, and a core inventory from a plant-specific calculation to determine the offsite consequences from potential releases of radioactive material (EH 2023-TN9534). VistraOps calculated the core inventory for 3,758 MWt, the licensed power level for Perry Plant (NRC 2003-TN8607: Perry Nuclear Power Plant, Unit 1, Current Facility Operating License NPF-58 Tech Specs, Revised 06/07/2024.).

The NRC staff reviewed the process used by VistraOps to extend the containment performance (Level 2) portion of the PRA to an assessment of offsite consequences (Level 3 PRA model). Source terms used to characterize fission product releases for the applicable containment release categories and the major input assumptions used in the offsite consequence analyses were considered. In response to an NRC staff RAI on the core inventory used in the SAMA radiological dose calculations and that expected during the 20-year period of extended operation if license renewal (LR) is approved (Vistra 2024-TN10350), VistraOps explained that the core inventory currently utilized at Perry Plant is for GNF-2 fuel and reflects the current design basis for the Perry Plant. VistraOps also explained that there are no current efforts to pursue power uprates.

Additional plant-specific input to the Level 3 assessment includes the core release fractions and source terms for each release category, site-specific meteorological data, projected population distribution and expected growth out to the year 2046 within a 50 mi (80 km) radius, emergency evacuation modeling, and economic data. This information is provided in Section G.1.4 of Attachment G to the ER (EH 2023-TN9534).

According to the ER and an RAI response (Vistra 2024-TN10350), VistraOps utilized site-specific meteorological data (wind speed, wind direction, atmospheric stability, accumulated precipitation) for the calendar years 2019 through 2021. Meteorological data was acquired from the Perry Plant meteorological monitoring system. Missing meteorological data were filled using five methods: (1) utilization of secondary sensor data for the Perry Plant site when the primary sensor data was missing, (2) interpolation of data to fill in gaps where hourly data was not available, (3) replacement of the missing data using data from a different year for the same time, (4) replacement of missing precipitation data with zero, and (5) calculation of missing hourly data from 15-minute data for the Perry Plant site.

Average seasonal morning and afternoon mixing height data for 1984 through 1991 for the Wright Patterson Air Force Base from the Environmental Protection Agency Support Center for Regulatory Atmospheric Modeling (SCRAM) was used as input to the MACCS code. The NRC staff notes that according to the SCRAM website these are the only years for which mixing height data are available and Wright Patterson Air force Base is the only location in Ohio for which mixing height data is available. VistraOps performed sensitivity analyses on the mixing height assumption, both decreasing it to the minimum mixing layer height in the SCRAM data and increasing it to the maximum mixing layer height in the SCRAM data. For the minimum mixing layer height, the population dose and offsite economic cost were reported to increase by 2.1 percent and 1 percent, respectively. For the maximum mixing layer height, the population dose and offsite economic cost were reported to decrease by 1.9 percent and 1.1 percent, respectively. Given the small change in the population dose and offsite economic cost, the NRC staff concludes that the mixing layer height assumption is reasonable and acceptable for the purposes of the SAMA evaluation.

The sources of data and models for atmospheric dispersion used by the applicant are consistent with standard industry practice and acceptable for calculating consequences from potential airborne releases of radioactive material. Because multiple years of meteorological data were considered by the applicant and data gaps were filled using acceptable methods, the NRC staff finds that the data selection was performed in accordance with NRC guidance (NEI 2005-TN1978), and thus, the meteorological data are appropriate for use in the SAMA analysis.

VistraOps projected population distribution and expected growth within a radius of 50 mi (80 km) at the Perry Plant site, out to the year 2046 to account for an anticipated 23-year period of remaining plant life, including 3 years remaining on the original operating license plus a 20-year LR period (EH 2023-TN9534). The VistraOps assessment used U.S. Census 2010 data and scaled the population data to 2046 county-level projection estimates for Ohio and Pennsylvania. Transient populations were not included in the projections. In response to an RAI (Vistra 2024-TN10350), VistraOps developed an estimate of the transient population by taking the difference between the population estimate reported in Section 3.11 of the ER for a 50 mi (80 km) radius around Perry Plant, which includes transient populations, and the 50 mi (80 km) radius population estimate used for the SAMA analysis. The difference was about 5 percent. VistraOps performed a sensitivity analysis by increasing the population estimates for each population segment reported in ER Table G1.4-1 by 5 percent and determined that both population dose and offsite economic costs correspondingly increase by 5 percent. VistraOps concluded based on the results of this sensitivity analysis that the conclusions of the SAMA analysis are minimally impacted by this non-conservatism. Given the small change in the population dose and offsite economic cost, the NRC staff concludes that not including the transient populations will not change the conclusions of the SAMA evaluation.

The NRC staff noted in an RAI that the population of most counties surrounding the Perry Plant site are projected to decline between 2020 and 2050. Therefore, using projected 2046 population data may be non-conservative for the SAMA analysis because populations early in the LR period are higher than in 2046, which is the end of the LR period (NRC 2024-TN9935). In response to the RAI (Vistra 2024-TN10350), VistraOps explained that the SAMA analysis assumed the higher of the 2020 Census county populations or the projected 2046 county populations and that, therefore, the SAMA analysis is conservative.

The NRC staff considers the methods and assumptions for estimating population reasonable and acceptable for purposes of the SAMA evaluation because its review of VistraOps' assessment determined that VistraOps had considered appropriate data sources, used a reasonable approach for applying data, and followed the NRC guidance (NEI 2005-TN1978), and showed that the non-conservatism associated with not crediting transient populations did not impact the SAMA analysis.

VistraOps assumed that 99.5 percent of the population within the emergency planning zone would evacuate (EH 2023-TN9534). This assumption is the same as used in the NUREG-1150 study (NRC 1990-TN525). VistraOps performed a sensitivity analysis on the percent of the population assumed to evacuate, reducing it to 90 percent of the population within the emergency planning zone. The population dose was reported to increase by 0.6 percent and the offsite economic cost was reported to be unchanged. Given the small or negligible change in the population dose and offsite economic cost, the NRC staff concludes that the evacuation assumption is reasonable and acceptable for the purposes of the SAMA evaluation.

VistraOps performed a sensitivity analysis on the time to declaration of an emergency, duration of release of plume segments, and start time of each plume segment from accident initiation

(EH 2023-TN9534). For the SAMA analysis these parameters were taken from the MAAP analyses for each STC. For the sensitivity analysis, each of these parameters was decreased by 50 percent. The population dose was reported to increase by 1.6 percent and the offsite economic cost was reported to decrease by 7.1 percent. Given that VistraOps performed a site-specific analysis to determine these timing assumptions and parameters and showed that the changes in the consequence results were small or negative, the NRC staff concludes that the timing assumptions are reasonable and acceptable for the purposes of the SAMA evaluation.

VistraOps assumed that the time for the population to take shelter following a declaration of an emergency is 120 minutes (EH 2023-TN9534). VistraOps performed a sensitivity analysis assuming the time to take shelter was decreased to 90 minutes. The population dose was reported to decrease by 0.7 percent and the offsite economic cost was reported to be unchanged. The NRC staff expects that an increase in the time to take shelter of 30 minutes would similarly increase the population dose by about 0.7 percent. Given the small or negligible change in the population dose and offsite economic cost, the NRC staff concludes that the time to take shelter assumption is reasonable and acceptable for the purposes of the SAMA evaluation.

VistraOps assumed that the rate of release of sensible heat in each plume segment was 0 W (EH 2023-TN9534), or in other words that there was no buoyant plume rise. VistraOps performed sensitivity analyses assuming the rate of release of sensible heat in each plume segment was 1×10^3 W, 1×10^6 W, and 1×10^{10} W. The 0 W and 1×10^{10} W are the minimum and maximum values permitted in the MACCS code (SNL 1998-TN10382). The population dose remained unchanged for 1×10^3 W, increased by 0.4 percent for 1×10^6 W, and decreased by 12.9 percent for 1×10^{10} W, respectively with each plume segment. Similarly, the offsite economic cost remained unchanged for 1×10^3 W, r increased by 0.5 percent for 1×10^6 watts, and decreased by 2.7 percent for 1×10^{10} W. Given the small or negligible change in the population dose and offsite economic cost, the NRC staff concludes that the time to take shelter assumption is reasonable and acceptable for the purposes of the SAMA evaluation.

VistraOps assumed that the height of the release of the plumes was at mid-containment or 22.4 m (73.5 ft) (EH 2023-TN9534). VistraOps performed sensitivity analyses assuming the height of the release of the plumes was at the ground surface (ground release) and at the top of containment or 44.8 m (147 ft). The population dose decreased by 0.6 percent for the ground release and increased by 2.1 percent for the top of containment release. Similarly, the offsite economic cost decreased by 1.2 percent for the ground release and increased by 2.1 percent for the top of containment release. Given the small change in the population dose and offsite economic cost, the NRC staff concludes that the plume release height assumption is reasonable and acceptable for the purposes of the SAMA evaluation.

According to Section G.1.4.2 of the ER, the site-specific regional economic and agricultural data used in VistraOps' analysis was provided from the 2017 U.S. Census of Agriculture, SECPOP 4.3.0, U.S. Bureau of Labor Statistics, 2020 U.S. Census for per capita income, U.S. Department of Commerce, and Federal Reserve economic data. Data was obtained for the 13 counties that are all or in part within 50 mi (80 km) radius of the Perry Plant site. Economic costs for evacuation, relocation, and decontamination were scaled to year 2021 costs from 1986 values obtained from MACSS using the ratio of the 2021 and 1986 consumer price index (CPI) values. The average cost of decontamination labor was scaled to 2021 costs from the 1984 value obtained from NUREG/CR-3673 (Burke et al. 1984-TN10377) using the ratio of the 2021 and 1984 CPI values.

VistraOps performed a sensitivity analysis on two of the MACCS offsite contamination inputs, increasing the decontamination time (TIMDEC) to approximately 365 days from 120 days and increasing the non-farmland decontamination costs (CDNFRM) to $100,000 per person from $19,760 per person (EH 2023-TN9534). These values bound the sensitivity analysis values recommended in U.S. NRC order CLI-16-06 (NRC 2016-TN4631). The offsite economic cost was reported to increase by 74 percent and the population dose was reported to be increased by 5.9 percent. The NRC determined that this change in the maximum averted cost risk is bounded by the uncertainty analysis results discussed in Section F.6.2.

The NRC staff considers the MACCS2 values (SNL 1998-TN10382), adjusted to 2021 costs using the CPI, used by the applicant to be reasonable for the SAMA analysis.

In summary, the NRC staff reviewed VistraOps' assessments of the source term, radionuclide releases, meteorological data, projected population distribution, emergency response, and regional economic and agricultural data and evaluated VistraOps' responses to NRC staff RAIs, as previously described in this subsection. Based on the NRC staff's review, the NRC staff concludes that VistraOps' consequence analysis is acceptable and that VistraOps' methodology to estimate offsite consequences for Perry Plant and consideration of parameter sensitivities provide an acceptable basis to assess the risk reduction potential for candidate SAMAs. Accordingly, the NRC staff based its assessment of offsite risk on the CDFs, population doses, and offsite economic costs reported by VistraOps.

F.3 Potential Plant Improvements

The process for identifying potential plant improvements (SAMAs), an evaluation of that process, and the improvements evaluated by VistraOps are discussed in this section.

F.3.1 Process for Identifying Potential Plant Improvements

VistraOps' process for identifying potential plant improvements consisted of the following elements (EH 2023-TN9534; Vistra 2024-TN10350):

- review of SAMAs identified in industry documents
- review of SAMA analyses for other BWR plants
- review of potential plant improvements identified in the Perry Plant IPE and IPEEE
- review of the risk-significant scenarios in the current Perry Plant PRA Levels 1 and 2 models

In Phase I of the evaluation, VistraOps performed a qualitative and bounding quantitative screening of the initial list of SAMAs and eliminated SAMAs from further consideration using the following criteria:

- the SAMA modified features not applicable to Perry Plant
- the SAMA has already been implemented at Perry Plant
- the SAMA is similar in nature and could be combined with another SAMA candidate
- if the SAMA has an excessive implementation cost (greater than 50 percent of the maximum benefit)
- if the SAMA is expected to have a very low benefit (small or no contribution to risk)

Based on this process, VistraOps identified an initial set of 157 candidate SAMAs, referred to as Phase I SAMAs. VistraOps explained that the list of SAMA candidates was significantly reduced after application of the first three screening criteria and that the remaining unscreened SAMA candidates were grouped into 12 SAMA candidate groups, which are identified and described in Table G2-1 of the ER. Based on the latter two screening criteria, 10 of the SAMA candidate groups were screened out. The remaining two SAMAs (SAMA-11, "Add Alternative EDG Room Cooling," and SAMA-17, "Increase Capacity of Relays"), referred to as Phase II SAMAs, are evaluated in Section G.2.4 of Attachment G to the applicant's ER (EH 2023-TN9534). In response to NRC staff RAIs (Vistra 2024-TN10350), SAMA-5, "Install Curbs for Switchgear Rooms," SAMA-6, "Install Flood Doors for Switchgear Rooms," SAMA-7, "Enhance DC Power for Internal Flooding," and SAMA-14, "Add Alternative Containment Spray (L2 only)," were also evaluated as a Phase II SAMAs. In Phase II, a detailed evaluation was performed for each of these six remaining SAMA candidates, as discussed in Sections F.4 and F.6 below.

F.3.2 Review of VistraOps' Process

The initial SAMA list was developed primarily from the cost-beneficial SAMAs identified in previous BWR LRAs and from Perry Plant-specific assessments.

VistraOps was asked in RAIs to provide additional information on the Perry Plant-specific assessments, to provide specifics of how the generic industry SAMAs (NEI 2005-TN1978) were considered in the development of Phase I SAMA candidates, describe how the list of Phase I SAMA candidates addressed the major Level 1 and Level 2 PRA risk contributors at Perry Plant, and how risk insights and potential plant improvements from the Perry Plant IPE and IPEEE were considered in the identification of SAMA candidates (NRC 2024-TN9935). In response to the RAIs (Vistra 2024-TN10350), VistraOps explained that 129 of the Phase I SAMAs were obtained from the potentially cost-beneficial SAMA candidates identified in 14 previous LRAs for BWR plants and that the remaining 28 Phase I SAMAs were developed from an assessment of the dominant Perry Plant-specific scenarios. The RAI response identified the previous LRAs that were reviewed, and the number of Phase I SAMA candidates obtained from each LRA. VistraOps further explained that the plant-specific SAMAs were identified to address the most risk-important scenarios determined from the internal events PRA and from the seismic PRA. Additionally, VistraOps explained that the list of generic industry SAMAs (NEI 2005-TN1978) were not explicitly identified as Phase I SAMA candidates but were implicitly considered since many of the LRAs considered this list in developing Phase I SAMA candidates.

VistraOps provided a description of equipment and human action failures that are the most significant contributors to internal events and seismic risk (Vistra 2024-TN10350). For each of these VistraOps identified the Phase II SAMA candidates that mitigate the failures. VistraOps further explained that the most dominant scenarios for seismic-initiated failures involved failure of plant structures due to seismic events having high spectral accelerations and that no cost-effective SAMA candidates were identified for these structural failures. For minor contributors to risk, SAMA candidates from the Phase I list were identified to mitigate these scenarios.

VistraOps explained that the risk significance of accident scenarios was determined based on their Fussell-Vesely value and that Phase I SAMA candidates were identified for risk significant scenarios that contribute 5 percent or more to the risk (Vistra 2024-TN10350). VistraOps explained that based on the maximum benefit (see Section F.6.1 below), this equates to a benefit of approximately $87,000, which is below the minimum cost of a procedure change. Because of the much greater contribution to risk from seismic events than from internal events, including internal flooding, VistraOps applied this cutoff for identifying risk-significant scenarios separately for seismic events and for internal events.

VistraOps summarized the potential plant improvements identified in the IPE and IPEEE and how they were considered in the SAMA analysis (Vistra 2024-TN10350). Potential plant improvements that were under evaluation at the time of the IPE were: (1) automatic depressurization system automatic initiation (other than ATWS), (2) passive containment vent, (3) ATWS/automatic depressurization system automatic inhibit, (4) ATWS/feedwater runback between minimum steam cooling water level and reactor pressure vessel Low Level 2 with main steam isolation valve isolation bypass, and (5) alternative boron injection. VistraOps explained that Items 2, 4, and 5 were addressed by Phase I SAMA candidates, and that Items 1 and 3 did not address risk-significant scenarios in the current Perry Plant PRA model and so were not considered as SAMA candidates. VistraOps explained that the only improvements identified in the IPEEE were related to providing restraining of certain equipment during seismic events (Vistra 2024-TN10350).

Further review of the IPEEE by the NRC staff confirmed no physical plant modifications were identified, and that the identified seismic-related improvements were plant changes to resolve spatial interaction concerns and were considered housekeeping items (CE 1996-TN10353; NRC 2001-TN10381). Based on this confirmation, the NRC staff agrees that these improvements need not be considered as SAMA candidates.

In an RAI, the NRC staff noted that while the IPEEE did not identify any fire-related plant improvements, it did identify several risk-significant fire compartments (i.e., those that exceeded a fire CDF of 1.0×10^{6} per year) and asked VistraOps to discuss the steps taken to identify potential SAMAs that would mitigate the Perry Plant specific risks due to fire hazards (NRC 2024-TN9935). In response to the RAI (Vistra 2024-TN10350), VistraOps identified and evaluated plant improvements to install incipient detection systems in the Unit 1 Control Room fire compartment (SAMA-30, “Incipient Detection MCR”) and in the Division 2 Switchgear Room fire compartment (SAMA-31, “Incipient Detection DIV 2”). These were evaluated as Phase II SAMAs. No other SAMA candidates were identified based on the review of the IPEEE results.

As discussed in Section F.2.2.2 above, the Perry Plant external flooding focused evaluation concluded that unbounded external flooding events do not impact any key systems, structures, and components or challenge key safety functions at Perry Plant after implementation of the flooding protection scheme that utilizes a combination of permanently installed passive protection (in the form of incorporated barriers) and temporary/removeable barriers deployed per operator action. The NRC staff evaluation of the external flooding focused evaluation submittal concluded that the Perry Plant site has effective flood protection measures (if implemented as described) for the reevaluated LIP, streams and rivers, storm surge, and combined events flood hazard mechanisms during beyond-design-basis external flooding events (NRC 2020-TN10383). Furthermore, the NRC staff notes that no additional external flooding SAMAs need to be considered because VistraOps has implemented the NRC-mandated safety enhancements from the lessons learned from the Fukushima Dai-ichi accident and has completed its response to the 50.54(f) letter for Perry Plant (NRC 2020-TN9941).

The NRC staff noted in an RAI (NRC 2024-TN9935) that Table G2-5 of Attachment G of the ER identifies SAMA-5, “Install Flood Doors for Switchgear Rooms,” as having a maximum benefit that exceeds the estimated implementation cost and so it is specified to be retained for the Phase II assessment. However, Table G2-6 determines the final outcome of the screening analyses is to screen this SAMA. The reason given is that it has a negative cost benefit based on implementation cost and maximum benefit, which contradicts the cost-benefit results reported in Table G2-5. The NRC staff asked VistraOps to justify the screening of SAMA-5 or provide a Phase II assessment for this SAMA. In response to the RAI (Vistra 2024-TN10350), VistraOps provided a revised implementation cost estimate of $700,000 for this SAMA candidate and a Phase II assessment.

VistraOps assumed that no single SAMA could eliminate more than 50 percent of the calculated maximum benefit based on a review of the Perry Plant risk contributors for CDF and LERF. In response to an RAI (Vistra 2024-TN10350), VistraOps explained that this review was based on the calculated Fussell-Vesely importance measures for the significant risk contributors. The NRC staff does not accept this screening approach because it does not address the potential risk reduction associated with population dose risk and offsite economic cost risk, which may be more impacted by the reduction in other risk-significant Level 2 release categories than by just CDF or LERF. Therefore, the NRC staff requested VistraOps to either justify the screening using the 50 percent criterion or perform a Phase II cost-benefit analyses for SAMA-6, “Install Curbs for Switchgear Rooms,” and SAMA-7, “Enhance DC Power for Internal Flooding,” because these SAMA candidates were screened using the 50 percent criterion and have a maximum benefit greater than the estimated implementation cost. In response to the RAI (Vistra 2024-TN10350), VistraOps provided a Phase II cost-benefit analyses for SAMA-6 and explained that this estimated benefit is the same for SAMA-7.

The NRC staff noted in an RAI (NRC 2024-TN9935) that all the identified SAMAs involve procurement and installation of major new systems and none of the SAMAs consider procedure and training improvements that are typically a much lower cost alternative. The NRC staff asked VistraOps to discuss the possibility of SAMAs to improve procedure and training enhancements and to specifically address this possibility as an alternative to SAMA-6, “Install Curbs for Switchgear Rooms,” and SAMA-17, “Increase Capacity of Relays.” In response to the RAI (Vistra 2024-TN10350), VistraOps explained that improvements in procedures and training have previously been implemented because of past NRC orders, industry studies, and initiatives and that an expert panel did not identify additional procedural improvements. VistraOps further explained with respect to SAMA-6 that procedures to mitigate flooding are already implemented and that potential new operator actions to isolate internal floods could not be implemented in a timely manner without making physical modifications to Perry Plant. With respect to SAMA-17 VistraOps explained that procedural actions were reviewed for mitigating locked-in relays during a seismic event and that no clear physical actions were identified to perform the mitigation in a timely manner.

The NRC staff notes that the set of SAMAs submitted is not all-inclusive because additional, possibly even less expensive, alternatives can always be proposed. However, the NRC staff concludes that the benefits of any additional modifications are unlikely to exceed the benefits of the modifications evaluated and that the alternative improvements likely would not cost less than the least expensive alternatives evaluated, when the subsidiary costs associated with maintenance, procedures, and training are considered.

The NRC staff concludes that VistraOps used a systematic and comprehensive process for identifying potential plant improvements for Perry Plant, and that the set of SAMAs evaluated in the ER, together with those evaluated in response to NRC staff inquiries, is reasonably comprehensive and, therefore, acceptable. This search included reviewing insights from the Perry Plant plant-specific risk studies that included internal initiating events, including internal flooding, as well as fire, seismic and other external initiated events, and reviewing plant improvements considered in previous SAMA analyses.

F.4 Risk Reduction Potential of Plant Improvements

In the ER, and in response to RAIs, the applicant evaluated the risk-reduction potential of the SAMAs that were not screened out in the Phase I analysis and retained for the Phase II evaluation. The SAMA evaluations were performed using generally conservative assumptions.

Table F-6 lists the assumptions considered to estimate the risk reduction for each of the evaluated SAMAs, the estimated cost to implement each SAMA, the estimated risk reduction in terms of percent reduction in CDF, PDR and OECR, and the estimated total benefit (present value) of the averted risk. The estimated benefits reported in Table F-6 reflect the combined benefit in both internal and external events. The determination of the benefits for the various SAMAs is further discussed in Section F.6.

VistraOps generally used model re-quantification to determine the potential benefits for each SAMA that was identified to specifically reduce the risk of internal events and seismic events. The CDF, PDR, and OECR were estimated using the PRA-PY1-AL-R01 model. The changes made to the model to quantify the impact of SAMAs are detailed in Section G.2.4 of Attachment G to the ER (EH 2023-TN9534) and in the response to NRC staff RAIs (Vistra 2024-TN10350). In response to an NRC staff RAI (Vistra 2024-TN10351), VistraOps developed estimates of the potential benefits from the reduction in fire and seismic risk for the SAMA candidates identified to reduce internal events risk and included these estimates in developing the total benefit of each SAMA candidate. Bounding evaluations were performed to address each of the Phase II SAMA candidates.

As discussed in Section F.3.2, SAMA-30, “Incipient Detection MCR,” and SAMA-31, “Incipient Detection DIV 2,” were identified by VistraOps in response to an NRC staff RAI (Vistra 2024-TN10350) to address fire risk in the MCR and Switchgear Rooms, respectively. For these internal fire related SAMAs, the benefit was estimated using the results of the IPEEE fire analysis to eliminate the risk associated with the fire compartment impacted by the SAMA. For both SAMAs, addition of incipient detection in the main control room and Division 2 Switchgear Room, respectively, it was conservatively assumed that the SAMA eliminated the entire fire CDF of the associated fire compartment, each of which makes up about 30 percent of the total fire CDF (see Table F-6). Based on the scenario descriptions provided in the IPEEE, VistraOps assigned the entire risk reduction for SAMA-30 to the Intact release category and the entire risk reduction for SAMA-31 to the M/L release category. The reduction in PDR and OECR for each of the fire compartments was then calculated by multiplying the fire CDF reduction by the estimated population dose and offsite economic cost for the respective release categories.

The NRC staff concludes that, with the above clarifications, the consideration of risk reduction potential of Perry Plant improvements by VistraOps is sufficient and appropriate for use in the SAMA evaluation because it is technically sufficient and meets the guidance provided in NEI 05-01A.

Table F-6 Severe Accident Mitigation Alternatives Cost/Benefit Analysis for Perry Nuclear Power Plant Unit 1. Percentage Risk Reductions are Presented for Core Damage Frequency, Population Dose Risk, and Offsite Economic Cost Risk[a]

SAMAs	Analysis Assumptions	% Risk Reduction			Internal and External Benefit	Internal and External Benefit with Uncertainty	Implementation Cost
		CDF	PDR	OECR			
5 – Install Curbs for Switchgear Rooms[b]	Completely eliminate internal flooding risk in the Switchgear Rooms (internal flooding events only)	34	36	36	$486,600	n/a	$700,000
6 – Install Flood Doors for Switchgear Rooms[b]	Completely eliminate internal flooding risk in the Switchgear Rooms (internal flooding events only)	34	36	36	$486,600	n/a	$500,000
7 – Enhance DC Power for Internal Flooding[b]	Completely eliminate internal flooding risk in the Switchgear Rooms (internal flooding events only)	34	36	36	$486,600	n/a	$1,000,000
11 – Add Alternative EDG Room Cooling	Completely eliminate failure of EDG Room ventilation.	<1	<1	<1[b]	$26,500[b]	n/a	$90,000
14 – Add Alternative Containment Spray (L2 only)[b]	Increase the effectiveness of fission product scrubbing.	n/a	n/a	n/a	$258,800	n/a	$620,000
17 – Increase Capacity of Relays	Increase the seismic capacity (fragility) of selected relays to a median capacity of 10.0 *g* (seismic events only).	37	9	6[b]	$1,676,000	$6,702,500[b]	$6,892,000
30[c] – Install Incipient Detection MCR	Completely eliminate all the risk associated with the MCR (fire events only).	32	25	32	$659,400	n/a	$4,987,500
31[c] – Install Incipient Detection DIV 2 (Division 2 Switchgear Compartment)	Completely eliminate all the risk associated with Division 2 Switchgear Room (fire events only).	29	39	26	$681,500	n/a	$4,312,500

CDF = core damage frequency; DC = direct current; EDG = emergency diesel generator; MCR = main control room; n/a –= not applicable or not available; OECR = offsite economic cost risk; PDR = population dose risk; SAMA = severe accident mitigation alternative.

(a) SAMAs in bold are potentially cost-beneficial.

(b) Information provided in response to NRC staff RAIs (Vistra 2024-TN10350, Vistra 2024-TN10351).

(c) New SAMA evaluated in response to NRC staff RAI (Vistra 2024-TN10350).

F.5 Cost Impacts of Candidate Plant Improvements

As enumerated in Table F-6, VistraOps estimated the costs of implementing the Phase II SAMAs using a site-specific cost estimating process based on a proposed design and input and review from an expert panel of Perry Plant personnel.

In response to an RAI (Vistra 2024-TN10350), VistraOps clarified that the cost estimates were developed using VistraOps staff knowledgeable in project management, plant operations, plant maintenance, engineering, and PRA. The cost estimates only included the cost of procurement, installation, procedure changes, and operator training and did not include the cost of replacement power during extended outages if required to implement the modifications, nor did the cost estimates include contingency costs associated with unforeseen implementation obstacles.

The NRC staff reviewed the applicant's cost estimates, presented in Table G2-5 of Attachment G to the ER (EH 2023-TN9534) and provided in response to RAIs (Vistra 2024-TN10350). For certain improvements, the NRC staff also compared the cost estimates to estimates developed elsewhere for similar improvements, including estimates developed as part of other licensees' analyses of SAMAs for operating reactors.

The NRC staff concludes that the cost estimates provided by VistraOps are sufficient for use in the SAMA evaluation because economic viability of the proposed modification could be adequately gauged and the cost estimating process meets the guidance provided in NEI 05-01A.

F.6 Cost-Benefit Comparison

VistraOps' cost-benefit analysis and the NRC staff's review are described in the following sections.

F.6.1 VistraOps' Evaluation

The methodology used by VistraOps was based primarily on NRC's guidance for performing cost-benefit analysis (i.e., NUREG/BR–0184 [NRC 1997-TN676]), which is referenced in the guidance provided in NEI 05-01A. As described in Section G.3 of the ER (EH 2023-TN9534), the net value was determined for each SAMA according to the following formula:

Net Value = (APE + AOC + AOE + AOSC) – COE

where

APE (averted public exposure) = present value of APE costs ($)

AOC (averted offsite property damage costs) = present value of AOC costs ($)

AOE (averted occupational exposure) = present value of AOE costs ($)

AOSC (averted onsite costs) = present value of AOSC ($)

COE = cost of enhancement ($)

If the net value of a SAMA is negative, the cost of implementing the SAMA is larger than the benefit associated with the SAMA, and it is not considered to be cost beneficial. VistraOps' derivation of each of the associated costs is summarized next.

NEI 05-01A states that two sets of estimates should be developed for discount rates of 7 percent and 3 percent (NEI 2005-TN1978). VistraOps provided a base set of results using a discount rate of 7 percent and a 24-year LR period.

F.6.1.1 APE Costs

VistraOps defined annual offsite exposure risk, or APE, as the monetary value of accident risk avoided from population doses after discounting (EH 2023-TN9534). The APE costs were calculated using the following formula:

APE = Annual reduction in public exposure (Δ person-rem per year)

× monetary equivalent of unit dose ($2,000 per person-rem)

× present value conversion (NRC 1997-TN676)

The annual reduction in public exposure was calculated according to the following formula:

Annual reduction in public exposure = (Accident frequency without modification × accident population dose without modification) – (Accident frequency with modification × accident population dose with modification)

As stated in NUREG/BR–0184 (NRC 1997-TN676), it is important to note that the monetary value of the public health risk after discounting does not represent the expected reduction in public health risk due to a single accident. Rather, it is the present value of a stream of potential losses extending over the remaining lifetime of the facility (in this case, the 20-year renewal period plus the 4 years remaining on the current operating license). Thus, it reflects the expected annual loss due to a single accident, the possibility that such an accident could occur at any time over the renewal period, and the effect of discounting these potential future losses to present value. For a discount rate of 7 percent and a 24-year remaining Perry Plant life with an internal events CDF of 1.33×10^{-6} per year and a monetary equivalent of unit dose of $2,000 per person-rem, the applicant calculated an APE cost of approximately $397,900 for internal events (EH 2023-TN9534). Similarly, with a seismic events CDF of 1.46×10^{-5} per year and a monetary equivalent of unit dose of $2,000 per person-rem, the applicant calculated an APE cost of approximately $6,471,800 for seismic events (EH 2023-TN9534). The applicant calculated a total APE cost as the sum of the APE costs for internal events and seismic events of approximately $6,869,700 (EH 2023-TN9534).

F.6.1.2 Averted Offsite Property Damage Costs (AOC)

VistraOps defined annual offsite economic cost risk, or AOC, as the monetary value of risk avoided from offsite property damage after discounting (EH 2023-TN9534). The AOC values were calculated using the following formula:

AOC = Annual reduction in offsite property damage × present value conversion

The annual reduction in offsite property damage was calculated according to the following formula:

Annual reduction in offsite property damage = (Accident frequency without modification × accident property damage without modification) – (Accident frequency with modification × accident property damage with modification)

For a discount rate of 7 percent and a 24 year remaining Perry Plant life with an internal events CDF of 1.33×10^{-6} per year, the applicant calculated an AOC of approximately $884,400 for internal events (EH 2023-TN9534). Similarly, with a seismic events CDF of 1.46×10^{-5} per year the applicant calculated an AOC of approximately $13,801,000 for seismic events (EH 2023-TN9534). The applicant calculated a total AOC cost as the sum of the AOC costs for internal events and seismic events of approximately $14,685,500 (EH 2023-TN9534).

F.6.1.3 AOE Costs

VistraOps defined annual onsite or occupational exposure risk, or AOE, as the avoided onsite exposure (EH 2023-TN9534). Similar to the APE calculations, the applicant calculated costs for immediate onsite exposure. Long-term onsite exposure costs were calculated consistent with guidance in NUREG/BR–0184 (NRC 1997-TN676).

VistraOps derived the values for averted occupational exposure from information provided in Section 5.7.3 of NUREG/BR–0184 (NRC 1997-TN676). Best estimate values provided for immediate occupational dose (3,300 person-rem) and long-term occupational dose (20,000 person-rem over a 10-year clean-up period) were used. The present value of these doses was calculated using the equations provided in the NUREG/BR–0184 handbook with a monetary equivalent of unit dose of $2,000 per person-rem, a real discount rate of 7 percent, and a time of 24 years to represent the remaining life of Perry Plant. Immediate and long-term onsite exposure costs were summed to determine AOE cost. For an internal events CDF of 1.33×10^{-6} per year, the applicant calculated an AOE cost of approximately $500 for internal events (EH 2023-TN9534). Similarly, for a seismic events CDF of 1.46×10^{-5} per year, the applicant calculated an AOE cost of approximately $6,000 for seismic events (EH 2023-TN9534). The applicant calculated a total AOE cost as the sum of the AOE costs for internal events and seismic events of approximately $6,500 (EH 2023-TN9534).

F.6.1.4 AOSC

AOSC includes averted cleanup and decontamination costs and averted power replacement costs. Repair and refurbishment costs are considered for recoverable accidents only and not for severe accidents. The applicant derived the values for AOSC based on information provided in Section 5.7.6 of NUREG/BR–0184 (NRC 1997-TN676). This cost element was divided into two parts: the onsite cleanup and decontamination cost, also commonly referred to as averted cleanup and decontamination costs, and the replacement power cost (RPC).

Averted cleanup and decontamination costs (ACC) were calculated using the following formula:

ACC = Annual CDF reduction × present value of clean-up costs per core damage event × present value conversion factor

The total cost of clean-up and decontamination subsequent to a severe accident is estimated in NUREG/BR–0184 to be $\$1.5 \times 10^{9}$ (undiscounted). This value was converted to present costs spread over a 10 year clean-up period and integrated over the term of the proposed license extension. For a discount rate of 7 percent and a 24 year remaining Perry Plant life with a CDF of 1.33×10^{-6} per year, VistraOps calculated an ACC of approximately $16,700 from internal events (EH 2023-TN9534). Similarly, for a seismic events CDF of 1.46×10^{-5} per year, the applicant calculated an ACC cost of approximately $182,700 for seismic events (EH 2023-TN9534).

Long-term RPCs were calculated using the following formula:

RPC = Annual CDF reduction × present value of replacement power for a single event × factor to account for remaining service years for which replacement power is required × reactor power scaling factor

The applicant based its calculations on a net electric output of 1277 MWe and scaled up from the 910 MWe reference plant in NUREG/BR-0184 (NRC 1997-TN676). Therefore, the applicant applied a power-scaling factor of 1.40 (1277/910) to determine the RPC. The applicant also applied two additional scaling factors: an inflation scaling factor and a plant capacity scaling factor. The purpose of the inflation scaling factor is to scale the cost of replacement power from the year 1993 cost in NUREG/BR-0184 to current year (2021) cost using the PPI for electric power. The purpose of the plant capacity scaling factor is to scale the power generation capacity of the reference plant in NUREG/BR-0184, which was assumed to have a capacity factor of 60–65 percent to that for Perry Plant (which, for Perry Plant, is approximately 91.9 percent). The applicant applied an inflation scaling factor of 1.73 and a plant capacity scaling factor of 1.53. For a discount rate of 7 percent and a 24 year remaining Perry Plant life with a CDF of 1.33×10^{-6} per year, VistraOps calculated an RPC of approximately $53,000 from internal events (EH 2023-TN9534). Similarly, for a seismic events CDF of 1.46×10^{-5} per year, the applicant calculated an RPC cost of approximately $581,000 for seismic events (EH 2023-TN9534).

AOSC, the summation of ACC and RPC, is therefore approximately $69,700 from internal events and approximately $763,700 for seismic events for the 24 year period of remaining Perry Plant life and a discount rate of 7 percent. The applicant calculated a total AOSC cost as the sum of the AOSC costs for internal events and seismic events of approximately $833,400 (EH 2023-TN9534).

Using the above equations, VistraOps estimated the total present dollar value equivalent associated with completely eliminating severe accidents due to internal events and seismic events at Perry Plant to be about $22,395,100 (EH 2023-TN9534). The total present dollar value equivalent for internal events is approximately $1,352,500 and for seismic events is approximately $21,042,600.

As discussed in Section F.5, in response to an NRC staff RAI (Vistra 2024-TN10351), VistraOps developed estimates of the potential benefits from the reduction in fire and seismic risk for the SAMA candidates identified to reduce internal events risk and included these estimates in developing the total benefit of each SAMA candidate. In response to this same NRC staff RAI (Vistra 2024-TN10351), VistraOps qualitatively considered the impact of uncertainties in the CDF calculations used to determine the benefits of internal events and seismic events.

F.6.1.5 VistraOps' Results

If the implementation costs for a candidate SAMA exceeded the calculated benefit, the SAMA was determined not cost beneficial. If the benefit exceeded the estimated cost, the SAMA candidate was considered cost beneficial. In VistraOps' analysis, no SAMA candidates were found to be potentially cost beneficial (EH 2023-TN9534; Vistra 2024-TN10350; Vistra 2024-TN10351). The results of the cost-benefit evaluation are presented in Table F-6.

F.6.2 Review of VistraOps' Cost-Benefit Evaluation

Based primarily on NUREG/BR–0184 (NRC 1997-TN676) and NEI guidelines on discount rates (NEI 2005-TN1978), the NRC staff determined the cost-benefit analysis performed by VistraOps was consistent with the guidance. The benefit of external (fire and seismic) events was explicitly considered and, if applicable, estimated by VistraOps for each SAMA candidate (Vistra 2024-TN10351). The IPEEE fire analysis results were used to develop an estimate of the reduction in fire risk for SAMAs that impact fire risk. No SAMA candidates were found to be potentially cost beneficial based on the benefit from internal and external events.

The applicant considered possible increases in benefits from analysis uncertainties on the results of the SAMA assessment. In response to an RAI (Vistra 2024-TN10350), VistraOps stated that the 95th percentile value of the Perry Plant internal events CDF was a factor of 3 greater than the mean CDF and the 95th percentile value of the Perry Plant seismic events CDF was a factor of 5 greater than the mean seismic CDF. Multiplication factors of 3 and 4 were selected by the applicant to account for uncertainty in internal events and seismic events, respectively. The NRC staff considers the multiplier of 3 to account for uncertainty for internal events provides adequate margin and is acceptable for the SAMA analysis (SAMA-11, Alternative EDG Room Cooling) was the only SAMA candidate evaluated by the applicant using this multiplier). Because the baseline assessment of the benefit of SAMA-17, Increase Capacity of Relays (which was the only SAMA that was evaluated using the seismic PRA), assumes that all seismic relay chatter was eliminated, which is conservative, the NRC staff finds that use of a multiplication factor of 4 rather than 5 is reasonable. These multiplication factors were applied to the baseline benefit for SAMAs 11 and 17. Neither SAMA was determined to be potentially cost-beneficial as a result of the uncertainty analysis (Vistra 2024-TN10350).

For the other SAMA candidates VistraOps qualitatively addressed analysis uncertainties (Vistra 2024-TN10351). For Phase I SAMA-2 (Automate Suppression Pool Cooling), SAMA-8 (Hard Pipe Diesel Fire Pump Injection), SAMA-10 (Terminate Makeup on ATWS), and SAMA-12 (Install ESW Cross-tie), VistraOps explained that the benefit estimates assume all internal event risk (these SAMA candidates were determined to provide little or no benefit for external events) was eliminated which significantly over estimates the benefit (in some cases by more than a factor of 10) and that this inherent conservatism therefore already accounts for analysis uncertainties. For Phase I SAMA-3 (Install Passive Containment Vent), VistraOps explained that the implementation cost estimate is conservative in that it does not account for the cost of replacement power during the prolonged outage that would be required to install the system, which could exceed the estimated implementation cost, and that it doesn't account for the cost of development of this system, which would be a first-of-a-kind system. VistraOps further explained that the benefit estimate is conservative because it assumes complete elimination of the risk for scenarios that would not benefit from this SAMA. For example, the benefit estimate assumes all internal event risk was eliminated and that the seismic risk is reduced by 74 percent, which significantly overestimates the benefit. For Phase I SAMA-16, "Automate SLC Actuation," VistraOps explained that the benefit estimate assumes all internal event risk was eliminated and that the risk of seismic ATWS scenarios was eliminated, which significantly overestimates the benefit, and that this inherent conservatism therefore already accounts for analysis uncertainties. None of these SAMA candidates were determined to be potentially cost-beneficial as a result of the uncertainty analysis (Vistra 2024-TN10351).

As discussed in Section F.3.2, the NRC staff noted in an RAI (NRC 2024-TN9935) that Table G2-5 of Attachment G of the ER identifies SAMA 14, "Add Alternative Containment Spray (L2 only)," as having a maximum benefit that exceeds the estimated implementation cost and so it is specified to be retained for the Phase II assessment. In response to the RAI (Vistra 2024-TN10351), VistraOps provided a Phase II assessment that increased the reliability of the containment spray function to scrub fission products more effectively prior to release for both internally initiated events and external (fire and seismic) events. VistraOps concluded based on its baseline assessment that this SAMA was not cost-beneficial. In its uncertainty assessment of SAMA-14 VistraOps explained that the estimated implementation cost does not include the cost for a seismically qualified design and installed system nor does it include the cost of replacement power during the prolonged outage that would be required to install the system. VistraOps further explained that the estimated benefit for fire events conservatively assumes that all fire scenarios allocated to the M/L release category are moved to the small/intermediate release category. This SAMA candidate was determined to not be potentially cost-beneficial as a result of the uncertainty analysis (Vistra 2024-TN10351).

As discussed in Sections F.3.2 and F.4, in response to an NRC staff RAI (Vistra 2024-TN10350), VistraOps identified two SAMA candidates to reduce the risk of fire events, specifically SAMA-30, “Incipient Detection MCR,” and SAMA-31, “Incipient Detection DIV 2.” VistraOps performed a bounding assessment of the benefit of these two SAMA candidates by assuming they eliminated the risk of Control Room and Control Building fires and Division 2 Switchgear Room fires, respectively. Neither SAMA candidate was determined to be cost-beneficial in the baseline analysis. VistraOps did not consider the impact of analysis uncertainties on the cost-benefit results for these two SAMA candidates. The NRC staff assessment is that neither of these SAMA candidates are cost-beneficial after consideration of uncertainties because the implementation cost for both SAMA candidates is over a factor of 6 greater than the estimated benefits for each, and that the benefit estimate for each SAMA candidate is based on a bounding assessment that completely eliminates the fire risk associated with the applicable fire areas.

In response to an RAI, VistraOps analyzed the sensitivity of the cost-benefit analysis results for SAMA-11 and SAMA-17 to a lower discount rate of 3 percent. No cost-beneficial SAMAs were identified as a result of this sensitivity analysis (Vistra 2024-TN10350). The NRC staff considers only evaluating this sensitivity analysis for SAMA-11 and SAMA-17 to be reasonable because the results for this sensitivity analysis are bounded by the results of the uncertainty analysis.

In response to an NRC staff RAI, VistraOps evaluated new and significant information regarding the monetary equivalent of unit dose. Consistent with guidance in Revision 1 of NUREG-1530 (NRC 2022-TN7859), VistraOps provided a sensitivity analysis for SAMA-11 and SAMA-17 replacing the monetary equivalent of unit dose value of $2,000 per person-rem used in the baseline analysis with a value of $6,200 per person-rem in January 2022 dollars. Based on the results of the sensitivity analysis, no cost-beneficial SAMAs were identified (Vistra 2024-TN10350). The NRC staff considers only evaluating this sensitivity analysis for SAMA-11 and SAMA-17 to be reasonable because the results for this sensitivity analysis are bounded by the results of the uncertainty analysis.

As discussed in Section F.2.2.4, VistraOps performed additional sensitivity analyses on MACCS input parameters for lower percentages of the population that are assumed to evacuate, for an earlier declaration of the general emergency, shorter plume durations, and earlier plume releases, for a quicker time for the population to take shelter, for higher and lower mixing layer heights, for higher rates of release of sensible heat, for a longer decontamination time and higher non-farm decontamination costs, and lower and higher plume release heights. No cost-beneficial SAMAs were identified as a result of these sensitivity analyses (Vistra 2024-TN10350). The ER shows that the sensitivity analysis for a longer decontamination time and higher non-farm decontamination costs had the most significant increase in the population dose and offsite economic risk (5.9 percent and 74 percent, respectively) of these sensitivity analyses. While VistraOps did not evaluate the impact on the benefit estimates for each SAMA candidate, the NRC staff finds the impact is bounded by the results of the uncertainty analysis.

As discussed in Section F.3.2, in response to NRC staff RAIs (Vistra 2024-TN10350), VistraOps provided a Phase II assessment of SAMA-5, “Install Curbs for Switchgear Rooms,” SAMA-6, “Install Flood Doors for Switchgear Rooms,” and SAMA-7, “Enhance DC Power for Internal Flooding.” The Phase II assessment was the same for each and assumed that all internal flooding risk in the Switchgear Rooms was eliminated. None of these SAMA candidates were determined to be cost-beneficial in the baseline analysis. VistraOps did not consider the impact of analysis uncertainties and the other sensitivity analyses (e.g., 3 percent discount rate) on the cost-benefit results for these three SAMA candidates. The NRC staff assessment is that a sensitivity analysis assuming a 3 percent discount rate or assuming a monetary equivalent of unit dose of $6,200 per person-rem would result in SAMA-5 and SAMA-6 being potentially cost-beneficial. Furthermore, the NRC staff assessment is that an uncertainty analysis assuming a multiplication factor of 3 based on the 95th percentile value of the Perry Plant internal events CDF would result in SAMA-5, SAMA-6, and SAMA-7 being potentially cost-beneficial. Based on this assessment, and that these SAMA candidates address the same contributions to internal flooding risk, the NRC staff suggests that SAMA-5, or SAMA-6, or SAMA-7 be considered for implementation since they are potentially cost-beneficial after consideration of sensitivity and uncertainty analyses. Since the three SAMAs address the same contributions to internal flooding risk, implementation of just one or two of these SAMAs may achieve most of the risk reduction.

The NRC staff concludes that the cost-benefit results provided by VistraOps are sufficient for use in the SAMA evaluation because the process and methodology for estimating the maximum benefit, and for performing uncertainty and sensitivity analyses, meets the guidance provided in NEI 05-01A (NEI 2005-TN1978), NUREG/BR–0184 (NRC 1997-TN676), and NUREG-1530 (NRC 2022-TN7859).

F.7 <u>Conclusions</u>

VistraOps considered 157 candidate SAMAs based on NRC and industry documentation of potential plant improvements, its review of SAMA analyses for other BWR plants, Perry Plant IPE and IPEEE assessments, and risk significant contributors at Perry Plant from plant-specific probabilistic safety assessment models. VistraOps explained that the list of SAMA candidates was significantly reduced by eliminating SAMAs that were not applicable to Perry Plant, had already been implemented at Perry Plant, or were combined into a more comprehensive or plant-specific SAMA. The remaining unscreened SAMA candidates were grouped into 12 SAMA candidate groups. Six of these SAMA candidates were screened out if the SAMA had an excessive implementation cost or if the SAMA was expected to have a very low benefit.

For these remaining SAMA candidates, VistraOps performed a cost-benefit analysis with results shown in Table F-6. In response to NRC staff RAIs (Vistra 2024-TN10350), VistraOps identified and performed a cost-benefit analysis for two additional SAMA candidates to reduce fire risk. The VistraOps cost-benefit analysis did not identify any potentially cost-beneficial SAMAs. Sensitivity cases were analyzed for the present value discount rate, the monetary equivalent of unit dose, uncertainty in the risk estimates, and the MACCS input parameters. No potentially cost-beneficial SAMAs were identified. However, the NRC staff suggests that SAMA-5, or SAMA-6, or SAMA-7 to reduce internal flooding risk in the Switchgear Rooms be considered for implementation since they are potentially cost-beneficial after consideration of sensitivity and uncertainty analyses.

The NRC staff reviewed the VistraOps SAMA analysis and concludes that, subject to the discussion in this appendix, the methods used and implementation of the methods were sound. Based on the applicant's treatment of SAMA benefits and costs, the NRC staff finds that the SAMA evaluations performed by VistraOps are reasonable and sufficient for the LR submittal.

The NRC staff generally agrees with VistraOps' conclusion that none of the candidate SAMAs are potentially cost beneficial, which was based on generally conservative treatment of costs, benefits, and uncertainties. The exception to this conclusion is that the NRC staff suggests SAMA-5, or SAMA-6, or SAMA-7 be considered for implementation since they are potentially cost-beneficial after consideration of sensitivity and uncertainty analyses. This conclusion of a small number of potentially cost-beneficial SAMAs is consistent with the low residual level of risk indicated in the Perry Plant PRA and the fact that VistraOps has already implemented many of the plant improvements identified from the IPE and IPEEE. Because the potentially cost-beneficial SAMAs identified by the NRC staff do not relate to aging management during the period of extended operation, the NRC recommends considering them under the current license and not as part of LR in accordance with 10 CRF Part 54.

F.8 <u>References</u>

10 CFR Part 50. *Code of Federal Regulations*, Title 10, *Energy*, Part 50, "Domestic Licensing of Production and Utilization Facilities." TN249.

ASME (American Society of Mechanical Engineers). 2005. Addendum B to ASME RA-S-2002, Standard for Level 1/Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications. ASME/ANS RA-Sb-2005, Washington, D.C. TN10374.

ASME/ANS (American Society of Mechanical Engineers/American Nuclear Society). 2009. Addenda to ASME/ANS RA-S-2008, Standard for Level 1/Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications. ASME/ANS RA-Sa-2009, Washington, D.C. TN6220.

ASME/ANS (American Society of Mechanical Engineers/American Nuclear Society). 2013. Case for to ASME/ANS RA-S-2013, Standard for Level 1/Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications. ASME/ANS RA-S CASE 1, Washington, D.C. TN10372.

Burke, R.P., D.C. Aldrich, and N.C. Rasmussen. 1984. *Economic Risks of Nuclear Power Reactor Accidents*. NUREG/CR-3673, Sandia National Laboratory, Albuquerque, New Mexico. ADAMS Accession No. ML103050360. TN10377.

CE (Centerior Energy Corporation). 1992. Letter from M.D. Lyster, Vice President, Nuclear, to NRC Document Control Desk, dated July 15, 1992, regarding "Perry Nuclear Power Plant, Docket No. 50-440, PNPP Level 2 PRA Submittal." Perry, Ohio. ADAMS Accession No. ML20102A253. TN10352.

CE (Centerior Energy Corporation). 1996. Letter from D.C. Shelton, Senior Vice President, Nuclear, to NRC Document Control Desk, dated July 22, 1996, regarding “Perry Nuclear Power Plant, Docket No. 50-440, Resubmittal of Individual Plant Examination - External Events.” Perry, Ohio. ADAMS Accession No. ML20115J972. TN10353.

EH (Energy Harbor). 2023. Appendix E, Applicant’s Environmental Report, License Renewal Stage, Perry Nuclear Power Plant Unit 1. Perry, Ohio. May. TN9536.

EPRI (Electric Power Research Institute). 1992. *Fire-Induced Vulnerability Evaluation (FIVE)*. TR-100370, Professional Loss Control, Inc., Palo Alto, CA. TN10380.

FENOC (FirstEnergy Nuclear Operating Company). 2016. Letter from F.R. Payne, General Plant Manager, Nuclear, to NRC Document Control Desk, dated March 24, 2016, regarding “Perry Nuclear Power Plant, Docket No. 50-440, License No. NPF-58, Revision of Flood Hazard Reevaluation Report in Response to 10 CFR 50.54(f) Regarding the Flooding Aspects of Recommendation 2.1 of the Near-Term Task Force (NTTF) Review of Insights from the Fukushima Dai-ichi Accident (TAC No. MF6099).” Perry, Ohio. ADAMS Accession No. ML16084A871. TN10354.

FENOC (FirstEnergy Nuclear Operating Company). 2017. Letter from F.R. Payne, General Plant Manager, Perry Nuclear Power Plant, to NRC Document Control Desk, dated July 24, 2017, regarding “Perry Nuclear Power Plant, Docket No. 50-440, License No. NPF-58, Mitigating Strategies Assessment (MSA) for Flooding (CAC No. MF6099).” ADAMS Accession No. ML17205A336. TN10356.

FENOC (FirstEnergy Nuclear Operating Company). 2017. Letter from D.B. Hamilton, Vice President, to NRC Document Control Desk, dated August 11, 2017, regarding “Perry Nuclear Power Plant, Docket No. 50-440, License No. NPF-58, Mitigating Strategies Assessment (MSA) Report for the Reevaluated Seismic Hazard Information – NEI 12-06, Appendix H, Revision 2, H.4.4 Path 4: GMRS < 2xSSE (CAC No. MF3729).” Perry, Ohio. ADAMS Accession No. ML17223A367. TN10355.

FENOC (FirstEnergy Nuclear Operating Company). 2019. Letter from F. Payne, Vice President, Perry Nuclear Power Plant, to NRC Document Control Desk, dated November 18, 2019, regarding “Perry Nuclear Power Plant, Docket No. 50-440, License No. NPF-58, Focused Evaluation Regarding Near-Term Task Force Recommendation 2.1 for Flooding.” Perry, Ohio. ADAMS Accession No. ML19323F020. TN10357.

NEI (Nuclear Energy Institute). 2005. *Severe Accident Mitigation Alternatives (SAMA) Analysis Guidance Document*. NEI-05-01, Revision A, Washington, D.C. ADAMS Accession No. ML060530203. TN1978.

NEI (Nuclear Energy Institute). 2017. Letter from V.K. Anderson, Senior Project Manager, to S. Rosenberg, NRC, dated February 21, 2017, regarding “Final Revision of Appendix X to NEI 05-04/07-12/12-16, Close-Out of Facts and Observations (F&Os).” Washington, D.C. ADAMS Accession No. ML17086A431. TN10358.

NRC (U.S. Nuclear Regulatory Commission). 1975. *Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants*. NUREG–75/087, Washington, DC. ADAMS Accession No. ML081510814. TN10359.

NRC (U.S. Nuclear Regulatory Commission). 1990. *Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants*. NUREG–1150, Washington, D.C. ADAMS Accession No. ML040140729. TN525.

NRC (U.S. Nuclear Regulatory Commission). 1991. *Individual Plant Examination of External Events (IPEEE) for Severe Accident Vulnerabilities - 10 CFR 50.54(f) (Generic Letter 88–20, Supplement 4).* Washington, DC. ADAMS Accession No. ML031150485. TN10360.

NRC (U.S. Nuclear Regulatory Commission). 1991. Procedural and Submittal Guidance for the Individual Plant Examination of External Events (IPEEE) for Severe Accident Vulnerabilities, Final Report. NUREG-1407, Washington, DC. ADAMS Accession No. ML063550238. TN10361.

NRC (U.S. Nuclear Regulatory Commission). 1997. *Individual Plant Examination Program: Perspectives on Reactor Safety and Plater Performance*. Volume 1, Part 1 Final Summary Report and Volume 2, Parts 2-5, Final Report, NUREG-1560, Washington D.C. TN7812. Nonpublic.

NRC (U.S. Nuclear Regulatory Commission). 1997. *Regulatory Analysis Technical Evaluation Handbook.* NUREG/BR–0184, Washington, D.C. ADAMS Accession No. ML050190193. TN676.

NRC (U.S. Nuclear Regulatory Commission). 2001. Letter from D.V. Pickett, to J.K. Wood, FirstEnergy Nuclear Operating Company, dated March 9, 2001, regarding “Perry Nuclear Power Plant, Unit 1 – Review of Individual Plant Examination of External Events (IPEEE) Submittal, (TAC No. M83569).” Washington, D.C. ADAMS Accession No. ML010850146. TN10381. Nonpublic.

NRC (Nuclear Regulatory Commission). 2003. Power Reactor Operating Licenses and Technical Specifications, Washington, D.C. ADAMS Accession No. ML101940006. TN8607.

NRC (U.S. Nuclear Regulatory Commission). 2009. *An Approach for Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed Activities*. Regulatory Guide 1.200, Revision 2, Washington, D.C. ADAMS Accession No. ML090410014. TN6211.

NRC (U.S. Nuclear Regulatory Commission). 2011. Memorandum from Chairman Jaczko to Commissioners Svinicki, Apostolakis, Magwood, and Ostendorff, dated March 21, 2011, regarding “NRC Actions Following the Events in Japan.” COMGBJ-11-0002, Washington, D.C. TN7448.

NRC (U.S. Nuclear Regulatory Commission). 2011. NRC Information Notice 2010–18:Generic Issue 199, Implications of Updated Probabilistic Seismic Hazard Estimates in Central and Eastern United States on Existing Plants. Washington, DC. ADAMS Accession No. ML112270223. TN10386.

NRC (U.S. Nuclear Regulatory Commission). 2012. “In the Matter of All Power Reactor Licensees and Holders of Construction Permits in the Active or Deferred Status. Order Modifying Licenses with Regard to Requirements For Mitigation Strategies For Beyond-Design-Basis External Events (Effective Immediately).” 7590-01-P, EA-12-049, NRC-2012-0068, Washington, D.C. ADAMS Accession No. ML12056A045. TN7947.

NRC (U.S. Nuclear Regulatory Commission). 2012. Letter from E. Leeds and M. Johnson to All Power Reactor Licensees and Holders of Construction Permits in Active or Deferred Status, dated March 12, 2012, regarding "Issuance of Order to Modify Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events." Washington, D.C. ADAMS Accession No. ML12054A735. TN3237.

NRC (U.S. Nuclear Regulatory Commission). 2012. Letter from E. Leeds to All Power Reactor Licensees and Holders of Construction Permits in Active or Deferred Status, dated March 12, 2012, regarding "Request for Information Pursuant to Title 10 of the *Code of Federal Regulations* 50.54(f) Regarding Recommendations 2.1, 2.3, and 9.3, of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident." Washington, D.C. ADAMS Accession No. ML12053A340. TN2198.

NRC (U.S. Nuclear Regulatory Commission). 2013. *Preparation of Environmental Reports for Nuclear Power Plant License Renewal Applications*. Regulatory Guide 4.2, Supplement 1, Revision 1, Washington, D.C. ADAMS Accession No. ML13067A354. TN4791.

NRC (U.S. Nuclear Regulatory Commission). 2014. Letter from E.A. Brown, Senior Project Manager, to E.J. Harkness, FirstEnergy Nuclear Operating Company, dated June 30, 2014, regarding "Perry Nuclear Power Plant, Unit 1 - Staff Assessment of the Flooding Walkdown Report Supporting Implementation of Near-Term Task Force Recommendation 2.3 Related to the Fukushima Dai-ichi Nuclear Power Plant Accident (TAC No. MF0263)." Washington, D.C. ADAMS Accession No. ML14141A460. TN10364.

NRC (U.S. Nuclear Regulatory Commission). 2014. Letter from E.A. Brown, Senior Project Manager, to E.J. Harkness, FirstEnergy Nuclear Operating Company, dated May 30, 2014, regarding "Perry Nuclear Power Plant, Unit 1 - Staff Assessment of the Seismic Walkdown Report Supporting Implementation of Near-Term Task Force Recommendation 2.3 Related to the Fukushima Dai-ichi Nuclear Power Plant Accident (TAC No. MF0159)." Washington, D.C. ADAMS Accession No. ML14115A234. TN10363.

NRC (U.S. Nuclear Regulatory Commission). 2015. Letter from T.V. Govan, Project Manager, to E.J. Harkness, FirstEnergy Nuclear Operating Company, dated August 3, 2015, regarding "Perry Nuclear Power Plant, Unit 1 - Staff Assessment of Information Provided Pursuant to Title 10 of the Code of Federal Regulations Part 50, Section 50.54(f), Seismic Hazard Reevaluations for Recommendation 2.1 of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident (TAC No. MF3729)." Washington, D.C. ADAMS Accession No. ML15208A034. TN10365.

NRC (U.S. Nuclear Regulatory Commission). 2015. *Tornado Missile Protection*. NRC Regulatory Issue Summary 2015-06. Washington, D.C. ADAMS Accession No. ML15020A419. TN10366.

NRC (U.S. Nuclear Regulatory Commission). 2016. "Memorandum and Order in the Matter of Entergy Nuclear Operations, Inc. (Indian Point Nuclear Generating Units 2 and 3)." CLI-16-07, Rockville, Maryland. ADAMS Accession No. ML16125A150. TN4631.

NRC (U.S. Nuclear Regulatory Commission). 2016. Letter from F. Vega, Project Manager, to D.B. Hamilton, Site Vice President, FirstEnergy Nuclear Operating Company, dated December 6, 2016, regarding "Perry Nuclear Power Plant, Unit 1 - Staff Review of Spent Fuel Pool Evaluation Associated with Reevaluated Seismic Hazard Implementing Near-Term Task Force Recommendation 2.1 (CAC No. MF3729)." Washington, D.C. ADAMS Accession No. ML16337A361. TN10367.

NRC (U.S. Nuclear Regulatory Commission). 2017. Letter from S. Wyman, Project Manager, to D.B. Hamilton, Site Vice President, FirstEnergy Nuclear Operating Company, dated August 23, 2017, regarding "Perry Nuclear Power Plant, Unit 1 - Staff Review High Frequency Confirmation Associated with Reevaluated Seismic Hazard Implementing Near-Term Task Force Recommendation 2.1." Washington, D.C. ADAMS Accession No. ML17234A646. TN10370.

NRC (U.S. Nuclear Regulatory Commission). 2017. Letter from M. Valentin, Project Manager, to D.B. Hamilton, Vice President, FirstEnergy Nuclear Operating Company, dated October 23, 2017, regarding "Perry Nuclear Power Plant, Unit 1 - Staff Review of Mitigation Strategies Assessment Report of the Impact of the Re-evaluated Seismic Hazard Developed in Response to the March 12, 2012, 50.54(f) Letter (CAC No. MF7861; EPID L-2016-JLD-0006)." Washington, D.C. ADAMS Accession No. ML17291A708. TN10371.

NRC (U.S. Nuclear Regulatory Commission). 2017. Letter from J. Giitter, Director, Division of Risk Assessment, and M.J. Ross-Lee, Director, Division of Operating Reactor Licensing, to G. Krueger, Director, Risk Regulation, Nuclear Energy Institute, dated May 3, 2017, regarding "U.S. Nuclear Regulatory Commission Acceptance on Nuclear Energy Institute Appendix X to Guidance 05-04, 07-12, and 12-13, Close-out of Facts and Observations (F&Os)." Washington, D.C. ADAMS Accession No. ML17079A427. TN10369.

NRC (U.S. Nuclear Regulatory Commission). 2017. Memorandum from Risk Informed Steering Committee, NRC, to S.L. Rosenberg, Branch Chief, dated May 1, 2017, regarding "U.S. Nuclear Regulatory Commission Staff Expectations for an Industry Facts and Observations Independent Assessment Process." Washington, D.C. ADAMS Accession No. ML17121A271. TN10368.

NRC (U.S. Nuclear Regulatory Commission). 2018. Letter from J.F. Uribe, Project Manager Integrated Program Management and Beyond-Design-Basis Management Branch Division of Operating Reactor Licensing Office of Nuclear Reactor Regulation, to D.B. Hamilton, FirstEnergy Nuclear Operating Company, Perry Nuclear Power Plant, dated January 24, 2018, regarding "Perry Nuclear Power Plant, Unit 1 - Staff Assessment and Summary Report for the Audit of the Response to 10 CFR 50.54(F) Information Request - Flood-Causing Mechanism Reevaluation (CAC No. MF6099; EPID L-2015-JLD-0004)." Washington, D.C. ADAMS Accession No. ML18002A555. TN10383.

NRC (U.S. Nuclear Regulatory Commission). 2018. Letter from J.F. Uribe, Project Manager Integrated Program Management and Beyond-Design-Basis Management Branch Division of Operating Reactor Licensing Office of Nuclear Reactor Regulation, to D.B. Hamilton, FirstEnergy Nuclear Operating Company, Perry Nuclear Power Plant, dated May 3, 2018, regarding "Perry Nuclear Power Plant, Unit 1- Flood Hazard Mitigation Strategies Assessment (CAC No. MF7960; EPID L-2016-JLD-0007)." Washington, D.C. ADAMS Accession No. ML18108A694. TN10385.

NRC (U.S. Nuclear Regulatory Commission). 2020. Letter from J.F. Uribe, Project Manager Integrated Program Management and Beyond-Design-Basis Management Branch Division of Operating Reactor Licensing Office of Nuclear Reactor Regulation, to F.R. Payne, Site Vice President, Energy Harbor Nuclear Corp., Perry Nuclear Power Plant, dated May 7, 2020, regarding “Perry Nuclear Power Plant, Unit 1 - Staff Assessment of Flooding Focused Evaluation (EPID NO. L-2019-JLD-0020).” Washington, D.C. ADAMS Accession No. ML20115E243. TN10383.

NRC (U.S. Nuclear Regulatory Commission). 2020. Letter from R.J. Bernardo, Project Manager, Integrated Program Management and BDB Branch, Division of Operating Reactor Licensing, Office of Nuclear Reactor Regulation, to Mr. F.R. Payne, Site Vice President, dated August, 17, 2020, regarding “Perry Nuclear Power Plant, Unit No. 1 - Documentation of the Completion of Required Actions Taken in Response to the Lessons Learned from the Fukushima Dai-Ichi Accident.” Washington, D.C. ADAMS Accession No. ML20219A129. TN9941.

NRC (U.S. Nuclear Regulatory Commission). 2022. *Reassessment of NRC’s Dollar Per Person-Rem Conversion Factor Policy, Final Report*. NUREG-1530, Washington, D.C. ADAMS Accession No. ML22053A025. TN7859.

NRC (U.S. Nuclear Regulatory Commission). 2024. Letter from L.J. Rakovan, Sr. Project Manager Environmental Review License Renewal Branch Division of Rulemaking, Environmental, and Financial Support Office of Nuclear Material Safety and Safeguards, to R.L. Penfield, Site Vice President, dated March 14, 2024, regarding “Perry Nuclear Power Plant Unit 1 - Summary of the January-February 2024 Environmental Audit Related to the Review of the License Renewal Application Environmental Report (EPID Number: L-2023-LNE-002).” Washington, D.C. ADAMS Accession No. ML24064A217. TN9935.

NRC (U.S. Nuclear Regulatory Commission). 2024. Second Round Request for Additional Information - Perry Nuclear Power Plant Unit 1 License Renewal Environmental Review. Washington, D.C. ADAMS Accession No. ML24190A080. TN10378.

SNL (Sandia National Laboratories). 1998. *Code Manual for MACCS2 User’s Guide*. NUREG/CR-6631, Volume 1, SAND97-0594, Washington, D.C. ADAMS Accession No. ML110030976. TN10382.

Vistra. 2024. Letter from R.L. Penfield, Site Vice President, to NRC Document Control Desk, dated May 16, 2024, regarding “Perry Nuclear Power Plant, Unit No. 1, Docket No. 50-440, License No. NPF-58, Response to Perry Nuclear Power Plant License Renewal Environmental Report Requests for Accident Mitigation Alternatives Requests for Additional Information and Request for Clarification (EPID No. L-2023-LNE-0002).” Perry, Ohio. ADAMS Accession No. ML24137A283. TN10350.

Vistra. 2024. Letter from R.L. Penfield, Site Vice President, to NRC Document Control Desk, dated August 15, 2024, regarding “Perry Nuclear Power Plant, Unit No. 1, Docket No. 50-440, License No. NPF-58, Response to Perry Nuclear Power Plant License Renewal Environmental Report Severe Accident Mitigation Alternatives 2nd Round Requests for Additional Information.” Perry, Ohio. ADAMS Accession No. ML24137A283. TN10351.

APPENDIX G

ENVIRONMENTAL ISSUES AND IMPACT FINDINGS CONTAINED IN THE FINAL RULE, 10 CFR PART 51, "ENVIRONMENTAL PROTECTION REGULATIONS FOR DOMESTIC LICENSING AND RELATED REGULATORY FUNCTIONS"

The U.S. Nuclear Regulatory Commission (NRC, the Commission) staff prepared this supplemental environmental impact statement (SEIS) in accordance with the NRC's environmental protection regulations in Title 10 of the *Code of Federal Regulations* (10 CFR) Part 51 (TN250), "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions," implement the National Environmental Policy Act of 1969, as amended (42 U.S.C. § 4321-TN8608) to evaluate the environmental impacts of license renewal (LR) of Perry Nuclear Power Plant Unit 1(Perry Plant) by Vistra Operations Company LLC (VistraOps). This SEIS supplements NUREG-1437, Generic Environmental Impact Statement for License Renewal of Nuclear Power Plants (NRC 1996-TN288, NRC 1999-TN289, NRC 2013-TN2654).

On August 6, 2024, the NRC published a final rule (88 FR 64166-TN10321) amending its environmental protection regulations in 10 CFR Part 51. Specifically, the rule updates the NRC's 2013 Generic Environmental Impact Statement for License Renewal of Nuclear Plants (LR GEIS) findings concerning the environmental impacts of renewing the operating license of a nuclear power plant. The technical basis for the rule is provided by Revision 2 to NUREG-1437, Generic Environmental Impact Statement for License Renewal of Nuclear Plants (the 2024 LR GEIS; NRC 2024-TN10161), which updates NUREG-1437, Revision 1 (the 2013 LR GEIS; NRC 2013-TN2654), which, in turn, was an update of NUREG-1437, Revision 0 (1996 LR GEIS; NRC 1996-TN288). The 2024 LR GEIS supports the revised list of National Environmental Policy Act (42 U.S.C. § 4321-TN8608) issues and associated environmental impact findings for LR to be contained in Table B-1 in Appendix B to Subpart A of 10 CFR Part 51. The 2024 LR GEIS and rule reflect lessons learned and knowledge gained from the NRC's conducting of environmental reviews for initial LR and subsequent LR since 2013.

The rule redefines the number and scope of the environmental issues that must be addressed by the NRC during LR environmental reviews. The rule identifies 80 environmental impact issues, 20 of which would require plant-specific analysis. The rule reclassifies some previously site-specific (Category 2) issues as generic (Category 1) issues and consolidates other issues. It also adds new Category 1 and Category 2 issues to Table B-1. These changes are summarized as follows:

- One Category 2 issue, "Groundwater quality degradation (cooling ponds at inland sites)," and a related Category 1 issue, "Groundwater quality degradation (cooling ponds in salt marshes)," were consolidated into a single Category 2 issue, "Groundwater quality degradation (plants with cooling ponds)."
- Two related Category 1 issues, "Infrequently reported thermal impacts (all plants)" and "Effects of cooling water discharge on dissolved oxygen, gas supersaturation, and eutrophication," and the thermal effluent component of the Category 1 issue, "Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses," were consolidated into a single Category 1 issue, "Infrequently reported effects of thermal effluents."

- One Category 2 issue, “Impingement and entrainment of aquatic organisms (plants with once-through cooling systems or cooling ponds),” and the impingement component of the Category 1 issue, “Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses,” were consolidated into a single Category 2 issue, “Impingement mortality and entrainment of aquatic organisms (plants with once-through cooling systems or cooling ponds).”
- One Category 1 issue, “Impingement and entrainment of aquatic organisms (plants with cooling towers),” and the impingement component of the Category 1 issue, “Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses,” were consolidated into a single Category 1 issue, “Impingement mortality and entrainment of aquatic organisms (plants with cooling towers).”
- One Category 2 issue, “Threatened, endangered, and protected species and essential fish habitat,” was divided into three Category 2 issues: (1) “Endangered Species Act: federally listed species and critical habitats under U.S. Fish and Wildlife jurisdiction,” (2) ”Endangered Species Act: federally listed species and critical habitats under National Marine Fisheries Service jurisdiction,” and (3) “Magnuson-Stevens Act: essential fish habitat.”
- Two new Category 2 issues, “National Marine Sanctuaries Act: sanctuary resources” and “Climate change impacts on environmental resources,” were added.
- One Category 2 issue, “Severe accidents,” was changed to a Category 1 issue.
- One new Category 1 issue, “Greenhouse gas impacts on climate change,” was added.
- Several issue titles and findings were revised to clarify their intended meanings.

To account for the final rule and 2024 LR GEIS, the NRC staff analyzed in this appendix their new and revised environmental issues as they may apply to the LR of Perry Plant. Table G-1 lists the new and revised environmental issues that apply to Perry Plant LR. The sections that follow discuss how the NRC staff addressed each of these new and revised issues in this SEIS and explains how this SEIS covers all the issues in the rule and 2024 LR GEIS.

Table G-1 New and Revised 10 CFR Part 51 License Renewal Environmental Issues Applicable to Perry Plant

Issue	2024 LR GEIS Section	Category
Infrequently reported effects of thermal effluents	4.6.1.2	1
Impingement mortality and entrainment of aquatic organisms (plants with cooling towers)	4.6.1.2	1
Endangered Species Act: federally listed species and critical habitats under U.S. Fish and Wildlife jurisdiction	4.6.1.3.1	2
Endangered Species Act: federally listed species and critical habitats under National Marine Fisheries Service jurisdiction	4.6.1.3.2	2
Magnuson-Stevens Act: essential fish habitat	4.6.1.3.3	2
National Marine Sanctuaries Act: sanctuary resources	4.6.1.3.4	2
Severe accidents	4.9.1.2.1	1
Greenhouse gas impacts on climate change	4.12.1	1
Climate change impacts on environmental resources	4.12.2	2

LR GEIS = license renewal generic environmental impact statement.

G.1 Infrequently Reported Effects of Thermal Effluents

The final rule combines two Category 1 issues, “Infrequently reported thermal impacts (all plants),” and “Effects of cooling water discharge on dissolved oxygen, gas supersaturation, and eutrophication,” and the thermal effluent component of the Category 1 issue, “Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses,” into one Category 1 issue, “Infrequently reported effects of thermal effluents.” This issue pertains to interrelated and infrequently reported effects of thermal effluents, including cold shock, thermal migration barriers, accelerated maturation of aquatic insects, and proliferated growth of aquatic nuisance species, as well as the effects of thermal effluents on dissolved oxygen, gas supersaturation, and eutrophication. This issue also considers sublethal stresses associated with thermal effluents that can increase the susceptibility of exposed organisms to predation, parasitism, or disease. These changes do not introduce any new environmental issues; rather, the proposed rule would reorganize existing issues. The changes are fully summarized and explained in Section 4.6.1.2 of the 2024 LR GEIS and in the proposed rule.

As indicated in Section 3.1 of this SEIS, the NRC staff did not identify any new and significant information associated with Category 1 issues that would change the conclusions of the LR GEIS. Therefore, consistent with the analysis and conclusions in the LR GEIS, the environmental impacts of the Category 1 issue of infrequently reported effects of thermal effluents are addressed in this SEIS and the NRC staff concludes that these impacts would be SMALL for the Perry Plant LR.

G.2 Impingement Mortality and Entrainment of Aquatic Organisms (Plants with Cooling Towers)

The final rule combines the Category 1 issue, “Impingement and entrainment of aquatic organisms (plants with cooling towers),” and the impingement component of the Category 1 issue, “Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses,” into one Category 1 issue, “Impingement mortality and entrainment of aquatic organisms (plants with cooling towers).” This issue pertains to impingement mortality and entrainment of finfish and shellfish at nuclear power plants with cooling systems that rely solely on cooling towers to dissipate heat. Plants with helper cooling towers that are seasonally operated to reduce thermal load to the receiving water body, reduce entrainment during peak spawning periods, or reduce consumptive water use during periods of low river flow, are addressed under the Category 2 issue, “Impingement and entrainment of aquatic organisms (plants with once-through cooling systems or cooling ponds).”

In the 2024 LR GEIS (NRC 2024-TN10161), the NRC renamed this issue to specify impingement mortality, rather than simply impingement. This change is consistent with the U.S. Environmental Protection Agency (EPA) 2014 Clean Water Act Section 316(b) (79 FR 48300-TN4488) regulations and the EPA’s assessment that impingement reduction technology is available, feasible, and has been demonstrated to be effective. Additionally, the EPA 2014 Clean Water Act Section 316(b) regulations establish best technology available standards for impingement mortality based on the fact that survival is a more appropriate metric for determining environmental impact rather than simply looking at total impingement. Therefore, the 2024 LR GEIS also consolidates the impingement component of the “Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses” issue for plants with once-through cooling systems or cooling ponds into this issue.

As indicated in Section 3.1 of this SEIS, the NRC staff did not identify any new and significant information associated with Category 1 issues that would change the conclusions of the LR GEIS. Therefore, consistent with the analysis and conclusions in the LR GEIS, the environmental impacts related to the Category 1 issue of impingement and entrainment of aquatic organisms (plants with cooling towers) are addressed in the SEIS and the NRC staff concludes that these impacts would be SMALL for the Perry Plant LR.

G.3 Endangered Species Act: Federally Listed Species and Critical Habitats Under U.S. Fish and Wildlife Jurisdiction

The final rule divides the Category 2 issue, "Threatened, endangered, and protected species and essential fish habitat," into three separate Category 2 issues for clarity and consistency with the separate Federal statues and interagency consultation requirements that the NRC must consider with respect to federally protected ecological resources. When combined, however, the scope of the three issues is the same as the scope of the former "Threatened, endangered, and protected species and essential fish habitat" issue discussed in the 2013 LR GEIS.

The first of the three issues, "Endangered Species Act: federally listed species and critical habitats under U.S. Fish and Wildlife jurisdiction," concerns the potential effects of continued nuclear power plant operation and any refurbishment during the LR term on federally listed species and critical habitats protected under the Endangered Species Act (ESA) and under the jurisdiction of the U.S. Fish and Wildlife Service (FWS).

Sections 3.8.1 and 3.8.4 of this SEIS address the impacts of the Perry Plant LR on federally listed species and critical habitats under FWS jurisdiction. The NRC staff determined that the proposed LR may affect but is not likely to adversely affect the northern long-eared bat, Indiana bat, tricolored bat, Great Lakes Distinct Population Segment of the piping plover, red knot, and monarch butterfly. Appendix C.1 describes the NRC staff's ESA consultation with the FWS. Therefore, the environmental issue of "Endangered Species Act: federally listed species and critical habitats under FWS jurisdiction" is addressed in the SEIS.

G.4 Endangered Species Act: Federally Listed Species and Critical Habitats Under National Marine Fisheries Service Jurisdiction

As explained in the previous section, the final rule divides the Category 2 issue, "Threatened, endangered, and protected species and essential fish habitat," into three separate Category 2 issues. The second of the three issues, "Endangered Species Act: federally listed species and critical habitats under National Marine Fisheries Service jurisdiction," concerns the potential effects of continued nuclear power plant operation and any refurbishment during the LR term on federally listed species and critical habitats protected under the ESA and under the jurisdiction of the National Marine Fisheries Service (NMFS).

Sections 3.8.1 and 3.8.4 of this SEIS find that no federally listed species or critical habitats under NMFS jurisdiction occur within the action area. Accordingly, the NRC staff concludes that the proposed action would have no effect on federally listed species or habitats under this agency's jurisdiction. Therefore, the environmental issue of "Endangered Species Act: federally listed species and critical habitats under National Marine Fisheries Service jurisdiction" is addressed in the SEIS.

G.5 Magnuson-Stevens Act: Essential Fish Habitat

As explained above, the final rule divides the Category 2 issue, “Threatened, endangered, and protected species and essential fish habitat,” into three separate Category 2 issues. The third of the three issues, “Magnuson-Stevens Act: essential fish habitat,” concerns the potential effects of continued nuclear power plant operation and any refurbishment during the LR term on essential fish habitat protected under Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. § 1801-TN9966).

Sections 3.8.2 and 3.8.4.6 of this SEIS find that no essential fish habitat occurs within the affected area. Accordingly, the NRC staff concludes that the proposed action would have no effect on Essential Fish Habitat. Therefore, the environmental issue of “Magnuson-Stevens Act: essential fish habitat” is addressed in the SEIS.

G.6 National Marine Sanctuaries Act: Sanctuary Resources

The final rule adds a new Category 2 issue, “National Marine Sanctuaries Act: sanctuary resources,” to evaluate the potential effects of continued nuclear power plant operation and any refurbishment during the LR term on sanctuary resources protected under the National Marine Sanctuaries Act (TN4482).

Under the National Marine Sanctuaries Act, the National Oceanic and Atmospheric Administration Office of National Marine Sanctuaries designates and manages the National Marine Sanctuary System. Marine sanctuaries may occur near nuclear power plants located on or near marine waters as well as the Great Lakes.

Sections 3.8.3 and 3.8.4.7 of this SEIS find that no national marine sanctuaries occur within the affected area. Accordingly, the NRC staff concludes that the proposed action would have no effect on sanctuary resources. Therefore, the environmental issue of “National Marine Sanctuaries Act: sanctuary resources” is addressed in the SEIS.

G.7 Severe Accidents

With respect to postulated accidents, the final rule amends Table B-1 in Appendix B to Subpart A of 10 CFR Part 51 (TN250) by reclassifying the Category 2 “Severe accidents” issue as a Category 1 issue. In the 2013 LR GEIS, the issue of severe accidents was classified as a Category 2 issue to the extent that only alternatives to mitigate severe accidents must be considered for all nuclear power plants where the licensee had not previously performed a severe accident mitigation alternatives (SAMA) analysis for the plant. In the 2024 LR GEIS, the NRC notes that this issue will be resolved generically for the vast majority, if not all, expected LR applicants because the applicants who will likely reference the 2024 LR GEIS have previously completed a SAMA analysis. However, a SAMA analysis has not previously been performed for the Perry Plant and so a SAMA analysis is performed in the SEIS.

Severe accidents, including the SAMA analysis, are addressed in Section 3.11.6.4 and Appendix F of this SEIS. Therefore, the environmental issue of severe accidents is addressed in the SEIS.

G.8 Greenhouse Gas Impacts on Climate Change

With respect to greenhouse gas (GHG) emissions and climate change, the final rule amends Table B-1 in Appendix B to Subpart A of 10 CFR Part 51 (TN250) by adding a new Category 1 issue "Greenhouse gas impacts on climate change." This new issue has an impact level of SMALL. This new issue considers GHG impacts on climate change from routine operations of nuclear power plants and construction vehicles and other motorized equipment for refurbishment activities. GHG emissions from routine operations of nuclear power plants are typically very minor because such plants, by their very nature, do not normally combust fossil fuels to generate electricity. However, nuclear power plant operations do have some GHG emission sources, including diesel generators, pumps, diesel engines, boilers, refrigeration systems, and electrical transmission and distribution systems, as well as mobile sources (e.g., worker vehicles and delivery vehicles). GHG emissions from construction vehicles and other motorized equipment for refurbishment activities would be intermittent and temporary, restricted to the refurbishment period. GHG emissions from continued operations and refurbishment activities are minor. The issue of GHG impacts on climate change associated with nuclear power plant operations was not identified as either a generic or plant-specific issue in the 1996 LR GEIS and the 2013 LR GEIS. In the 2013 LR GEIS, however, the NRC staff presented GHG emission factors associated with the nuclear power life cycle. Following the issuance of CLI-09-21 (NRC 2009-TN6406), the NRC began to evaluate the effects of GHG emissions in plant-specific environmental reviews for LRAs. Accordingly, Section 3.15.3.1 of this SEIS evaluates GHG emissions associated with the operation of Perry Plant during the LR term. Table 3-35 of this SEIS presents quantified annual GHG emissions from sources at Perry Plant. Perry Plant's direct GHG emissions result from onsite stationary and portable combustion. Indirect emission sources include those from commuting activities of the workforce commuting.

VistraOps has no plans to conduct refurbishment during the Perry Plant LR term and, therefore, no GHG emissions from refurbishment or increases in GHG emissions from routine operations at Perry Plant are anticipated. The NRC staff concludes that there would be no impacts on climate change beyond the impacts discussed in the 2024 LR GEIS and in Table B-1 in Appendix B to Subpart A of 10 CFR Part 51 (TN250) of the final rule (89 FR 64166-TN10321). Based on this information, the NRC staff concludes that GHG impacts on climate change for the Perry Plant LR term would be SMALL. Therefore, the environmental issue of GHG impacts on climate change are addressed.

G.9 Climate Change Impacts on Environmental Resources

With respect to climate change, the final rule amends Table B-1 in Appendix B to Subpart A of 10 CFR Part 51 (TN250) by adding the new Category 2 issue "Climate change impacts on environmental resources." This new issue considers the additive effects of climate change on environmental resources that may also be directly affected by continued operations and refurbishment during the LR term. The effects of climate change can vary regionally and climate change information at the regional and local scale is necessary to assess trends and the impacts on the human environment for a specific location. The impacts of climate change on environmental resources during the LR term are location-specific and cannot be evaluated generically.

The issue of climate change impacts was not identified as either a generic or plant-specific issue in the 1996 LR GEIS and the 2013 LR GEIS. However, the 2013 LR GEIS described the environmental impacts that could occur on resource areas (land use, air quality, water resources, etc.) that may also be affected by LR. In plant-specific initial LR and subsequent LR environmental reviews prepared since the development of the 2013 LR GEIS, the NRC staff has considered projected differences in climate changes in the United States and climate change impacts on the resource areas that could be incrementally affected by the proposed action as part of its cumulative impacts analysis. Accordingly, Section 3.15.3.7 of this SEIS discusses the observed changes in climate and the potential future climate change across Midwest and Great Lakes region of the United States during the Perry Plant LR term based on climate model simulations under future global GHG emissions scenarios. The NRC staff considered regional projected climate changes from numerous climate assessment reports, including the U.S. Global Change Research Program, the Intergovernmental Panel on Climate Change, and the EPA. Furthermore, in Section 3.15.3.7 of this SEIS the NRC staff evaluated the impacts of climate change on environmental resources (air quality, and water resources) where there are incremental impacts due to the Perry Plant LR.

G.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." TN250.

79 FR 48300. August 15, 2014. "National Pollutant Discharge Elimination System—Final Regulations to Establish Requirements for Cooling Water Intake Structures at Existing Facilities and Amend Requirements at Phase I Facilities." *Federal Register*, Environmental Protection Agency. TN4488.

89 FR 64166. August 6, 2024. "Renewing Nuclear Power Plant Operating Licenses - Environmental Review." Final rule and guidance; issuance, *Federal Register*, Nuclear Regulatory Commission. TN10321.

16 U.S.C. § 1801 *et seq*. Conservation, Chapter 38, "Fishery Conservation and Management." TN9966.

42 U.S.C. § 4321 *et seq*. U.S. Code Title 41, The Public Health and Welfare, Section 4321 "Congressional Declaration of Purpose." TN8608.

National Marine Sanctuaries Act, as amended. 16 U.S.C. § 1431 *et seq*. TN4482.

NRC (U.S. Nuclear Regulatory Commission). 1996. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*. Volumes 1 and 2, NUREG-1437, Washington, D.C. ADAMS Accession Nos. ML040690705, ML040690738. TN288.

NRC (U.S. Nuclear Regulatory Commission). 1999. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants Addendum to Main Report, NUREG–1437, Volume 1, Addendum 1.* Washington, D.C. ADAMS Accession No. ML040690720. TN289.

NRC (U.S. Nuclear Regulatory Commission). 2009. "Memorandum and Order in the Matter of Duke Energy Carolinas, LLC (Combined License Application for William States Lee III Nuclear Station, Units 1 and 2) and Tennessee Valley Authority (Bellefonte Nuclear Power Plant, Units 3 and 4)." CLI-09-21, Rockville, Maryland. ADAMS Accession No. ML093070690. TN6406.

NRC (U.S. Nuclear Regulatory Commission). 2013. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*. NUREG-1437, Revision 1, Washington, D.C. ADAMS Package Accession No. ML13107A023. TN2654.

NRC (U.S. Nuclear Regulatory Commission). 2024. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*. NUREG-1437, Volume 1-3, Revision 2, Washington, D.C. ADAMS Accession No. ML24087A133. TN10161.

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 61
2. TITLE AND SUBTITLE Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Supplement 61, Regarding License Renewal of Perry Nuclear Power Plant Draft Report for Comment	3. DATE REPORT PUBLISHED MONTH: August — YEAR: 2024 4. FIN OR GRANT NUMBER
5. AUTHOR(S) See Chapter 6	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 Rulemaking, Environmental, and Financial Support
Office of Nuclear Material Safety and Safeguards
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 Nos. 50-269, 50-270, 50-287

11. ABSTRACT (200 words or less)

The U.S. Nuclear Regulatory Commission (NRC) prepared this supplemental environmental impact statement (SEIS) in response to Energy Harbor Nuclear Corp.'s application to renew the operating license for Perry Nuclear Power Plant, Unit 1 (Perry Plant), for an additional 20 years. Since submittal of the license application, the direct and indirect transfer of control of Perry Plant has been transferred to Vistra Operations Company, LLC. This SEIS evaluates the environmental impacts of the proposed action and alternatives to the proposed action. Alternatives considered include: (1) natural gas-fired combined-cycle, (2) renewable and natural gas combination, and (3) not renewing the operating license (the no-action alternative). The NRC staff's preliminary recommendation is that Perry Plant license renewal is a reasonable option for energy planning decision-makers.

12. KEY WORDS/DESCRIPTORS (List words or phrases that will assist researchers in locating the report.)	13. AVAILABILITY STATEMENT
Vistra Operations Company Perry Nuclear Power Plant, Unit 1 Perry Plant, Unit 1 Perry Draft Environmental Impact Statement National Environmental Policy Act (NEPA)	unlimited 14. SECURITY CLASSIFICATION *(This Page)* unclassified *(This Report)* unclassified 15. NUMBER OF PAGES 16. PRICE

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, DC 20555-0001

OFFICIAL BUSINESS

@NRCgov

NUREG-1437
Supplement 61, Draft
Report for Comment

Generic Environmental Impact Statement for License Renewal of Nuclear Plants
Supplement 61, Regarding License Renewal of Perry Nuclear Power Plant

August 2024