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United States Nuclear Regulatory Commission
Protecting People and the Environment

NUREG-1437, Volume 2
Revision 2

Generic Environmental Impact Statement for License Renewal of Nuclear Plants

Comment Response Document

Final Report

Office of Nuclear Material Safety and Safeguards

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ABSTRACT

U.S. Nuclear Regulatory Commission (NRC) regulations allow for the renewal of commercial nuclear power plant operating licenses. There are no specific limitations in the Atomic Energy Act or the NRC's regulations restricting the number of times a license may be renewed. To support license renewal environmental reviews, the NRC published the first *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (LR GEIS) in 1996. Per NRC regulations, a review and update of the LR GEIS is conducted every 10 years, if necessary. The proposed action is the renewal of nuclear power plant operating licenses.

Since publication of the 1996 LR GEIS, 59 nuclear power plants (96 reactor units) have undergone license renewal environmental reviews and have received renewed licenses (either an initial license renewal [initial LR] or subsequent license renewal [SLR]), the results of which were published as supplements to the LR GEIS. This revision evaluates the issues and findings of the 2013 LR GEIS (Revision 1). Lessons learned and knowledge gained from initial LR and SLR environmental reviews provide an important source of new information for this assessment. In addition, new research, findings, public comments, changes in applicable laws and regulations, and other information were considered in evaluating the environmental impacts associated with license renewal. Additionally, this revision fully considers and evaluates the environmental impacts of initial LR and one term of SLR.

The purpose of the LR GEIS is to identify and evaluate environmental issues for license renewal and determine which could result in the same or similar impact at all nuclear power plants or a specific subset of plants (i.e., generic issues) and which issues could result in different levels of impact.

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ACRONYMS, ABBREVIATIONS, AND CHEMICAL NOMENCLATURE

ADAMS	Agencywide Documents Access and Management System
AEA	Atomic Energy Act
AEC	U.S. Atomic Energy Commission
ALARA	as low as is reasonably achievable
APE	area of potential effect
BCG	Biota Concentration Guide
BEIR	Biological Effects of Ionizing Radiation (National Research Council Committee)
BMP	best management practice
BTA	best technology available
Btu	British thermal unit(s)
BWR	boiling water reactor
CAA	Clean Air Act
CCS	cooling canal system
CDC	Centers for Disease Control and Prevention
CDF	core damage frequency
CEQ	Council on Environmental Quality
CFR	*Code of Federal Regulations*
CH_4	methane
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
CWA	Clean Water Act
dB	decibel(s)
dBA	A-weighted decibel(s)
DOE	U.S. Department of Energy
DPS	distinct population segment
DSM	demand-side management
EFH	essential fish habitat
EI	exposure index
EIA	Energy Information Administration
EIS	environmental impact statement
EMF	electromagnetic field
EPA	U.S. Environmental Protection Agency
EPRI	Electric Power Research Institute
EPU	extended power uprate
ESA	Endangered Species Act

FLEX	flexible coping strategies
FPRA	fire probabilistic risk assessment
FR	*Federal Register*
FWS	U.S. Fish and Wildlife Service
GEIS	generic environmental impact statement
GHG	greenhouse gas
gpm	gallon(s) per minute
GTCC	greater-than-Class C
GWd	gigawatt day(s)
GWd/MT	Gigawatt-days (units of energy) per metric tonne
H_2O	water; water vapor
HAPC	habitat areas of particular concern
HLW	high-level waste
hr	hour(s)
Hz	hertz
ICRP	International Commission on Radiological Protection
IM&E	impingement mortality and entrainment
initial LR	initial license renewal
IPE	Individual Plant Examination
IPEEE	Individual Plant Examination of External Events
ISFSI	independent spent fuel storage installation
Kd	partition coefficient
km	kilometer(s)
kV	kilovolt(s)
kW	kilowatt(s)
kWh	kilowatt-hour(s)
L	liter(s)
LAR	license amendment request
lb	pound(s)
LCF	latent cancer fatality
LERF	large early release frequency
LLW	low-level (radioactive) waste
Ln	statistical sound level
LOOP	loss of offsite power
lpm	liter(s) per minute
LR GEIS	*Generic Environmental Impact Statement for License Renewal of Nuclear Plants*
LWR	light water reactor

m	meter(s)
m^2	square meter(s)
m^3	cubic meter(s)
m^3/s	cubic meter(s) per second
mA	milliampere(s)
MACCS	MELCOR Accident Consequence Code System
MCR	main cooling reservoir
MEI	maximally exposed individual
mG	milligauss
mg	milligram(s)
mg/L	milligram(s) per liter
Mgd	million gallons per day
mGy	milligray(s)
MHz	megahertz
mi	mile(s)
min	minute(s)
mL	milliliter(s)
MLd	million liters per day
MMBtu	million Btu
MPa	megapascal(s)
mph	mile(s) per hour
mrad	millirad(s)
mrem	millirem(s)
MSA	Magnuson-Stevens Fishery Conservation and Management Act
mSv	millisievert(s)
MT	metric tonne(s)
mT	millitesla(s)
MTHM	metric tonne(s) of heavy metal
MTU	metric tonne(s) of uranium
MW	megawatt(s)
MWe	megawatt(s) electric
MWt	megawatt(s) thermal
MWh	megawatt-hour(s)
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act of 1969
NGCC	natural gas combined cycle
NHPA	National Historic Preservation Act of 1966
NMFS	National Marine Fisheries Service
NMSA	National Marine Sanctuaries Act
NO	nitrogen oxide
NO_2	nitrogen dioxide
NOAA	National Oceanic and Atmospheric Administration
NO_x	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission

NREL	National Renewable Energy Laboratory
NRHP	National Register of Historic Places
NTTF	Near-Term Task Force
ONMS	Office of National Marine Sanctuaries
OSHA	Occupational Safety and Health Administration
pCi	picocurie(s)
pCi/L	picocuries per liter
PDR	population dose risk
PM	particulate matter
PM_{10}	particulate matter with a mean aerodynamic diameter of 10 μm or less
$PM_{2.5}$	particulate matter with a mean aerodynamic diameter of 2.5 μm or less
ppm	part(s) per million
ppmv	parts per million by volume
ppt	part(s) per thousand
PSHA	probabilistic seismic hazard assessment
PRA	probabilistic risk assessment
PSD	prevention of significant deterioration
psi	pound(s) per square inch
PWR	pressurized water reactor
QHO	quantitative health objective
RCRA	Resource Conservation and Recovery Act of 1976
rem	roentgen-equivalent-man
REMP	Radiological Environmental Monitoring Program
ROW	right-of-way
RY	reactor year
s	second(s)
SAMA	severe accident mitigation alternative
SAMDA	severe accident mitigation design alternative
SAMG	severe accident management guideline
SBO	station blackout
SCDF	seismic core damage frequency
scf	standard cubic foot (feet)
SEIS	supplemental environmental impact statement
SFP	spent fuel pool
SLR	subsequent license renewal
SO_2	sulfur dioxide
SOARCA	state-of-the-art reactor consequence analysis
SPRA	seismic probabilistic risk assessment
SRM	Staff Requirements Memorandum
SST	siting source term
Sv	sievert(s)

T	ton(s)
TDS	total dissolved solids
TEDE	total effective dose equivalent
T/yr	ton(s) per year
UA	uncertainty analysis
UCB	upper confidence bound
UF_6	uranium hexafluoride
U.S.	United States
USACE	U.S. Army Corps of Engineers
VOC	volatile organic compound
yr	year(s)
µCi	microcurie(s)
µGy	microgray(s)

SHORTENED NUCLEAR POWER PLANT NAMES USED IN THIS REPORT

Arkansas	Arkansas Nuclear One
Beaver Valley	Beaver Valley Power Station
Braidwood	Braidwood Station
Browns Ferry	Browns Ferry Nuclear Plant
Brunswick	Brunswick Steam Electric Plant
Byron	Byron Station
Callaway	Callaway Plant
Calvert Cliffs	Calvert Cliffs Nuclear Power Plant
Catawba	Catawba Nuclear Station
Clinton	Clinton Power Station
Columbia	Columbia Generating Station
Comanche Peak	Comanche Peak Nuclear Power Plant
Cooper	Cooper Nuclear Station
Crystal River	Crystal River Nuclear Power Plant
Davis-Besse	Davis-Besse Nuclear Power Station
Diablo Canyon	Diablo Canyon Power Plant
D.C. Cook	Donald C. Cook Nuclear Plant
Dresden	Dresden Nuclear Power Station
Duane Arnold	Duane Arnold Energy Center
Farley	Joseph M. Farley Nuclear Plant
Fermi	Enrico Fermi Atomic Power Plant
FitzPatrick	James A. FitzPatrick Nuclear Power Plant
Fort Calhoun	Fort Calhoun Station
Ginna	R.E. Ginna Nuclear Power Plant
Grand Gulf	Grand Gulf Nuclear Station
Harris	Shearon Harris Nuclear Power Plant
Hatch	Edwin I. Hatch Nuclear Plant
Hope Creek	Hope Creek Generating Station
Indian Point	Indian Point Energy Center
Kewaunee	Kewaunee Power Station
LaSalle	LaSalle County Station
Limerick	Limerick Generating Station
McGuire	McGuire Nuclear Station
Millstone	Millstone Power Station
Monticello	Monticello Nuclear Generating Plant
Nine Mile Point	Nine Mile Point Nuclear Station
North Anna	North Anna Power Station
Oconee	Oconee Nuclear Station
Oyster Creek	Oyster Creek Nuclear Generating Station
Palisades	Palisades Nuclear Plant
Palo Verde	Palo Verde Nuclear Generating Station
Peach Bottom	Peach Bottom Atomic Power Station

Perry	Perry Nuclear Power Plant
Pilgrim	Pilgrim Nuclear Power Station
Point Beach	Point Beach Nuclear Plant
Prairie Island	Prairie Island Nuclear Generating Plant
Quad Cities	Quad Cities Nuclear Power Station
River Bend	River Bend Station
Robinson	H.B. Robinson Steam Electric Plant
St. Lucie	St. Lucie Nuclear Plant
Salem	Salem Nuclear Generating Station
San Onofre	San Onofre Nuclear Generating Station
Seabrook	Seabrook Station
Sequoyah	Sequoyah Nuclear Plant
South Texas	South Texas Project Electric Generating Station
Summer	Virgil C. Summer Nuclear Station
Surry	Surry Power Station
Susquehanna	Susquehanna Steam Electric Station
Three Mile Island	Three Mile Island, Unit 1
Turkey Point	Turkey Point Nuclear Plant
Vermont Yankee	Vermont Yankee Nuclear Power Station
Vogtle	Vogtle Electric Generating Plant
Waterford	Waterford Steam Electric Station
Watts Bar	Watts Bar Nuclear Plant
Wolf Creek	Wolf Creek Generating Station

CONVERSION TABLE

Multiply	By	To Obtain
To Convert English to Metric Equivalents		
acres (ac)	0.4047	hectares (ha)
cubic feet (ft^3)	0.02832	cubic meters (m^3)
cubic yards (yd^3)	0.7646	cubic meters (m^3)
curies (Ci)	3.7×10^{10}	becquerels (Bq)
degrees Fahrenheit (°F) -32	0.5555	degrees Celsius (°C)
feet (ft)	0.3048	meters (m)
gallons (gal)	3.785	liters (L)
gallons (gal)	0.003785	cubic meters (m^3)
inches (in.)	2.540	centimeters (cm)
miles (mi)	1.609	kilometers (km)
pounds (lb)	0.4536	kilograms (kg)
rads	0.01	grays (Gy)
rems	0.01	sieverts (Sv)
short tons (tons)	907.2	kilograms (kg)
short tons (tons)	0.9072	metric tons (t)
square feet (ft^2)	0.09290	square meters (m^2)
square yards (yd^2)	0.8361	square meters (m^2)
square miles (mi^2)	2.590	square kilometers (km^2)
yards (yd)	0.9144	meters (m)
To Convert Metric to English Equivalents		
becquerels (Bq)	2.7×10^{-11}	curies (Ci)
centimeters (cm)	0.3937	inches (in.)
cubic meters (m^3)	35.31	cubic feet (ft^3)
cubic meters (m^3)	1.308	cubic yards (yd^3)
cubic meters (m^3)	264.2	gallons (gal)
degrees Celsius (°C) +17.78	1.8	degrees Fahrenheit (°F)
grays (Gy)	100	rads
hectares (ha)	2.471	acres
kilograms (kg)	2.205	pounds (lb)
kilograms (kg)	0.001102	short tons (tons)
kilometers (km)	0.6214	miles (mi)
liters (L)	0.2642	gallons (gal)
meters (m)	3.281	feet (ft)
meters (m)	1.094	yards (yd)
metric tons (t)	1.102	short tons (tons)
sieverts (Sv)	100	rems
square kilometers (km^2)	0.3861	square miles (mi^2)
square meters (m^2)	10.76	square feet (ft^2)
square meters (m^2)	1.196	square yards (yd^2)

EXECUTIVE SUMMARY

The Atomic Energy Act of 1954 authorizes the U.S. Nuclear Regulatory Commission (NRC) to issue licenses to operate commercial nuclear power plants for up to 40 years and permits the renewal of these licenses. By regulation, the NRC is allowed to renew these licenses for up to an additional 20 years, depending on the outcome of safety and environmental reviews. There are no specific limitations in the Atomic Energy Act or the NRC's regulations restricting the number of times a license may be renewed.

NRC regulations in Title 10 of the *Code of Federal Regulations* Section 54.17(c) (10 CFR 54.17(c)) allow a license renewal application to be submitted within 20 years of license expiration, and NRC regulations at 10 CFR 54.31(b) specify that a renewed license will be for a term of up to 20 years plus the length of time remaining on the current license. As a result, renewed licenses may be for a term of up to 40 years.

The license renewal process is designed to ensure safe operation of the nuclear power plant and protection of the environment during the license renewal term. Under the NRC's environmental protection regulations in 10 CFR Part 51, which implements Section 102(2) of the National Environmental Policy Act (NEPA), the renewal of a nuclear power plant operating license requires an analysis of the environmental effects (impacts) of the action and the preparation of an environmental impact statement (EIS).

To support the preparation of license renewal EISs, the NRC conducted a comprehensive review to identify the environmental effects of license renewal. The review determined which environmental effects could result in the same or similar (generic) impact at all nuclear power plants or a specific subset of plants, and which effects could result in different levels of impact, requiring nuclear power plant-specific analyses for an impact determination. The review culminated in the issuance of the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (LR GEIS), NUREG-1437, in May 1996, followed by the publication of the final rule that codified the LR GEIS findings on June 5, 1996 (61 *Federal Register* [FR] 28467).[1]

The 1996 LR GEIS[2] improved the efficiency of the license renewal environmental review process by (1) identifying and evaluating all of the environmental effects that may occur when renewing commercial nuclear power plant operating licenses, (2) identifying and evaluating the environmental effects that are expected to be generic (the same or similar) at all nuclear plants or a specific subset of plants, and (3) defining the number and scope of the environmental effects that need to be addressed in nuclear power plant-specific EISs. For the issues that cannot be evaluated generically, the NRC conducts nuclear power plant-specific (hereafter called plant-specific) environmental reviews and prepares plant-specific supplemental EISs (SEISs) to the LR GEIS. The generic environmental findings in the LR GEIS are applicable to the 20-year license renewal increment plus the number of years remaining on the current license, up to a maximum of 40 years.

The 1996 final rule codified the findings of the 1996 LR GEIS into regulations at 10 CFR Part 51, Appendix B to Subpart A, "Environmental Effect of Renewing the Operating License of

[1] Final rules were also issued on December 18, 1996 (61 FR 66537), and September 3, 1999 (64 FR 48496).

[2] Any reference to the 1996 LR GEIS includes the two-volume set published in May 1996 and Addendum 1 to the LR GEIS published in August 1999.

a Nuclear Power Plant," and Table B-1, "Summary of Findings on NEPA Issues for License Renewal of Nuclear Power Plants" (61 FR 28467, June 5, 1996). As stated in the final rule, the Commission recognized that environmental issues might change over time and that additional issues may need to be considered. Based on this recognition, and as further stated in the rule and in the introductory paragraph to Appendix B to Subpart A in Part 51 of the regulations, the Commission intends to review the material in Appendix B, including Table B-1 and the underlying LR GEIS, on a 10-year basis, and update it if necessary.

Subsequently, the NRC completed its first 10-year review of the 1996 LR GEIS and Table B-1 on June 20, 2013. That review of the LR GEIS considered lessons learned and knowledge gained from completed license renewal environmental reviews since 1996. The updated LR GEIS, Revision 1, and final rule (78 FR 37282), including Table B-1, redefined the number and scope of the NEPA issues that must be addressed in license renewal environmental reviews.

The NRC began the second 10-year review on August 4, 2020, by publishing a notice of intent to review and potentially update the LR GEIS approximately 7 years after the last revision cycle (see 85 FR 47252). For further information regarding the review and update of this LR GEIS see Section 1.6. As part of this review and update, the following activities occurred:

- NRC staff conducted a series of public scoping meetings in August 2020 (see 85 FR 47252 for more details). The scoping period concluded on November 2, 2020.
- NRC staff submitted a rulemaking plan in July 2021 requesting Commission approval to initiate a rulemaking to amend Table B-1 and update the LR GEIS and associated guidance.
- In February 2022, the Commission directed the NRC staff to develop a new rulemaking plan that would update the LR GEIS to fully account for subsequent license renewal (SLR) in light of recent Commission adjudicatory decisions.
- NRC staff submitted a revised rulemaking plan in March 2022.
- In April 2022, the Commission approved the staff's recommendation to proceed with the rulemaking.
- NRC staff submitted the proposed rule package and draft revised LR GEIS to the Commission for its review on December 6, 2022.
- On January 23, 2023, the Commission approved publication of the proposed rule in the *Federal Register* for a 60-day comment period.
- NRC staff published the proposed rule, draft LR GEIS, and associated guidance for public comment in the *Federal Register* on March 3, 2023 (88 FR 13329).
- NRC staff conducted a series of public meetings in March and April 2023 to take comment on the proposed rule package.

The revisions to the LR GEIS are based on the consideration of (1) comments received from the public during the public scoping period, (2) a review of comments received on plant-specific SEISs, (3) lessons learned and knowledge gained from previously completed and ongoing initial license renewal (initial LR) and SLR environmental reviews, (4) Commission direction, and (5) comments received from the public and other stakeholders on the draft LR GEIS and proposed rule. In addition, new scientific research, public comments, changes in environmental regulations and impacts methodology, and other new information were considered in evaluating the potential impacts associated with nuclear power plant continued operations and refurbishment during the initial LR term or SLR.

Changes made in response to comments in this final LR GEIS, as well as changes made to include updated information, corrections, and substantial editorial revisions, are marked with a change bar (vertical line) on the side margin of the page where the changes or additions were made. Minor editorial revisions and those limited to formatting are not marked. The NRC also made several targeted text changes that are not marked, which included the removal of duplicative text and organizational changes to this LR GEIS to address changes to NEPA from the Fiscal Responsibility Act of 2023.

The purpose of the review for this LR GEIS was to determine if the findings presented in the 2013 LR GEIS remain valid for initial LR and support the scope of license renewal, consider whether those findings also apply to SLR, and to update or revise those findings as appropriate. When conducting a thorough update to the LR GEIS that reflects the "hard look" that is required for a NEPA document, the NRC considered changes in applicable laws and regulations, new data in its possession from scientific literature and nuclear power plant operations, collective experience, and lessons learned and knowledge gained from conducting initial LR and SLR environmental reviews since development of the 2013 LR GEIS. The NRC also considered comments received on the draft LR GEIS and proposed rule (see Section 1.10) in finalizing this LR GEIS. As a result of the NRC's review and update, the NRC identified 80 environmental issues for inclusion in revised Table B-1. They include 59 issues which were determined to be same or similar impact at all nuclear power plants or a specific subset of plants (i.e., generic issues, Category 1); 20 issues which require a plant-specific analysis (Category 2); and one issue that remains uncategorized.

S.1 Purpose and Need for the Proposed Action

The proposed action is the renewal of commercial nuclear power plant operating licenses. A renewed license is just one of a number of conditions that licensees must meet to be allowed to continue to operate the nuclear power plant during the renewal term.

The purpose and need for the proposed action (license renewal) is to provide an option that allows for baseload 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 State, utility, system, and, where authorized, Federal (other than NRC) decisionmakers. Except to the extent that findings in the safety review required by the Atomic Energy Act or in the environmental review could lead the NRC to not renew the operating license, the NRC has no role in the energy-planning decisions of power plant owners, State regulators, system operators, and, in some cases, other Federal agencies as to whether the nuclear power plant should continue to operate.

In addition, the NRC has no authority or regulatory control over the ultimate selection of replacement energy alternatives. The NRC also cannot ensure the selection of environmentally preferable replacement power alternatives. While a range of reasonable replacement energy alternatives are discussed in the LR GEIS, and evaluated in detail in plant-specific supplements to the LR GEIS, the only alternative to license renewal within NRC's decisionmaking authority is to not renew the operating license. The environmental impacts of not renewing the operating license are addressed under the no action alternative.

At some point, all nuclear power plants will terminate reactor operations and begin the decommissioning process. Under the no action alternative, reactor operations would be terminated at or before the end of the current operating license. The no action alternative, unlike the other alternatives, does not expressly meet the purpose and need of the proposed action

(license renewal), because it does not provide an option for energy-planning decisionmakers in meeting future electric power system needs. No action, on its own, would likely create a need for replacement power, energy conservation and efficiency (demand-side management), purchasing power from outside the region, or some combination of these options. Thus, a range of reasonable replacement energy alternatives is described in the LR GEIS, including fossil fuel, new nuclear, and renewable energy sources. Conservation and power purchasing are also considered as replacement energy alternatives to license renewal because they represent other options for electric power system planners.

S.2 Development of the Revised Generic Environmental Impact Statement

This LR GEIS documents the results of the systematic approach the NRC used to evaluate the environmental effects (impacts) of renewing the operating licenses of commercial nuclear power plants. The environmental consequences of both initial LR and SLR include (1) impacts associated with continued operations and any refurbishment activities similar to those that have occurred during the current license term; (2) impacts of various alternatives to the proposed action; (3) impacts from the termination of nuclear power plant operations and decommissioning after the license renewal term (with emphasis on the incremental effect caused by an additional 20 years of operation); (4) impacts associated with the uranium fuel cycle; (5) impacts of postulated accidents; (6) cumulative effects of the proposed action; and (7) resource commitments associated with the proposed action, including unavoidable adverse impacts, relationship between short-term use and long-term productivity, and irreversible and irretrievable commitment of resources. The LR GEIS also discusses the impacts of various reasonable alternatives to the proposed action (initial LR or SLR). The environmental consequences of these activities are discussed in the LR GEIS.

In a notice of intent published in the *Federal Register* on August 4, 2020 (85 FR 47252), the NRC notified the public of its preliminary analysis and plan to review and potentially revise the LR GEIS, including to address SLR, and to provide an opportunity to participate in the environmental scoping process. The NRC held four public webinars in August 2020 to support public participation in the LR GEIS revision. The NRC staff issued a scoping summary report in June 2021.

In evaluating the impacts of the proposed action (license renewal) and considering comments received during the scoping and public comment periods, new and updated technical and regulatory information, as well as Commission direction, the NRC identified 80 environmental issues: 72 environmental issues were associated with continued operations, refurbishment, and other supporting activities; 2 with postulated accidents; 1 with termination of plant operations and decommissioning; 4 with the uranium fuel cycle; and 1 with cumulative effects (impacts). For all of these issues, the incremental effect of license renewal was the focus of the evaluation.

For each environmental issue, the revised LR GEIS (1) describes the nuclear power plant activity or operational aspect during the initial LR or SLR term that could affect the resource; (2) identifies the resource that is affected; (3) evaluates past license renewal reviews and other available information, including information related to impacts during a SLR term; (4) assesses the nature and magnitude of the environmental effect (impact) from initial LR or SLR; (5) characterizes the significance of the effect; (6) determines whether the results of the analysis apply to all or a specific subset of nuclear power plants (i.e., whether the environmental issue is Category 1, Category 2, or uncategorized); and (7) considers additional mitigation measures for reducing adverse impacts.

The scope of the revised LR GEIS also discusses a range of alternatives to license renewal, including replacement power generation (using fossil fuels, new nuclear, and renewables), energy conservation and efficiency (demand-side management), and purchased power. It also evaluates the impacts from the no action alternative (not renewing the operating license). This LR GEIS includes the NRC's evaluation of construction, operation, postulated accidents, decommissioning, and fuel cycles for replacement energy alternatives.

Together with publication of the proposed rule, the NRC issued the draft LR GEIS for public comment. This LR GEIS provides the technical basis for the Commission's license renewal regulations in 10 CFR Part 51, including for the 80 identified environmental issues associated with continued operation and refurbishment of nuclear power plants during a license renewal term. In the proposed rule, the NRC sought comment on whether the scope of the rule, including the scope and applicability of Table B-1 of 10 CFR Part 51, should be expanded beyond two license renewal terms. The NRC also issued for public comment associated guidance documents, including draft Revision 2 (DG-4027) of Regulatory Guide 4.2, Supplement 1, and draft Revision 2 to NUREG-1555, Supplement 1.

The public comment period ran from March 3, 2023, to May 2, 2023. The NRC received 1,889 comment submissions (i.e., letters, emails, and other documents), which the NRC posted to the Regulations.gov website. During the public comment period, the NRC held six hybrid public meetings, which were transcribed. The NRC also conducted an informational meeting with Federally recognized Tribes on April 19, 2023, to afford Tribal representatives the opportunity to discuss the rule with the staff. All comment submissions, including those received in writing and those provided at the public meetings, were considered in preparing this LR GEIS. The NRC's responses to all comments are provided in Appendix A.2 of this LR GEIS.

S.3 Impact Definitions and Categories

The NRC's environmental impact standard considers Council on Environmental Quality terminology, including Council on Environmental Quality revisions in Part 1501—NEPA and Agency Planning (40 CFR 1501) and Part 1508—Definitions (40 CFR 1508).

In considering whether the incremental environmental effects (impacts) of the proposed action (license renewal—either initial LR or SLR) are significant, the NRC analyzes the geographic area and intensity of the effects. The geographic area consists of the characteristics of the area and its resources, such as proximity to unique or sensitive resources or communities with environmental justice concerns. For nuclear power plant-specific environmental issues, significance depends on the effects in the relevant geographic area—including, but not limited to consideration of short- and long-term effects, as well as beneficial and adverse effects.

Based on this, the NRC has established three significance levels for potential impacts: SMALL, MODERATE, and LARGE. The three significance levels, presented in a footnote to Table B-1 of 10 CFR Part 51, Appendix B to Subpart A, are defined as follows:

- SMALL: Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource. For the purposes of assessing radiological impacts, the Commission has concluded that those impacts that do not exceed permissible levels in the Commission's regulations are considered SMALL.
- 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.

In addition to evaluating the impacts for each environmental issue, the NRC also determined whether the analysis in the LR GEIS could be applied to all nuclear power plants or plants with specified design or site characteristics. Issues were assigned Category 1 (i.e., generic issues and applicable to all or a specific subset of nuclear plants) or Category 2 (i.e., requiring a plant-specific analysis), as further described in Section 1.5.2.3 of this LR GEIS.

S.4 Affected Environment

For purposes of the evaluation in this LR GEIS revision, the "affected environment" is the environment currently existing at and around operating commercial nuclear power plants. Current conditions in the affected environment are the result of past construction and ongoing operations at the plants, as well as reasonably foreseeable environmental trends. The NRC has considered the effects of these past and ongoing impacts and how they have shaped the environment. The NRC evaluated impacts of license renewal that are incremental to existing conditions. These existing conditions serve as the baseline for the evaluation and include the effects of past and present actions at the nuclear power plant sites and vicinity. This existing affected environment comprises the environmental baseline against which potential environmental impacts of license renewal are evaluated.

In the LR GEIS, the NRC describes the affected environment in terms of the following resource areas or subject matter areas: (1) description of nuclear power plant facilities and operations; (2) land use and visual resources; (3) meteorology, air quality, and noise; (4) geologic environment; (5) water resources (surface water and groundwater resources); (6) ecological resources (terrestrial resources, aquatic resources, and federally protected ecological resources); (7) historic and cultural resources; (8) socioeconomics; (9) human health (radiological and nonradiological hazards and postulated accidents); (10) environmental justice; (11) waste management and pollution prevention (radioactive and nonradioactive waste); and (12) greenhouse gas emissions and climate change. The affected environment of the operating plant sites represents diverse environmental conditions.

S.5 Impacts from Continued Operations and Refurbishment Activities Associated with License Renewal (Initial or Subsequent)

The NRC identified 80 environmental issues related to continued operations and refurbishment associated with both initial LR or SLR. Twenty of the issues were identified as Category 2 issues and would require plant-specific evaluations in future SEISs. Fifty-nine issues have been evaluated and determined to be generic to all nuclear power plants or to a specific subset of plants, and one issue remains uncategorized. The conclusions for each Category 1 or Category 2 environmental issue are presented by resource area or subject matter. The conclusions for each issue are summarized in Table 2.1-1. Chapter 4 provides the NRC's detailed analysis of and technical basis for each issue and supports the finding codified in Table B-1 of Appendix B to Subpart A of 10 CFR Part 51.

S.6 Comparison of Alternatives

This LR GEIS evaluates the impacts of the proposed action (license renewal) and describes a range of alternatives to license renewal, including the no action alternative (not renewing the operating license). It also evaluates the impacts of replacement energy alternatives (fossil fuel,

new nuclear, and renewables), energy conservation and efficiency (demand-side management), and purchased power. The impacts of renewing the operating license of a nuclear power plant are comparable to the impacts of replacement energy alternatives. Replacement energy alternatives could require the construction of a new power plant and/or modification of the electric transmission grid. New power plants would also have operational impacts. Conversely, license renewal does not require new construction and operational impacts beyond what is already being experienced. Other alternatives not requiring construction or causing operational impacts include energy conservation and efficiency (demand-side management), delayed retirement, repowering, and purchased power.

Under NEPA, the NRC has an obligation to consider reasonable alternatives to the proposed action (license renewal). The LR GEIS facilitates that analysis by providing NRC review teams with environmental information related to the range of reasonable replacement energy alternatives as of the time this LR GEIS was prepared. A plant-specific analysis of replacement energy alternatives will be performed for each SEIS, taking into account changes in technology and science since the preparation of this LR GEIS.

APPENDIX A

COMMENTS RECEIVED ON THE ENVIRONMENTAL REVIEW

APPENDIX A

COMMENTS RECEIVED ON THE ENVIRONMENTAL REVIEW

A.1 Public Scoping

On August 4, 2020, the U.S. Nuclear Regulatory Commission (NRC) staff issued a *Federal Register* notice (85 FR 47252) initiating the scoping process for the review and potential update of the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (LR GEIS, NUREG-1437, Revision 1; NRC 2013a). The notice indicated the results of the NRC staff's preliminary review and invited public comments and proposals for other areas of the LR GEIS that should be updated, including accounting for subsequent license renewal. The staff also contacted State government agencies and Tribal officials and other Federal agencies and Tribes to invite their participation (NRC 2020a). In accordance with Title 10 of the *Code of Federal Regulations* Section 51.26 (10 CFR 51.26), the NRC conducted scoping meetings and collected comments from the public for the LR GEIS update.

The scoping process consisted of a 90-day public comment period and included four webinar meetings conducted on August 19, 2020, and August 27, 2020, from 1:30 p.m. to 4:00 p.m. and 6:30 p.m. to 9:00 p.m., to receive comments. Because of the COVID-19 public health emergency, no in-person meetings were held. The official transcripts of the public scoping meetings, written comments, and meeting summaries are available for public inspection by appointment at the NRC's Public Document Room or electronically from the NRC's Agencywide Documents Access and Management System (ADAMS) (NRC 2020b). The scoping period for the LR GEIS update closed on November 2, 2020.

The NRC staff and its contractor reviewed the transcripts from the public meetings and all written materials received during the public comment period. All comments were considered. In June 2021, the NRC issued the scoping summary report (NRC 2021a). In accordance with 10 CFR 51.29(b), this report has been made publicly available at the NRC's Public Document Room, located at One White Flint North, 11555 Rockville Pike, Rockville, Maryland 20852, or from ADAMS. The ADAMS Public Electronic Reading Room is accessible through the NRC's public website, www.nrc.gov. The NRC also forwarded the scoping summary report to State and Tribal officials (NRC 2021b).

A.2 Public Comments Received on the Draft LR GEIS and Proposed Rule Package

The NRC distributed the draft *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*, Draft Report for Comment (NUREG-1437, Revision 2, referred to as the draft LR GEIS) (NRC 2023a), associated guidance, and the associated proposed rulemaking package amending the NRC regulations in 10 CFR Part 51 (88 FR 13329), to Federal, State, and local government agencies; Indian Tribes; environmental interest groups; and members of the public who requested copies of the draft. As part of the process to solicit public comments on the proposed rule package, the NRC:

- established a public website to consolidate pertinent rulemaking information, that included links to documents in the proposed rule package, information related to submitting public comments, related Commission correspondence, rulemaking schedules and milestones, public meeting information and transcripts, and other supporting documentation;
- distributed notice of availability of the draft LR GEIS and proposed rule to members of the public and environmental interest groups, Indian Tribes, and Federal, State, and local agencies;
- published the proposed rule, draft LR GEIS, and associated guidance for public comment in the *Federal Register* (88 FR 13329);
- issued press releases and social media posts regarding the issuance of the draft LR GEIS, associated guidance, and proposed rule;
- issued a *Federal Register* notice (88 FR 14958) notifying the public of six public meetings to receive comments on the draft LR GEIS and proposed rule;
- announced and conducted hybrid (in-person with virtual attendance option) public meetings in (1) Rockville, Maryland, on March 16, 2023 (two sessions); (2) Naperville, Illinois, on March 28, 2023; (3) Westlake, Texas, on March 30, 2023; (4) King of Prussia, Pennsylvania, on April 4, 2023; and (5) Decatur, Georgia, on April 6, 2023, to receive public comments on the draft LR GEIS and proposed rulemaking;
- issued press releases, social media posts announcing the public meetings, and instructions on how to comment on the draft LR GEIS; and
- conducted an informational meeting with federally recognized Tribes on April 19, 2023, to provide an overview of the proposed rule and draft LR GEIS and afford Tribal representatives an opportunity to discuss the rule with NRC staff.

Approximately 220 people attended the meetings, either in person or virtually. During the public comment period, the NRC received a total of 44 unique and technically complex comment submissions, which the NRC posted on the Federal Rulemaking website (Regulations.gov), in addition to comments received during the six public meetings.[1] During the comment period, 1,839 individuals submitted a campaign letter sponsored by the Nuclear Information and Resource Service. The NRC reviewed public meeting transcripts, comment letters, emails, and other comment documents, which have been incorporated by reference in this LR GEIS. The comment documents are also available online in ADAMS and on the Federal rulemaking website (Regulations.gov), under Docket ID NRC-2018-0296.

[1] The NRC received 1,889 comment document submissions on the proposed rule package and supporting documents. A comment submission contains one or more comments. The NRC identified and responded to 659 unique comments in the submissions.

Table A.2-1 identifies the individuals that provided comments during the comment period, including the commenter's affiliation (if available), corresponding ADAMS Accession number for the comment document, and comment document identification number.

Many individuals submitted a generic campaign letter sponsored by the Nuclear Information Resource Service and were considered as Correspondence ID 20 (see Table A.2-1). Copies of the form letters can be found in ADAMS (Accession Nos. ML23135A775, ML23135A776, ML23135A777, and ML23135A779).

The NRC categorized and consolidated specific comments according to topic or subject matter (see Table A.2-2). Comments expressing similar concerns were grouped to capture the common issues. Some comment submissions contained attachments that provided supplemental reference material. The NRC staff acknowledges the receipt of supplemental material, which was reviewed and considered in developing responses to comments. Comments fall into one of the following general groups:

- Comments that were actually questions and introduced no new information.
- Comments that were related to support of or opposition to renewing nuclear power plant operating licenses, opposed to nuclear power in general, or made general statements about the license renewal process. These comments may make only a general statement regarding environmental impact issues. In addition, they provide no new information and/or do not pertain to 10 CFR Part 51.
- Comments about an environmental issue in the draft LR GEIS that provide no new information that would require evaluation during the review.
- Comments about an environmental issue in the draft LR GEIS that provide new information that would require evaluation during the review.
- Comments that raise an environmental issue that was not addressed in the draft LR GEIS.
- Comments regarding alternatives to the proposed action or nuclear power.
- Comments outside the regulatory scope of license renewal (not related to 10 CFR Part 51).

The following pages and sections reproduce the substantive comments, suggestions, and/or questions received on the proposed rule package. Comments of a general or non-substantive nature as well as comments determined to be outside the scope of this LR GEIS and rulemaking are also included. This is followed by the NRC's responses to the comments. The NRC endeavored to reproduce the comment text as submitted and received (retaining any notations, subheadings, underlining, or emphasis in the original submittal) without editing, except for changes in line spacing and removal of italics to improve readability. In addition, while new or substantially revised text is marked with a change bar (vertical line) elsewhere in this LR GEIS, this convention is not used in this Appendix A.2 to further improve readability and because the content of this appendix is new. Parenthetical numbers after each comment block refer to the commenter identification and the comment number. Comments can be tracked to the commenter and the source document through the Commenter and Correspondence ID information listed in Table A.2-1.

Table A.2-1 Individuals Providing Comments on the Proposed Rule Package

Commenter	Affiliation (if stated)	Comment Source and Document ID	Correspondence ID
Anonymous, Anonymous		Regulations.gov (ML23096A070)	5
Arnold, Richard	Tribal Radioactive Materials Transportation Committee	Letter (ML23136A560)	35
Belisle, Mavis		Meeting Transcript (ML23107A243)	9-4
Bilz, Reed		Email (ML23080A061)	2
Boudart, Jan	Nuclear Energy Information Service	Meeting Transcript (ML23107A242)	8-4
Burnham, Lon	Citizens for Fair Utility Regulation	Meeting Transcript (ML23107A243)	9-3
Burnham, Lon	Citizens for Fair Utility Regulation	Meeting Transcript (ML23107A243)	9-8
Cameron, Chip	Prairie Island Indian Community	Meeting Transcript (ML23082A151)	3-1
Carson, Jonathan		Regulations.gov (ML23100A025)	6
Casals, Rafael	Town of Cutler Bay, FL	Email (ML23123A406)	26
Cassiere, Daniel		Letter (ML23136A563)	40
Cockerell, LaVonne		Meeting Transcript (ML23107A243)	9-2
Collins, Charlotte		Meeting Transcript (ML23107A243)	9-5
Curran, Diane	Harmon, Curran, Spielberg & Eisenberg, LLP, Counsel to San Luis Obispo Mothers for Peace	Letter (ML23123A410)	27
Curran, Diane	Harmon, Curran, Spielberg & Eisenberg, LLP, Counsel to Beyond Nuclear and Sierra Club	Letter (ML23123A411)	24
Curran, Diane	Harmon, Curran, Spielberg & Eisenberg, LLP, Counsel to Beyond Nuclear and Sierra Club	Letter (ML23139A275) [duplicate submittal with errata]	24
Devoe, Anthony		Regulations.gov (ML23136A562)	41
Evgeniadis, Ted	Lower Susquehanna Riverkeeper Association	Letter (ML23123A405)	25
Fettus, Geoffrey	Natural Resources Defense Council	Email (ML23124A112)	32
Francis, Meshelle		Regulations.gov (ML23100A025)	6

Commenter	Affiliation (if stated)	Comment Source and Document ID	Correspondence ID
Frankl, Harrison		Regulations.gov (ML23100A025)	6
Gallagher, Michael		Regulations.gov (ML23117A137)	12
Gosslee, Susybelle		Email (ML23122A313)	21
Gosslee, Susybelle		Meeting Transcript (ML23107A243)	9-6
Gosslee, Susybelle		Meeting Transcript (ML23107A243)	9-7
Gunter, Paul	Beyond Nuclear	Meeting Transcript (ML23082A152)	4-1
Gunter, Paul	Beyond Nuclear	Meeting Transcript (ML23082A152)	4-4
Hadden, Karen	Sustainable Energy & Economic Development Coalition	Email (ML23122A116)	18
Halpin, Beki		Meeting Transcript (ML23107A243)	9-9
Hernandez, Laurie	Tribal Radioactive Materials Transportation Committee	Letter (ML23136A560)	35
Hutar, J Jeremy		Regulations.gov (ML23143A256)	45
Johnson, Johnny	Prairie Island Indian Community	Letter (ML23117A164)	14
Judson, Timothy	Nuclear Information and Resource Service	Email (ML23124A113)	29
Judson, Timothy		Regulations.gov (ML23135A775)	20
Kaegi, Glen	Constellation Energy Generation, LLC	Letter (ML23136A561)	34
Kirby, Laurence		Regulations.gov (ML23143A257)	46
Kraft, David	Nuclear Energy Information Service	Meeting Transcript (ML23107A242)	8-1
Kraft, David	Nuclear Energy Information Service	Meeting Transcript (ML23107A242)	8-3
Lee, Gary		Regulations.gov (ML23143A255)	44
Littleton, Brian	U.S. Environmental Protection Agency	Meeting Transcript (ML23082A151)	3-3
Lloveras, Leigh Anne	The Breakthrough Institute	Letter (ML23136A559)	38
Luse, Jeff		Meeting Transcript (ML23107A244)	10-1
Luse, Jeff	Generation Atomic	Regulations.gov (ML23142A170)	16
Magnuson, Brian		Meeting Transcript (ML23107A242)	8-2
Magnuson, Brian		Regulations.gov (ML23123A408)	33
Magnuson, Brian		Regulations.gov (ML23123A409)	33
Magnuson, Brian		Regulations.gov (ML23139A187)	43
Mattern, Janet		Meeting Transcript (ML23107A243)	9-1
McCorry, Kathy	South County Chambers of Commerce	Regulations.gov (ML23136A558)	39
McReynolds, Clif		Regulations.gov (ML23100A025)	6
Ramsay, Rebecca		Email (ML23124A114)	28

Commenter	Affiliation (if stated)	Comment Source and Document ID	Correspondence ID
Ray, Thomas	Duke Energy	Letter (ML21322A311)	23
Rayfield, Bettina	Virginia Department of Environmental Quality	Letter (ML23107A241)	11
Reiser, Caroline	Natural Resources Defense Council	Email (ML23075A106)	1
Reiser, Caroline	Natural Resources Defense Council	Email (ML23124A112)	32
Reynolds, Laura	Everglades Coalition	Email (ML23123A412)	36
Rippingille, Bonnie	Ocean Reef Community Association	Email (ML23130A393)	37
Rippingille, Bonnie	Ocean Reef Community Association	Email (ML23130A088)	37
Rippingille, Bonnie	Ocean Reef Community Association	Regulations.gov (ML23136B032)	17
Rippingille, Bonnie	Ocean Reef Community Association	Regulations.gov (ML23136B033)	42
Rippingille, Bonnie	Ocean Reef Community Association	Regulations.gov (ML23143A258)	17
Rizo, Britsy		Regulations.gov (ML23100A025)	6
Schoedinger, Steven	Key Largo Utility Corporation	Regulations.gov (ML23117A138)	13
Silverstein, Rachel	Miami Waterkeeper	Letter (ML23123A404)	31
Spadafina, Lisa	Miami-Dade County Division of Environmental Resources Management	Letter (ML23124A361)	30
Stein, Adam	The Breakthrough Institute	Meeting Transcript (ML23082A152)	4-2
Stoddard, Philip	Florida International University	Email (ML23100A026)	7
Strand, Dianne	Florida Power & Light Company	Letter (ML23122A312)	22
Titus, Brett	Nuclear Energy Institute	Meeting Transcript (ML23082A152)	4-3
Titus, Brett	Nuclear Energy Institute	Meeting Transcript (ML23082A152)	4-5
Tomiak, Robert	U.S. Environmental Protection Agency	Letter (ML23118A308)	15
Uhle, Jennifer	Nuclear Energy Institute	Letter (ML23123A407)	19
Westra, Heather	Prairie Island Indian Community	Meeting Transcript (ML23082A151)	3-2

Table A.2-2 Commenter Categories

A.2.1	Meteorology, Air Quality, and Noise
A.2.2	Geologic Environment
A.2.3	Water Resources: Surface Water Resources
A.2.4	Water Resources: Groundwater Resources
A.2.5	Ecological Resources: Terrestrial Resources
A.2.6	Ecological Resources: Aquatic Resources
A.2.7	Ecological Resources: Federally Protected Ecological Resources
A.2.8	Historic and Cultural Resources
A.2.9	Socioeconomics
A.2.10	Human Health: Radiological
A.2.11	Human Health: Nonradiological
A.2.12	Environmental Justice
A.2.13	Postulated Accidents and Severe Accident Mitigation Alternatives (SAMA)
A.2.14	Waste Management: Radioactive Waste Including Spent Nuclear Fuel
A.2.15	Waste Management: Nonradiological Waste
A.2.16	Greenhouse Gas Emissions and Climate Change
A.2.17	Cumulative Effects
A.2.18	Uranium Fuel Cycle
A.2.19	Termination of Plant Operations and Decommissioning
A.2.20	Alternatives: Alternative Energy Sources
A.2.21	Alternatives: No Action Alternative
A.2.22	Alternatives: Plant System Design and Mitigation
A.2.23	General Environmental Concerns
A.2.24	NEPA Process
A.2.25	License Renewal Process and Rulemaking
A.2.26	Public Participation
A.2.27	Comments Opposing the Commission’s Consideration of Beyond One Term of SLR
A.2.28	General Opposition: LR GEIS, Rulemaking, or License Renewal
A.2.29	Comments Supporting the Commission’s Consideration of Beyond One Term of SLR
A.2.30	Comments Concerning General Support: LR GEIS, Rulemaking, or License Renewal
A.2.31	Out of Scope: Energy Cost or Need for Power
A.2.32	Out of Scope: Emergency Preparedness
A.2.33	Out of Scope: Nuclear Plant Safety
A.2.34	Out of Scope: Security and Terrorism
A.2.35	Out of Scope: Plant-Specific Issues
A.2.36	Out of Scope: Other
A.2.37	Miscellaneous Issues

A.2.1 Meteorology, Air Quality, and Noise

Comment: b. Air Quality

The Draft GEIS acknowledges that air emissions will be site specific and therefore its conclusion that air emissions can be Category 1 is wrong.[52] The Draft GEIS states that:

- "[S]pecial permit conditions may be applicable under various regulatory jurisdictions for facilities located in EPA designated nonattainment areas."[53]
- "The degree of impacts would depend on a number of factors, such as the size of the particles, the steam condenser flow rate or throughput, and the type and height of the cooling tower."[54]
- "The magnitude of drift-related PM10 and PM2.5 emissions from wet towers *depends on several conditions and parameters*, such as the makeup water composition, concentrations of TDS (organic matter, biocides, corrosion inhibitors, sodium chloride), steam condenser flow rate, drift eliminator efficiency, number of cooling towers/cells, and annual hours of operation. In comparison, drift emissions from cooling tower systems using seawater are *over 7 times greater* than those from systems supplied with freshwater makeup feeds, if everything else is held constant."[55]
- "The NRC staff determined that the estimated increase in particulate emissions would exceed the New Jersey Department of Environmental Protection's (NJDEP's) regulatory maximum hourly emission limit of 30 lb/hr 11 (13.6 kg/hr) for particulates."[56] And in fact, the NJDEP only issued the air permit with a variance to the plant's air operating permit with an hourly emission rate of 42 lb/hr.[57] The Draft GEIS concludes that "although there is the potential for some air quality impacts to occur as a result of equipment and cooling tower operations, as in the case with Hope Creek, the impacts have been small."[58]
- "Because the drift droplets generally contain the same chemical impurities (primarily dissolved solids) as those in the cooling water circulating through the tower, these impurities wind up in the drift that escapes the tower."[59]

[52] We also note that the EPA agrees that there are site-specific aspects of air quality impacts requiring the issue be Category 2.

Comment from U.S. EPA, Robert Tomiak, Director, Office of Federal Activities to Jennifer Davis U.S. Nuclear Regulatory Commission, Office of Nuclear Material Safety and Safeguards (Apr. 27, 2023) (ADAMS Accession No. ML23118A308).

[53] Draft GEIS at 3-31.
[54] Draft GEIS at 3-31.
[55] Draft GEIS at 3-31 (emphasis added).
[56] Draft GEIS at 3-32.
[57] Draft GEIS at 3-32.
[58] Draft GEIS at 4-12.
[59] Draft GEIS at 3-31. (**32-4-3** [Reiser, Caroline])

Comment: As the Draft GEIS explains,[60] the 1996 GEIS concluded that air quality was a Category 2 issue because, while impacts were expected to be small for most plants, certain emissions could be cause for concern "at locations in or near nonattainment or maintenance areas."[61] The 2013 GEIS continued with the same conclusion, that impacts "would be small for

most plants, but could be cause for concern at plants located in or near air quality nonattainment or maintenance areas."[62] Contrary to this acknowledgement, the 2013 GEIS concluded that air quality could be moved to a Category 1 issue because the impacts would be small for all plants. This follows the same pattern throughout the Draft GEIS--that so long as impacts would be small, the fact that the environmental impacts themselves might be different does not matter. The NRC moved Air Quality to Category 1 by arbitrarily and capriciously disregarding the first requirement in its test to determine whether an issue can be analyzed generically.

[60] Draft GEIS at 4-14.
[61] Draft GEIS at B-5.
[62] 2013 GEIS at 4-18. (**32-5-1** [Reiser, Caroline])

Comment: Air emissions from nuclear power plants include conventional pollutants from the combustion of fuels like diesel in various engines (including emergency engines) as well as radiological contaminants. Air quality impacts also include the effects of transmission lines and their effects including electromagnetic radiation on exposed populations.
(**32-10-7** [Reiser, Caroline])

Comment: F. Air Quality Issues

In addition to the improper or lack of support for the Category 1 classification for surface water impacts, the proposed Revision 2 to NUREG-1437 similarly misclassifies air quality issues as Category 1 impacts without foundation. As I have noted prior, air quality impacts around the plant are intimately dependent on the population in the area of the plant.[14]

[14] This is in distinction to surface water impacts which can adversely affect populations significantly further from a plant when, for example, that population is dependent on its potable or other water needs downstream from the discharge of a plant into a river.

F1. Air Quality Impacts

The proposed Revision 2 to NUREG-1437 addresses two types of air quality impacts during the initial or subsequent license renewal for a plant:

- air quality impacts - this issue encompasses impacts of continued operations and refurbishment activities on air quality, including nonattainment or maintenance area conformity; and
- air quality effects of transmission lines.

These are discussed in Section 4.3 of the proposed Revision 2 to NUREG-1437.

I note that the issue of radiological impacts (as opposed to the more common air pollutants such as NO_x, SO_2, PM_{10}/$PM_{2.5}$, CO, etc.) are not discussed at all in the proposed Revision 2 to NUREG-1437. (**32-15-2** [Reiser, Caroline])

Comment: F2. Population Growth and Air Quality Impacts

There is little discussion about how population growth near the plants would be adversely impacted by continued operation of the plants into future decades upon license renewal. In this

discussion, I am speaking to overall population growth and not just specific sub-populations that would be studies as part of an Environmental Justice analysis.

As noted, in addition to conventional air pollutants such as NO_x, SO_2, $PM_{10}/PM_{2.5}$, CO, etc. from diesel engines located at nuclear power plants and also emissions of these pollutants from any construction activities, nuclear power plants do produce gaseous and liquid effluents containing radiological contaminants.

In fact, all plants conduct some monitoring at specified monitors for air-borne radiological contaminants as noted in their respective annual environmental reports available on NRC's website. The nature and extent of these air impacts will change as the population changes near a specific plant. This must be a site-by-site analysis since the population growth and its spatial distribution is a site-by-site feature. Classifying air quality impacts as Category 1, as the proposed Revision 2 to NUREG-1437 does, therefore completely misses the mark since the site-specific radiological impacts due to population growth cannot be addressed generically. A Category 2 analysis would focus on the need for additional monitors guided by past population growth as well as future potential population growth - and possibly mitigation monitors depending on the monitored levels. Since the locations of the monitors are the only means to determine if the airborne radiological impacts are within acceptable limits, a Category 2 analysis is critical.

The same logic also applies for non-radiological air quality impacts, such as the emissions of traditional pollutants such as NO_x, SO_2, $PM_{10}/PM_{2.5}$, CO, and hazardous air pollutants such as diesel particulate matter etc. from emergency diesel engines. The impacts of these pollutants depend on the local meteorological data which drive their dispersion into the nearby communities and populations. Therefore they are also site-specific and a Category 1 classification is flawed and insufficient.

Finally, the same logic also affects the misclassification of transmission line impacts as Category 1. As the population near a plant increases, the same transmission line (assuming that the license renewal does not further increase the capacity of the plant - in which case, that alone is reason for rejecting a Category 1 analysis) impacts will affect more persons, and these impacts can only be addressed in a Category 2 analysis. (**32-15-3** [Reiser, Caroline])

Response: *The NRC disagrees with the comment that air quality impacts should be a Category 2 issue. The NRC has stated its methods and criteria for environmental issue identification, categorization, and definitions in Section 1.5 of this LR GEIS as well as in the footnotes to Table B-1 in Appendix B to Subpart A of 10 CFR Part 51, as revised pursuant to this final rule.*

Section 4.3.1.1.1 of the LR GEIS discusses the technical basis for concluding that air quality impacts are a Category 1 issue. NRC's update of the LR GEIS included a review of changes to applicable laws and regulations, new data in its possession, collective experience, and lessons learned and knowledge gained from conducting environmental reviews for initial license renewal (initial LR) and subsequent license renewal (SLR) since development of the 2013 LR GEIS.

The NRC staff did not identify any new information or situations that resulted in air quality impacts that differed from what was concluded in the 2013 LR GEIS. As discussed in the LR GEIS, onsite combustion sources at nuclear power plants are operated infrequently and for short periods of time, and quantified annual air emissions are minor. Similarly, emissions from cooling tower operations have not been found to noticeably alter or destabilize air quality. The

LR GEIS also discusses that the findings from license renewal supplemental environmental impact statements published since 2013 have shown that quantified air emissions from refurbishment activities have not been significant because of the small size of land disturbed, short duration of activities, and small number of workers. Furthermore, air pollutant emissions associated with nuclear plant operations and any refurbishment activities are subject to applicable State and Federal permitting requirements under the Clean Air Act, or applicable exemptions. The NRC has concluded that air quality impacts are SMALL, that impacts have been found to be the same or similar at all plant sites, and that mitigation measures are not warranted. Therefore, a generic, Category 1 grouping is appropriate. Furthermore, as part of a plant-specific environmental review, the NRC staff will determine whether there is any new and significant information that was not considered in the LR GEIS for Category 1 issues. Thus, even though an issue is designated as a Category 1 issue, mechanisms are in place to conduct a full plant-specific review if new and significant information is identified.

The NRC disagrees with the comment that the impacts of continued nuclear plant operations on air quality are dependent on population size in the vicinity of the plant site. The effects of continued operations of the plant on air quality do not change with population size and are dependent on emission sources and air emissions. Such emissions are regulated in accordance with applicable State or local operating permits to ensure compliance with air quality standards. Section 4.3.1.1.1 of the LR GEIS discusses emissions sources and air pollutant emissions.

The NRC also disagrees that it has omitted consideration of radiological air quality impacts in the LR GEIS. Radiological impacts are discussed in Section 4.9.1.1.1 of the LR GEIS. Radiation doses to members of the public from current operations of nuclear power plants were examined in the 1996 and 2013 LR GEIS and in this revised LR GEIS from a variety of perspectives (e.g., releases of radioactive gaseous and liquid effluents, radiation from radioactive waste storage buildings, radiological impacts from refueling and maintenance activities), and the impacts were found to be within dose standards specified in NRC regulations in 10 CFR Part 20 and Appendix I of 10 CFR Part 50, as well as the U.S. Environmental Protection Agency (EPA) regulations in 40 CFR Part 190. As stated in Section 1.5.2.3 of this LR GEIS, for the purposes of assessing radiological impacts, the Commission has concluded that the impacts that do not exceed permissible levels in the Commission's regulations are considered SMALL. No aspect of future operation or refurbishment associated with license renewal has been identified that would substantially alter this situation. The NRC expects its licensees to continue to comply with its radiation protection standards at all times, including during any extended period of operation resulting from license renewal. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.

Comment: 1. Section/Page 3.2 Air Quality 21, Comment/Recommendation: NEI supports the change to the applicant providing 5 years of meteorological data versus the prior 30 year requirement. This is a good example of regulatory efficiency. (**19-2-8** [Uhle, Jennifer])

Response: *The NRC acknowledges the comment. No changes were made in the LR GEIS, final rule, or guidance as a result of this comment.*

Comment: 2. Section/Page 3.2 Air Quality 21, Comment/Recommendation: New information request was added: "Estimate fugitive dust emissions generated during ground-disturbing activities." This information is not required for some state permitting agencies, therefore this request appears to go above and beyond state Clean Air Act regulatory requirements. (**19-2-9** [Uhle, Jennifer])

Response: *The NRC disagrees with this comment. As stated in Section 3.2 of Regulatory Guide 4.2, Supplement 1, Revision 2 (NRC 2024a), the requested information is needed to facilitate NRC's conformity analysis, if applicable, in accordance with 40 CFR Part 93. On April 5, 2010, the EPA issued its 40 CFR Part 51 and 93 revisions to the General Conformity Regulations in the Federal Register (75 FR 17254). The General conformity rule was established under the Clean Air Act (Section 176(c)(4)). General conformity requires Federal Agencies to ensure that a proposed Federal action, such as reactor license renewal, in air quality nonattainment or maintenance areas conforms to the applicable State Implementation Plan. A conformity analysis must be completed before the action is taken, as stated in Section 4.3.1.1.1 of this LR GEIS. If a conformity analysis is required, the total direct and indirect emissions of the proposed action must be quantified, including fugitive dust. Therefore, this information request is consistent with the Clean Air Act General Conformity requirements. Furthermore, fugitive emissions, including those generated from ground-disturbing activities, are included in Title V permit requirements, as described in 40 CFR Part 70 and 40 CFR Part 71. No changes were made in the LR GEIS, final rule, or guidance as a result of this comment.*

Comment: 4. Section/Page 3.3 Noise 22, Comment/Recommendation: The following statement appears to have been added: "The applicant should also identify and discuss primary offsite generating sources in the vicinity of the power plant site." What is the sound threshold to determine a "primary" noise generating source that is offsite? (**19-2-11** [Uhle, Jennifer])

Response: *The NRC acknowledges the comment. The NRC understands the comment requests clarification about what sound level threshold constitutes a primary offsite noise generating source, which is discussed in Section 3.3 of Regulatory Guide 4.2, Supplement 1, Revision 2 (NRC 2024a). As discussed in the LR GEIS, there are no Federal regulations for public exposures to noise. The purpose of the language added in Section 3.3 of the Regulatory Guide regarding primary offsite generating sources is for the applicant to describe in its environmental report the main offsite sources that contribute to noise in the vicinity of the plant site in order to characterize the affected noise environment. A sound level threshold does not need to be met for the requested information to be included in the environmental report. No changes were made in the LR GEIS, final rule, or guidance as result of this comment.*

Comment: The Draft GEIS identifies air quality as a generic issue common to all plants (Category 1 issue) that is addressed by the Generic EIS (GEIS). While this may be appropriate for general impacts to air quality, the GEIS also attempts to address General Conformity as a Category 1 (generic to all plants) issue.

We appreciate the narrative of the requirements of General Conformity and prior analysis as they relate to some of the *de minimis* rates listed in 40 C.F.R. § 93.153(b) (page 4-12 through 4-14). However, the discussion in the GEIS is not sufficient to meet the requirements of General Conformity that will need to be met when an action is taken that results in emissions in a nonattainment or maintenance area. The requirements of General Conformity depend on the time and place of the emission generating activity as well as the current designation status of the area in which emissions will occur, which cannot be predicted at this time. Additionally, there are activities which may be presumed to conform, or that are exempt, which may be specific to the actions that are necessary during specific plant LR and SLR. Therefore, we reiterate that General Conformity is a case specific requirement (Category 2 issue). While General Conformity and NEPA are interrelated, the requirements of General Conformity cannot be met with the discussion of potential impacts in the GEIS.

*EPA recommends addressing General Conformity as a Category 2 consideration, specific to the plant license renewal (LR) or subsequent license renewal (SLR) if there are emission generating activities within a nonattainment or maintenance area at the time of the action. (**15-6** [Tomiak, Robert])

Response: *The NRC acknowledges the comment, and clarifies the distinction between the generic treatment of air quality impacts and conformity determinations. The NRC does not intend for the discussion in Section 4.3.1.1.1 of this LR GEIS to address General Conformity requirements. As discussed in Section 4.3.1.1.1 of the LR GEIS, if applicable, a conformity analysis must be completed before the proposed action is taken. The Category 1 issue, "Air quality impacts," in the LR GEIS does not exempt the NRC from the General Conformity requirements of the Clean Air Act. Regardless of the LR GEIS concluding that the issue, "Air quality impacts," is a generic issue, if a nuclear power plant is located in a designated nonattainment or maintenance area, the NRC must ensure that the proposed action (license renewal) is in accordance with the General Conformity regulations. If a conformity analysis is required, this will be documented in the plant-specific supplement to the LR GEIS. Section 3.3.3 of NUREG-1555, Supplement 1, Revision 2 (NRC 2024b) provides guidance to NRC staff on the steps that should be taken if a conformity determination needs to be performed and documented in the plant-specific supplement to the LR GEIS. In response to this comment, Section 4.3.1.1.1 of the LR GEIS has been updated to explicitly state that if license renewal will result in an increase in air emissions and the site is located in a designated attainment or maintenance area, a conformity determination will be conducted by the NRC and documented in the plant-specific supplement to the LR GEIS.*

Comment: 3. Section/Page 3.3 Noise 22, Comment/Recommendation: Provide clarification on the following statement, "indicate their distance to the nearest site boundary and noise-sensitive receptors." Clarify whether the noise-sensitive receptors are only the "nearest" noise-sensitive receptors or whether the requirement is for "all noise-sensitive receptors in the vicinity." (**19-2-10** [Uhle, Jennifer])

Response: *The NRC agrees with the comment. The NRC revised Section 3.3 in Regulatory Guide 4.2, Supplement 1, Revision 2 (NRC 2024a) so that the statement now reads "…and indicate their distance to the nearest site boundary and nearest noise-sensitive receptor."*

A.2.2 Geologic Environment

Comment: (v) Geologic Environment

(8) Geology and soils - 1. Definitely site-specific (2). For example, the karst limestone substrate at Turkey Point has high horizontal transmissivity and significant vertical transmissivity. The research and understanding of the interaction of surface waters and "geology and soils" has indeed changed significantly between renewal applications and varies significantly between sites. (**7-3** [Stoddard, Philip])

Comment: Geologic Environment; Geology and soils: This is a unique and site specific environmental consideration at the Turkey Point plant. For example, the CCS is carved into ooliticlimestone and the porous nature of the limestone allows water to move freely in all directions. (**26-2** [Casals, Rafael])

Comment: The draft document claims that impacts of continued operations and refurbishment activities on geology and soils would be SMALL for all nuclear plants and would not change appreciably during the license renewal term.

This is a site-specific issue and an incorrect assumption based on the unique geologic features beneath the Turkey Point Power Plant. The geologic structure in south Florida is unique in that it consists of highly transmissive karst features. Karst formations consist of soluble limestone which can change over time due to water flow through the ground. It is now understood that there is significant movement of groundwater as a result of the operations at Turkey Point Power Plant and the Cooling Canal System (CCS). The cumulative effects of groundwater movement underneath the plant and the CCS is not entirely understood, and the initial licensing review was based on the assumption that these were only minor impacts. It is reasonable to assume that changes in the geologic formations underneath and adjacent to Turkey Point Power Plant as a result of operations at the plant have occurred. This is evidenced by water quality standard exceedances in adjacent water bodies including the L-31E canal, which appears to be influenced by the hypersaline plume underneath Turkey Point Power Plant. (**30-2** [Spadafina, Lisa])

Comment: Geologic Environment; Geology and soils: This is a unique and site-specific environmental consideration at the Turkey Point plant. For example, the CCS is carved into oolitic limestone and the porous nature of the limestone allows water to move freely in all directions. Research and understanding of the interaction of the CCS water budget and connectivity with the model lands region, L-31 E, and surrounding Biscayne National Park should be considered an important site-specific review. (**36-2** [Reynolds, Laura])

Response: *The NRC agrees in part and disagrees in part with the comments. The NRC agrees that the geology and soil characteristics of each operating nuclear power plant are unique. The NRC expects that a licensee would consider site-specific conditions when mitigating any impacts on geologic and soil resources from refurbishment activities (e.g., the breakwater construction at the Point Beach plant described in Section 4.4.1.1 of this LR GEIS). The NRC also understands this comment to mean that the Category 1 "Geology and soils" issue considered in this LR GEIS and rulemaking should be a Category 2 issue and not a Category 1 issue. The NRC disagrees with this suggestion. As described in Section 4.4.1.1 of this LR GEIS, the scope of the issue "Geology and soils" is limited to consideration of potential impacts on geologic and soil resources from continued operations and refurbishment activities such as soil disturbance, excavation and disturbance of subsurface materials including bedrock, and the use of geologic resources for refurbishment-related projects. Continued operations and maintenance activities within the scope of this issue include replacing or adding buildings, roads, parking lots, and belowground and aboveground utility structures. The NRC did not identify any significant impacts of this nature from continued operations and refurbishment activities in its review of plant-specific environmental reviews conducted to date. The NRC concluded that such impacts would be SMALL for all nuclear plants and therefore made a generic determination.*

The NRC also disagrees with the comments that reference the characteristics of the bedrock beneath the Turkey Point plant, which involve the movement of groundwater as the rationale for why the Category 1 issue "Geology and soils" should be a Category 2 issue. The hydrogeologic characteristics and interactions cited in the comments affect site water resources (surface water and groundwater) rather than constituting impacts on geologic and soil resources within the scope of the Category 1 issue "Geology and soils," as described in Section 4.4.1.1 of this LR GEIS and summarized above. Separately, however, the NRC has evaluated the issues of "Groundwater use conflicts (plants that withdraw more than 100 gallons per minute [gpm])" and

"Groundwater quality degradation (plants with cooling ponds)" as Category 2 issues in this LR GEIS (see Sections 4.5.1.2.3 and 4.5.1.2.6 of this LR GEIS). The NRC specifically considered new information identified during the SLR environmental review for Turkey Point Nuclear Generating Units 3 and 4 (NRC 2019a) in its analysis of these issues. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.

Comment: Did the analysis incorporate the latest updated seismological and geological assessments of nuclear power plants around the country?

Because, previously, there was --I won't call it a scandal, but it was revealed that very little had been done to revise the geology in the seismic analysis at reactor sites until fairly recently, which went all the way back to, like, the 1970s.

So, I want to know if this current analysis that took place incorporates the latest geological assessments for the reactor sites. (**8-1-2** [Kraft, David])

Response: *The NRC acknowledges the comment and understands the comment to request whether the NRC has considered the latest information regarding seismic hazards around operating nuclear power plants. The seismic setting of U.S. nuclear power plants described in Section 3.4 of this LR GEIS was based on the most recent seismic hazard mapping from the U.S. Geological Survey. In addition, the seismic hazard at operating plants was evaluated using updated information in response to the NRC Near-Term Task Force Recommendation 2.1, as described in NRC reference (NRC 2021c) of this LR GEIS. Separate from the NRC's license renewal process, the NRC requires all licensees to take into account changes in seismic hazard in order to maintain safe operating conditions at all nuclear power plants. When new seismic hazard information becomes available, the NRC evaluates the new information to determine whether any changes are needed at existing plants. No changes were made in the LR GEIS, final rule, or guidance as a result of this comment.*

Comment: And because of the concern of the seismic activity in the Comanche Peak area I found this map. It's dated 2018. So then I went and looked at the other maps and thought, well, this one is 2021, the farmland in the United States probably is the same, even though we're losing farmland because of global warming. And this one is 2022. So I'm wondering why this map, at the last meeting in Glen Rose you were giving, I think there were 28 seismic activities that had occurred around this plant. Which is a concern. I don't know who that material was given to, but have you, can you update this to include the fracking things? Put an insert, send me an insert? Because I think this is, it's not accurate. I don't want you basing much off of this because it doesn't show that there is a lot of seismic activity in Texas based on this chart. So I guess the comment is, would you get more current seismic readings for the State of Texas? (**9-2-1** [Cockerell, LaVonne])

Comment: But a new one has been brought up. I remember in, well, most of my experiences from environmental impact statements from the Department of Energy and around the Pantex Plant in Amarillo. One of the things that I can remember very specifically, the most recent of those saying, was that they did not have to analyze earthquake impacts because there was no earthquake activity in the area. Which is true, it's a very flat area. It's not very likely that you would have earthquakes there. But the problem is, considering fracking. They have very much the same impact as earthquakes do. And fracking is very pronounced in most of Texas right now because of oil extraction, or the gas extraction.

I have had, when I, again, when I lived in Amarillo I had pictures and mirrors fall from my walls because of that activity. That seismic activity, and from what I understand of people living around Comanche Peak, that same kind of seismic activity is taking place in that area from fracking.

I really think it should be analyzed on its effects on Comanche Peak. That even though it seems small, it may be enough over time to create damage to the system in the nuclear power plant. And I would request that you consider that. (**9-4-1** [Belisle, Mavis])

Comment: Also, we can give you the seismic, we can give you the seismic reports, but we can also give you the charts of the wells to give you an idea of how many wells there are that are close. (**9-7-2** [Gosslee, Susybelle])

Response: *The NRC agrees in part with the comments. The NRC agrees to the extent that it should consider the latest seismic activity, including induced seismic activity, in the description of the geologic environment in this LR GEIS, but disagrees that the NRC's environmental reviews should consider the effects of seismic events on operating nuclear power plants. Section 3.4 of this LR GEIS describes the range of geologic and soil conditions at existing nuclear power plant sites, as well as the range of possible geologic hazards including potential seismic hazards. Figure 3.4-2 in the LR GEIS depicts the current predicted earthquake ground motions based on the U.S. Geological Survey's (USGS) 2018 National Seismic Hazard Model (Petersen et al. 2020). While long-range seismic hazard models do not normally include the contribution of induced seismicity (e.g., such as those generated by fluid injection associated with oil and gas operations), Figure 3.4-2 includes the contribution of some induced earthquakes as part of the underlying seismic model. Recent seismic activity, including the occurrence of induced seismic events, is monitored and reported by the USGS (https://www.usgs.gov/programs/earthquake-hazards). During the environmental review of a license renewal application, the NRC reviews the USGS earthquake catalog for new and significant information applicable to the description of the seismic setting of a nuclear power plant site. Section 3.4 of the LR GEIS was revised to include a discussion of the NRC staff's consideration of recent seismic activity, including induced seismicity, as part of its preparation of plant-specific supplements to the LR GEIS. As described in Section 3.4 of this LR GEIS, however, changes in potential seismic hazards are not within the scope of the NRC's license renewal environmental review (except, where appropriate, in the analysis of severe accidents). Seismic design issues are considered during plant-specific safety reviews and are addressed on an ongoing basis through the reactor oversight process and other NRC safety programs.*

Comment: Geology and Soils. The Draft GEIS concludes that "[g]eologic and soil conditions at all nuclear power plants and associated transmission lines have been well established during the current licensing term. These conditions are expected to remain unchanged during the 20-year license renewal (initial LR or SLR) term."[142] The NRC must consider the new and significant information regarding ground settling at Davis-Bessie,[143] which demonstrates how geologic and soil conditions are not "well established" and can indeed continue to change during LR or SLR.

[142] Draft GEIS at 4-20.
[143] NRC begins special inspection at Davis-Besse Nuclear Power Station (Apr. 25, 2023) https://www.thenews- messenger.com/story/news/local/2023/04/25/nrc-begins-special-inspection-at-davais-besse-nuclear-power- station/70150672007/. (**32-9-5** [Reiser, Caroline])

Response: *The NRC agrees in part with the comment. The NRC agrees to the extent that it should consider new and significant information within the scope of the Category 1 issue, "Geology and soils," and the NRC's license renewal environmental review, which is the focus of this LR GEIS. The NRC disagrees that it should consider site-specific information concerning ground settling at Davis-Besse. The Category 1 issue, "Geology and soils," considers the potential impacts on geologic and soil resources from continued operations and refurbishment activities rather than the impacts of natural hazards, such as land subsidence, on nuclear power plant infrastructure, as described in Section 4.4.1.1 of this LR GEIS. Specifically, changes in geologic or soil conditions that affect safety are not within the scope of the NRC's license renewal environmental review. Issues such as ground settling that could affect plant safety are considered during plant-specific safety reviews and are addressed on an ongoing basis through the reactor oversight process and other NRC safety programs. If the NRC discovers an unsafe condition, or that a licensee is not complying with its licensing basis, the NRC has the authority to take whatever action is necessary to protect public health and safety. No changes were made in the LR GEIS, final rule, or guidance in response to this comment.*

A.2.3 Water Resources: Surface Water Resources

Comment: Among the critical issues identified in the policy is the under-allocation of surface and groundwater. This is a category 1 issue meaning that actions to mitigate it can be taken without further research. As a result of this, we believe that this needs more attention and should be acted upon now. Since the policy applies to all plants across the country, regional circumstances and water availability may differ significantly. It is of deep concern to us that the under-allocation of all water resources should be taken into account in areas with unpredictable water discharges, especially those in drought-prone regions with high variability in precipitation. Both groundwater and surface water are different sources of water but are heavily reliant upon each other. As stated in section 3.12.2.7, the policy acknowledges the higher temperatures in the Southwest are increasing evaporation and decreasing snowpack, resulting in reduced water availability. With less surface water leaching into the groundwater, these pools of claimable water do not refill as fast. This is true for most of the regions in America, yet the power stations still need a reliable source of water. The Palo Verde Generating Station in Phoenix, Arizona, has successfully addressed this issue [water availability] by using wastewater from the city to cool the plant, which provides power for 4 million people. Considering the high potential for drought in our region, this innovative approach to water conservation is particularly crucial. While this power plant is an extreme example it exhibits how different the conditions can be for other plants across the US.

We propose that these issues pertaining to surface water use (Sections 4.5.1.1.8, 4.5.1.1.9) and groundwater use (Sections 4.5.1.2.2, 4.5.1.2.3, 4.5.1.2.4) be raised to category 2. Category 2 would make issues with water rights be evaluated on a case-by-case basis. This would ensure that all plants are using the best source for their cooling water and would allow power plants to be built and operated in areas that have lower water availability. More people would potentially have access to energy that does not emit greenhouse gasses, without having to sacrifice a large amount of potable drinking water. This could help mitigate the negative climate changes that greenhouse gases perpetuate.

As a whole, we feel that the consideration of regional circumstances is critical when implementing policies related to water allocation and use. Natural resources and communities can be adversely affected by this. By utilizing smart and sustainable approaches to water usage like the Palo Verde Generating Station's use of wastewater, we can help mitigate these issues.

We request that your agency considers these concerns while finalizing the EIS for license renewals of nuclear plants. We believe that addressing these concerns will not only provide a better understanding of the potential risks but also ensure that appropriate measures are taken to minimize any adverse effects on the environment and public health.
(**6-2** [Carson, Jonathan] [Francis, Meshelle] [Frankl, Harrison] [McReynolds, Clif] [Rizo, Britsy])

Response: *The NRC agrees in part and disagrees in part with this comment. The NRC agrees that water availability should be considered as part of the license renewal environmental review process and that certain water availability issues should be considered on a plant-specific basis (Category 2). However, the NRC disagrees that all five issues cited in the comment should be Category 2 issues. The NRC has designated three water availability issues—"Surface water use conflicts (plants with cooling ponds or cooling towers using makeup water from a river)," "Groundwater use conflicts (plants that withdraw more than 100 gallons per minute [gpm])," and "Groundwater use conflicts (plants with closed-cycle cooling systems that withdraw makeup water from a river)"—as Category 2 issues because the environmental impacts for these three issues may vary among plant sites (see Sections 4.5.1.1.9, 4.5.1.2.3, and 4.5.1.2.4 in this LR GEIS). However, the NRC has concluded that the remaining two issues cited in the comment—"Surface water use conflicts (plants with once-through cooling systems)" and "Groundwater use conflicts (plants that withdraw less than 100 gallons per minute [gpm])"—are properly designated as Category 1 issues. This is because the environmental impacts for these two issues were found to be the same or similar at all plant sites based on previous license renewal environmental reviews (see Sections 4.5.1.1.8 and 4.5.1.2.2 in this LR GEIS). Category 1 (generic) issues are those that meet all of the following criteria: (1) the environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristics; (2) a single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective offsite radiological impacts of spent nuclear fuel and from high-level waste disposal and offsite radiological impacts—collective impacts from other than the disposal of spent fuel and high-level waste); and (3) mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are not likely to be sufficiently beneficial to warrant implementation. The NRC has stated its methods and criteria for environmental issue identification, categorization, and definitions in Section 1.5 of this LR GEIS as well as in the footnotes to Table B-1 in Appendix B to Subpart A of 10 CFR Part 51, as revised pursuant to this final rule.*

The designation of an issue as a Category 1 issue does not mean that potential impacts are not considered. During preparation of plant-specific supplements to the LR GEIS, the NRC staff considers changes in nuclear power plant operating parameters and new and potentially significant information provided by the applicant or identified through public comments, or resulting from the NRC's due diligence in reviewing relevant information. Data are reviewed in part for information that could change the conclusion in the LR GEIS with regard to an issue. Thus, even though an issue is a Category 1 issue, mechanisms are in place to conduct a full plant-specific review if new and significant information warrants such a review. No changes were made in the LR GEIS, final rule, or guidance as a result of this comment.

Comment: (vi) Surface Water Resources
(15) Discharge of biocides, sanitary wastes, and minor chemical spills. - 1. Is site specific (2) because Turkey Point sits inside the boundaries of Biscayne National Park, any discharges will have significant adverse effects on the environment. Sanitary wastes, for instance, are loaded with pharmaceuticals, which concentrate in marine life (as per findings of Rehage lab, FIU). (**7-4** [Stoddard, Philip])

Comment: (18) Effects of dredging on surface water quality. - 1. Widening of US1 south of Turkey Point produced significant algal blooms despite normal run-off controls. Significant amounts of phosphate are locked up in the sediments and the local environment is phosphate poor, so this area is unusually sensitive to phosphate release. (**7-5** [Stoddard, Philip])

Response: *The NRC disagrees with these comments to the extent that they suggest that "Discharge of biocides, sanitary wastes, and minor chemical spills" and "Effects of dredging on surface water quality" should be designated as Category 2 instead of Category 1 issues. The NRC has concluded that the two issues are properly designated as Category 1 issues, because the environmental impacts were found to be the same or similar at all plant sites (see Sections 4.5.1.1.7 and 4.5.1.1.10 in this LR GEIS). Additionally, discharges to surface waterbodies from operating reactors are monitored and controlled under National Pollutant Discharge Elimination System (NPDES) permits or equivalent State permits in accordance with Clean Water Act (CWA) Section 402 requirements. Dredging, if needed to support nuclear power plant operations, is permitted under a CWA Section 404 permit from the U.S. Army Corps of Engineers. The NRC has stated its methods and criteria for environmental issue identification, categorization, and definitions in Section 1.5 of this LR GEIS as well as in the footnotes to Table B–1 in Appendix B to Subpart A of 10 CFR Part 51, as revised pursuant to this final rule. The NRC's update of the LR GEIS included a review of changes to applicable laws and regulations, new data in its possession, collective experience, and lessons learned and knowledge gained from conducting environmental reviews for initial LR and SLR since 2013, including the SLR environmental review for Turkey Point Nuclear Generating Units 3 and 4 (NRC 2019a).*

However, the designation of an issue as a Category 1 issue does not mean that potential impacts are not considered. During preparation of plant-specific supplements to the LR GEIS, the NRC staff considers changes in nuclear power plant operating parameters and new and potentially significant information provided by the applicant or identified through public comments, or resulting from NRC's due diligence in reviewing relevant information. Data are reviewed in part for information that could change the conclusion in the LR GEIS with regard to an issue. Thus, even though an issue is a Category 1 issue, mechanisms are in place to conduct a full plant-specific review if new and significant information warrants such a review. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.

Comment: With the pollution in the lake, and the tritium in the lake, it's pretty clear that there is a dangerous amount of emission from the wells. I mean, from the well, from the plant reactor. And this is a major concern. There should have been, after all these years knowing that there is emissions, there should have been a process developed. But that was not released in contaminating the water. No, we don't have groundwater polluted, but we have the water polluted. (**9-7-3** [Gosslee, Susybelle])

Response: *The NRC acknowledges the comment and understands the comment to express concerns regarding the impact of Comanche Peak Nuclear Power Plant operations on water quality. As described in Section 1.0 of this LR GEIS, the purpose of this LR GEIS revision and*

associated rulemaking is to identify and evaluate the environmental issues that could result in the same or similar impact (i.e., generic issues) on the environment at all nuclear power plants or a specific subset of plants and determine which issues could result in different levels of impact during the license renewal term, thus requiring nuclear power plant-specific environmental analyses for impact determination. The cited site-specific environmental issues and concerns will be appropriately addressed by the NRC in plant-specific license renewal environmental reviews. Specifically, Vistra Operations Company LLC submitted an initial license renewal application for Comanche Peak to the NRC in October 2022 (Luminant 2022), and the NRC accepted the application for docketing on November 28, 2022. On December 13, 2022, the NRC published a notice of intent to conduct a scoping process and to prepare a plant-specific supplemental environmental impact statement (SEIS) to the 2013 LR GEIS (87 FR 76219, 88 FR 10940). When preparing the draft SEIS, the NRC staff considered scoping comments received from the public and relevant Category 1 (generic) and plant-specific (Category 2) environmental issues listed in the 2013 LR GEIS. The draft SEIS was issued for public comment in November 2023. The final SEIS is scheduled to be issued in the spring of 2024.

Nonetheless, as generally described in Section 3.5.1.2 of this LR GEIS, discharges to surface waterbodies from operating reactors are monitored and controlled under NPDES permits in accordance with CWA Section 402 requirements. Radioactive emissions from reactors are regulated by the NRC. The emission of radioactive materials is well regulated and characterized by the NRC, as described in Section 3.9.1.3 of this LR GEIS. Annual effluent reports from all power plants in the United States can be found at https://www.nrc.gov/reactors/operating/ops-experience/tritium/plant-info.html (NRC 2023f). Tables 3.9-21 to 3.9-24 in this LR GEIS demonstrate that annual emissions remain very low and will not adversely affect human health. The NRC also provides continuous oversight for the safe operation of nuclear power plants to verify that the nuclear plants are being operated and maintained in accordance with NRC regulations. This oversight includes having full-time NRC inspectors located at the plant and periodic safety inspections conducted by NRC inspectors based in an NRC Regional Office. The inspections look at a licensee's compliance with the NRC's regulations, which include the following: plant safety (routine and accident scenarios), radiation protection of plant workers and members of the public, radioactive effluent releases, radiological environmental monitoring, emergency preparedness, radioactive waste storage and transportation, quality assurance, and training. If the NRC discovers an unsafe condition, or that a licensee is not complying with its licensing basis, the NRC has the authority to take whatever action is necessary to protect public health and safety. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.

Comment: 3. Floodplain Management. The GEIS (page 3-50) notes that operating commercial nuclear power plants are located in a variety of terrestrial habitat types, including floodplains.

3(a) Agency Jurisdiction. DCR is the lead coordinating agency for the Commonwealth's floodplain management program and the National Flood Insurance Program (Executive Memorandum 2-97).

3(b) Agency Findings. The National Flood Insurance Program (NFIP) is administered by the Federal Emergency Management Agency (FEMA), and communities who elect to participate in this voluntary program manage and enforce the program on the local level through that community's local floodplain ordinance. Each local floodplain ordinance must comply with the minimum standards of the NFIP, outlined in 44 CFR 60.3; however, local communities may

adopt more restrictive requirements in their local floodplain ordinance, such as regulating the 0.2% annual chance flood zone (shaded X Zone).

All development within a Special Flood Hazard Area (SFHA) or floodplain, as shown on the locality's Flood Insurance Rate Map (FIRM), must be permitted and comply with the requirements of the local floodplain ordinance.

3(c) Requirement. Projects conducted by federal agencies within the SFHA must comply with Executive Order 11988: Floodplain Management. The applicant/developer must reach out to the local floodplain administrator for an official floodplain determination and comply with the community's local floodplain ordinance, including receiving a local permit. Failure to comply with the local floodplain ordinance could result in enforcement action from the locality. (**11-5** [Rayfield, Bettina])

Comment: 3. Floodplain Management. A facility must comply with the local floodplain ordinance

To find flood zone information, use the Virginia Flood Risk Information System (VFRIS): www.dcr.virginia.gov/vfris

To find community NFIP participation and local floodplain administrator contact information, use DCR's Local Floodplain Management Directory: www.dcr.virginia.gov/dam-safety-and-floodplains/floodplain-directory (**11-10** [Rayfield, Bettina])

Response: *The NRC acknowledges the information provided and agrees that each nuclear power plant licensee must conduct its operations in accordance with all applicable Federal, State, and local permits and regulations. Appendix F of this LR GEIS provides a summary of potentially relevant Federal and State laws, regulations, and other requirements that may affect the renewal and continued operation of NRC-licensed nuclear power plants. Section F.7.2 of this LR GEIS references the National Flood Insurance Program.*

As an independent agency, the NRC is not required to follow Executive Order (EO) 11988 (42 FR 26951). However, to the extent that the NRC, in the exercise of its licensing functions, undertakes activities and programs that affect land use, the NRC's regulatory regime adequately addresses flood hazards and floodplain issues and is generally aligned with EO 11988.

The NRC also evaluates new information important to flood projections and independently confirms that a licensee's actions appropriately consider potential changes in flooding hazards at the site. For clarity, the NRC revised Section 3.6.1.2 to include a reference to applicable National Flood Insurance Program requirements and local floodplain regulations.

Comment: Coastal Environment Issues: If the monthly evaporation rate of water from the canal system exceeds the monthly rainfall into the canal system, supplemental water ranging from 15 mgd to 30 mgd from the Floridan Aquifer is required to be pumped into the canal system. The Floridan Aquifer is the current secondary supply source of potable water and irrigation water for Miami- Dade County and Monroe County (FL Keys) residents, and will be in the near future the primary source of such water for these counties when seawater intrusion to the Biscayne aquifer wellfields serving these entities occurs. Miami-Dade County, Florida has offered to supply Turkey Point Power Plant with 60 mgd of highly-treated municipal wastewater

plant effluent to replace the 30 mgd cooling water being withdrawn from the Floridan drinking water aquifer as cooling water for the nuclear reactors but FPL has rejected the offer.

The new environmental rules for initially granting or renewal of a nuclear power plant must require a water needs/ water balance analysis of the entire plant by the applicant considering the sources and the total quantity requires for safe, full capacity plant operation. Am environmental rule requirement must be included to give first-priority use available treated domestic wastewater from nearby municipal utilities before considering extracting the water needed from any local surficial aquifer, groundwater aquifer and/or surface water supply used by a nearby City, County and/ or Public Utility. (**13-1** [Schoedinger, Steven])

Response: *The NRC understands the comment to express concern with regard to the impacts of groundwater use at the Turkey Point plant. The issue "Groundwater use conflicts (plants that withdraw more than 100 gallons per minute [gpm])" is Category 2 (plant-specific), as described in Section 4.5.1.2.3 of this LR GEIS. Plant- or site-specific environmental issues and concerns associated with operating nuclear power plants, such as those raised in the comment, are considered in a plant-specific supplement to the LR GEIS in accordance with the NRC's regulations set forth in 10 CFR Part 51. The NRC disagrees with the suggestions that the NRC revise the proposed rule to require that license renewal applicants provide a water needs analysis and that license renewal be made contingent upon operating nuclear plants using available, treated wastewater for cooling, and presumably other plant uses, before considering natural water sources. Nuclear power plants were licensed to operate using the cooling system infrastructure with which they were constructed along with the associated water source(s). The NRC does not regulate water use permitting for nuclear power plants. Further, the NRC has no statutory or regulatory authority to allocate a State's surface water or groundwater resources or to mandate the use of alternate sources of makeup water. As noted in Sections 3.5.1.1 and 3.5.2.1 of this LR GEIS, many States, including Florida, have in place water allocation and associated permitting requirements for surface water and groundwater. The NRC expects each nuclear power plant licensee to conduct its operations in accordance with all applicable Federal, State, and local permits and regulations. Additionally, licensees must operate their nuclear power plants in accordance with the NRC's regulations in 10 CFR Part 50 and the requirements of their license, including technical specifications, to provide reasonable assurance that the activities authorized by the license can be conducted without endangering the health and safety of the public and, as a consequence, that critical infrastructure important to safety will continue to perform its intended functions. No changes were made in the LR GEIS, final rule, or guidance as a result of this comment.*

Comment: New environmental rule must be added to require nuclear power plants along a coastline where its cooling canals or ponds are subject to tidal exchange of seawater, over-topping by storm tides and sea level rise to demonstrate how these environmental conditions will not adversely impact and effect the cooling ponds / canals to function as intended to be a reliable supply of water for cooling the nuclear reactors. Also the new rules must require the applicant demonstrate how these environmental conditions will not inhibit the regular and proper maintenance activities for the ponds or canal system as intended by the original plant designers. (**13-2** [Schoedinger, Steven])

Response: *The NRC disagrees with this comment. As detailed in Section 1.7 of this LR GEIS, the NRC's license renewal environmental review process, which is the focus of this LR GEIS and rulemaking, is confined to analyzing the effects (impacts) on the environment of continued operation of nuclear power plants through the period of extended operation (either initial LR or SLR). Nuclear power plant operational safety issues related to the management of aging*

systems, structures, and components, as well as the effects of external hazards, are outside the scope of the NRC's environmental reviews conducted under 10 CFR Part 51 as well as this LR GEIS and rulemaking. No changes were made in the LR GEIS, final rule, or guidance as a result of this comment.

Comment: 5. Section/Page 3.5 Surface Water Resources 23, Comment Recommendation: The following statement appears to *have* been added: "This discussion should address the design and construction of critical plant infrastructure to resist flooding." As noted by the NRC, the ER should focus on impacts of the plant on the environment. The assessment of impacts to the site from the environment is a safety function. Therefore, either remove this statement or clarify the purpose and basis for this information to be addressed in the Environmental Report. (**19-2-12** [Uhle, Jennifer])

Response: *The NRC agrees with this comment. The NRC has modified the text in Section 3.5 of Regulatory Guide 4.2, Supplement 1, Revision 2 (NRC 2024a) to clarify the scope of the requested floodplain information in relationship to plant infrastructure, by deleting the reference to design and construction and adding a statement requesting information about compliance with applicable floodplain regulations. The requested information will enable the NRC to meet its statutory obligations under Section 102(2) of the National Environmental Policy Act (NEPA), and specifically to fulfill its responsibilities under 10 CFR 51.71(d) to consider an applicant's compliance with environmental quality standards and requirements, as imposed by permitting and other authorities.*

Comment: Please include this letter as part of the responsive comments to the Federal Register notice issued March 10, 2023 at 88 FR 14958 regarding the agency's revision of its Generic Environmental Impact Statement for License Renewal of Nuclear Plants rule (LR GEIS). In the interest of protecting the health and integrity of our surrounding ecosystem for the benefit of our residents resiliency and health and safety, we strongly urge you to revise the LR GEIS in a way that incorporates the need for site-specific evaluations of unique and significant environmental impacts related to the Cooling Canal System (CCS) at the Turkey Point plant.

The CCS poses unique and significant geologic, hydrological, water and aquatic issues that should require site-specific environmental assessments at the Turkey Point plant. We trust the following information will inform the revision of your rule. (**26-1** [Casals, Rafael])

Comment: Surface Water Resources: This is a unique, significant and site-specific consideration. The plant and CCS are vulnerable to sea level rise and storm surge and discharge of biocides, sanitary wastes, and various chemicals. Turkey Point sits inside the boundaries of Biscayne National Park and is surrounded by wetlands earmarked for Everglades restoration activities, any discharges will have significant adverse impacts on the environment, as well as any usage of surrounding surface waters. Surface to surface water interactions happen regularly, especially during King Tides, storm events, heavy rains; there is an overflow of the CCS on a regular basis and this interacts with the surrounding resources. Biscayne Bay is a designated Outstanding Florida Water Body, National Park and Aquatic Preserve and therefore deserves a site specific level of review. (**26-3** [Casals, Rafael])

Comment: Nutrient Pollution and Algae Blooms in the CCS

The CCS has also been beset by nutrient and algae problems. In 2014, algae significantly bloomed within the CCS.[33] Large-scale application of copper sulfate was implemented to control algae, though this was reported as being ineffective and serving only to stabilize the existing concentrations.

[33] Chin, D. A., 2015. *The Cooling Canal System at the FPL Turkey Point Power Station at 9*.

While FPL has implemented multiple measures to improve the conditions of the CCS, some forms of pollution are still not abating: FPL's November 15, 2022, Remediation status report shows that total phosphorus exhibits no decreasing trend,[34] and chlorophyll-a concentrations - which act as a proxy for algae - do not exhibit a downward trend either.[35] This is concerning since the adjacent Biscayne Bay, a phosphorus-limited estuary, is exceptionally sensitive to phosphorus. Recently, overfertilization of the Bay has caused three consecutive years of summer algae blooms and fish kills beginning in 2020.

[34] FPL, November 15, 2022. Remedial Action Annual Status Report, Turkey Point Clean Energy Center, Year 4, Figure 6.21.
[35] Id., Figure 6.4-1. (**31-5** [Silverstein, Rachel])

Comment: (14) Discharge of Metals into Cooling System Effluent

This issue must be modified from a "1" to a "2" and significance should be elevated from "small" up to "moderate/large". Florida Power and Light's use of copper sulfate in cooling canals presents a toxic hazard to aquatic species, and a danger to the underlying drinking water aquifer. Copper sulfide is bio-accumulative.[42] Annual remediation status reports do not report on copper sulfate. As it has been clearly shown that hyper-salinized water migrates radially from the CCS, the plant operator should confirm whether groundwater and surface water surrounding the CCS are polluted with copper sulfide.
[42] Mirzaei VandKhanghah M, Hedayati A, Nazeri S, Mohammadi Azarm H, Ghorbani R. Biomagnification of Copper Along the Aquatic Food Chain (Artemia franciscana, Danio rerio, and Astronotus ocellatus). Biol Trace Elem Res. 2022 Apr;200(4):1854-1860. doi: 10.1007/s12011-021-02781-4. Epub 2021 Jul 15. PMID: 34264447.

(16) Surface Water Use Conflicts (plants with cooling ponds or cooling towers using makeup water from a river):

We agree that this issue should remain a "2". We further assert that significance must be elevated from "small/moderate" up to "moderate/large".

Everglades restoration is being programmed for the Model Lands area (shown in Attachment 16). The Army Corps and South Florida Water Management District, along with Miami-Dade County, are working on a component of the multi-billion dollar Comprehensive Everglades Restoration Plan, called the Biscayne Bay and Southeastern Everglades Ecosystem Restoration (BBSEER) project. This ecosystem restoration project directs surface and groundwater to the coast in efforts to restore hydrologic patterns resembling historic conditions. At this location, fresh water hydrating the coastline, Biscayne Bay, and Biscayne National Park would reinvigorate an ecosystem in precarious decline for lack of the fresh, clean water that once feathered from the Everglades into the Biscayne Bay.
Turkey Point, its 5,900 acres of cooling canals, and the lingering hypersaline plume are literal

impediments to the ecosystem restoration project. Any re-licensing review needs to thoroughly explore how the continued existence of the cooling canals and the underground hypersaline plume could blunt the objectives of a federally funded ecosystem restoration project. The license extension review should also evaluate a range of alternatives to the cooling canal system, including a cooling tower, and the water used to freshen the CCS or to supply a cooling tower. (**31-11** [Silverstein, Rachel])

Comment: On behalf of nearly 60 state, local and national organizations which make up the Everglades Coalition and its many individual members and supporters, we thank you for the opportunity to provide the following comments. Please include this letter as part of the responsive comments to the Federal Register notice issued March 10, 2023, at 88 FR 14958 regarding the agency's revision of its Generic Environmental Impact Statement for License Renewal of Nuclear Plants rule (LR GEIS). In the interest of protecting the health and integrity of the greater Everglades ecosystem, Florida's valuable natural resources, fresh-water supplies, and national parks, we strongly urge you to revise the LR GEIS in a way that incorporates the need for site-specific evaluations of unique and significant environmental impacts related to the Cooling Canal System (CCS) at the Turkey Point plant.

The CCS poses unique and significant geologic, hydrological, water, and aquatic issues that should require site-specific environmental assessments at the Turkey Point plant. We trust the following information will inform the revision of your rule. (**36-1** [Reynolds, Laura])

Comment: Surface Water Resources: This is a unique, significant, and site-specific consideration. The plant and CCS are vulnerable to sea level rise and storm surge and discharge of biocides, sanitary wastes, and various chemicals. Turkey Point sits inside the boundaries of Biscayne National Park and is surrounded by wetlands earmarked for Everglades restoration activities, any discharges will have significant adverse impacts on the environment, as well as any usage of surrounding surface waters. Surface to surface water interactions happen regularly, especially during King Tides, storm events, heavy rains; there is an overflow of the CCS on a regular basis and this interacts with the surrounding resources. Biscayne Bay is a designated Outstanding Florida Water Body, National Park and Aquatic Preserve and therefore deserves a site specific level of review. In addition to contamination, the CCS evaporates away 40 MGD and regularly uses between 3-5 MGD of freshwater otherwise earmarked for restoration and drinking water. The use of surface waters from the model lands region have been recorded by Miami Dade County DERM up to 90 MGD. The current operations are exacerbating saltwater intrusion to the west, while restoration efforts from Biscayne Bay Southeastern Everglades Restoration (BBSEER) are working to slow this process and restore coastal wetlands. (**36-3** [Reynolds, Laura])

Comment: South Florida is a highly transmissive area due to its unique geology and Turkey Point has a CCS that, at the time of licensing, was an experimental design, it has never been replicated anywhere else in the world. It is not a closed-loop system as determined recently by the Department of Environmental Protection in its new operating license. This coalition's concern is that we protect the investments of Everglades Restoration activities by ensuring there are no conflicts with our restoration efforts. We ask that you not use a one size fits all generic EIS process for this unique area and circumstance, but instead consider the uniqueness of this area and ensure you are taking into account all of this site-specific information and data that has been collected by various agencies, nonprofits, and governments.
(**36-7** [Reynolds, Laura])

Response: *The NRC agrees in part and disagrees in part with these comments. The NRC agrees with the comments that suggest that the NRC needs to consider unique issues and impacts at nuclear power plant sites as part of the NRC's license renewal environmental reviews. Plant- or site-specific environmental issues and concerns associated with operating nuclear power plants, such as those raised in the comments, are considered in a plant-specific supplement to the LR GEIS in accordance with the NRC's regulations set forth in 10 CFR Part 51. This revision to the LR GEIS was informed by lessons learned and knowledge gained from conducting initial LR and SLR environmental reviews since development of the 2013 LR GEIS, as discussed in Section 4.1.3 of this LR GEIS. This includes new information identified by the NRC staff during the SLR environmental review for Turkey Point Nuclear Generating Units 3 and 4 (NRC 2019a). Some of the particular hydrologic and ecological characteristics of the Turkey Point cooling canal system (CCS) are described in Sections 3.5.1.1, 3.6.3.1, and 3.6.6.3 of this LR GEIS. As stated in Section 1.11, the SLR environmental review of Turkey Point identified new and significant information related to CCS operation. The NRC staff determined, in part, that hypersaline groundwater (containing soluble salts, nutrients, and tritium) had migrated beyond the boundaries of the CCS and that a hypersaline groundwater plume was also a significant contributor to the westward migration of the saltwater interface and would remain so without mitigation. As a result of this information, a previously designated Category 1 issue, "Groundwater quality degradation (plants with cooling ponds in salt marshes)," and a previously designated Category 2 issue, "Groundwater quality degradation (plants with cooling ponds at inland sites)," were consolidated into a new Category 2 issue, "Groundwater quality degradation (plants with cooling ponds)" in this LR GEIS. The technical basis for this revised issue is described in Section 4.5.1.2.6 of this LR GEIS.*

The NRC disagrees with the comments that site-specific characteristics of the Turkey Point site and operation of the CCS provide justification to modify the LR GEIS and rulemaking and its characterization of several environmental issues from Category 1 (generic) to Category 2 (plant-specific). With regard to the suggestion that all surface water resources be treated as site- (plant-) specific due, in part, to the Turkey Point plant and CCS being affected by sea level rise, storm surge, king tides, and other events, the effects of such natural phenomena on structures, systems, and components are outside the scope of the NRC's license renewal environmental review. The environmental review documents the potential effects from continued nuclear power plant operations on the environment. However, a nuclear power plant is subject to continuous NRC oversight. On an ongoing basis, this oversight assesses the safety of structures, systems, and components of a nuclear power plant, including their exposure to hazards such as flooding. In the event a condition is needed to ensure public safety, it would be imposed by the NRC as part of its oversight of the operating license, outside the scope of license renewal.

The NRC also disagrees that the Category 1 issue "Discharge of metals in cooling system effluent" should be revised to Category 2 with an impact of MODERATE/LARGE. The scope and associated technical basis for this issue are described in Section 4.5.1.1.6 of this LR GEIS. For the issue of "Discharge of metals in cooling system effluent," the NRC's review of available information including lessons learned and knowledge gained from conducting environmental reviews for initial LR and SLR since 2013, which included the SLR environmental review for Turkey Point (NRC 2019a), revealed no instances in this updated information where the discharge of metals has resulted in violations of water quality standards in receiving waters or was injurious to aquatic life. Additionally, the discharge of metals in cooling system effluent is regulated under the nuclear plant's NPDES or a State-issued equivalent permit. The NRC has affirmed that this issue is properly designated as a Category 1 issue with an impact of SMALL,

because the environmental impacts were found to be the same or similar at all plant sites. However, a designation of an issue as a Category 1 issue does not mean that potential impacts are not considered. During the preparation of plant-specific supplements to the LR GEIS, the NRC staff considers changes in nuclear power plant operating parameters and new and potentially significant information provided by the applicant or identified through public comments, or resulting from NRC's due diligence in reviewing relevant information. Data are reviewed in part for information that could change the conclusion in the LR GEIS with regard to an issue. Thus, even though an issue is a Category 1 issue, mechanisms are in place to conduct a full plant-specific review if new and significant information warrants such a review.

Further, the NRC disagrees that the significance finding for the Category 2 issue of "Surface water use conflicts (plants with cooling ponds or cooling towers using makeup water from a river)" should be revised from SMALL/MODERATE up to MODERATE/LARGE based on the Turkey Point CCS's interaction with ecosystem restoration projects, the need to consider replacement of the CCS with cooling towers, and other factors. The scope and associated technical basis for making the significance finding for this issue are described in Section 4.5.1.1.9 of this LR GEIS. This issue is not applicable to the Turkey Point site, where the CCS is an enclosed waterbody excavated into the underlying bedrock with no direct inlet or outlet to receiving waters, aside from groundwater exchange, and which no makeup water is provided from a river (see NUREG-1437, Supplement 5, Second Renewal; NRC 2019a).

To the extent that some comments suggest that the NRC must consider and evaluate cooling towers as an alternative to cooling ponds under this Category 2 issue, the NRC does not have the authority to require its licensees to utilize a particular type of cooling system. For the Category 2 issue of "Surface water use conflicts (plants with cooling ponds or cooling towers using makeup water from a river)," the NRC's plant-specific analysis focuses on the potential impacts of continued operations of the nuclear plant and its associated cooling system as it exists and is licensed to operate. The NRC would, however, consider appropriate mitigation measures for adverse (MODERATE or LARGE) environmental impacts. Such mitigation measures would be identified in proportion to the potential adverse impact. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.

Comment: The draft document claims that effects on salinity gradients would be limited to the area in the vicinity of the intake and discharge structures. These impacts have been assumed to be SMALL at operating nuclear power plants.

This is a site-specific issue and an incorrect assumption for operations at Turkey Point Power Plant. It is now understood that the Turkey Point Power Plant has a large saline groundwater plume underneath the plant, the CCS, the adjacent wetlands to the west and Biscayne National Park to the east. A 2016 study by the US Geological Survey (USGS) showed that the saltwater intrusion line in the Model Lands basin, immediately adjacent to Turkey Point Power Plant, is advancing westward at a rate of 140 meters per year. This rapid migration of salt water is in part due to the operations at Turkey Point Power Plant. In addition, saltwater contamination has recently been documented in the nearby L-31E canal, a historically freshwater canal. Therefore, the operations at Turkey Point Power Plant should specifically be considered when reviewing a license renewal for this criterion. (**30-3** [Spadafina, Lisa])

Comment: (11) Altered Salinity Gradients

This issue must be modified from a "1" to a "2" and significance should be elevated from "small" up to "moderate/large". As noted above, Miami-Dade County has documented salinization

events on the L-31E canal that may be caused by cooling canal water augmentation. The L-31E, a freshwater canal, discharges water to the Biscayne Bay Aquatic Preserve. The waters of the preserve are historically estuarine, and life is adapted for estuarine conditions less saline than marine waters.

Any review of a future license extension should consider hydrological interactions between the cooling canal system, the L-31E, and any nearby control structures. If operation of the CCS is causing salinizing events to occur outside of the cooling canals, license review should also examine impacts to affected surface waters, ecological communities, and endangered species. (**31-10** [Silverstein, Rachel])

Response: *The NRC agrees in part and disagrees in part with these comments. The NRC agrees with the comments that suggest that the NRC needs to consider unique issues and impacts at nuclear power plant sites as part of the NRC's license renewal environmental reviews. The NRC disagrees that hydrologic interactions and operational effects of the Turkey Point CCS including the L-31E canal reflect information that supports changing the Category 1 issue, "Altered salinity gradients," to Category 2 with an impact of MODERATE/LARGE. The scope and associated technical basis for this issue are described in Section 4.5.1.1.3 of this LR GEIS. The issue of "Altered salinity gradients" is applicable to operating nuclear plants that have cooling systems that withdraw water from and discharge directly to receiving waters. It is not applicable to the Turkey Point site, where the CCS is an enclosed waterbody excavated into the underlying bedrock with no direct inlet or outlet to receiving waters—including Biscayne Bay or other surface waters—aside from groundwater exchange, as described in NUREG-1437, Supplement 5, Second Renewal (NRC 2019a).*

Separately, however, the NRC considers site-specific hydrologic conditions associated with the operation of cooling ponds in this LR GEIS. As stated in Section 1.11 of this LR GEIS, the NRC's SLR environmental review for Turkey Point identified new and significant information related to CCS operation. This information included consideration of the Turkey Point CCS's contribution to the westward migration of the saltwater interface in the Biscayne Aquifer. As a result of this information, a previously designated Category 1 issue, "Groundwater quality degradation (plants with cooling ponds in salt marshes)," and a previously designated Category 2 issue, "Groundwater quality degradation (plants with cooling ponds at inland sites)," were consolidated into a new Category 2 issue, "Groundwater quality degradation (plants with cooling ponds)," in this LR GEIS. The technical basis for this revised issue is described in Section 4.5.1.2.6 of this LR GEIS. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.

Comment: c. Discharge of Metals in Cooling System Effluent
The Draft GEIS notes two events in which plants discharged elevated copper levels, resulting in negative impacts to the local ecosystem. The Draft GEIS just notes that "[i]n both cases, copper condenser tubes were replaced with titanium ones, and the problem was eliminated."[63] The Draft GEIS fails to note whether other plants replaced copper condenser tubes to eliminate this problem at all nuclear plants.

[63] Draft GEIS at 4-28. (**32-5-2** [Reiser, Caroline])

Response: *The NRC disagrees with this comment. As stated in Section 4.5.1.1.6 of this LR GEIS, the discharge of metals in cooling system effluent is regulated under the nuclear plant's NPDES permit or a State-issued equivalent permit. These permits typically require monitoring for levels of contaminants in the discharge based on potential pollutant sources.*

When exceedances of the permitted limits are detected, the responsible regulatory authorities are notified, and corrective actions are taken. Further, this revision of the LR GEIS, and the associated review and update of this Category 1 issue, was informed by lessons learned and knowledge gained from conducting initial LR and SLR environmental reviews since development of the 2013 LR GEIS. The NRC found no instances in this updated information where the discharge of heavy metals in cooling system effluent has resulted in violations of water quality standards in receiving waters or was injurious to aquatic life. Without reported exceedances at other nuclear plants that can be attributed to cooling system design features, there is no evidence to suggest that replacement of copper condenser tubes would be warranted at all plants. No changes were made in the LR GEIS, final rule, or guidance as a result of this comment.

Comment: d. Surface Water Use Conflicts (plants with once through cooling systems)
The Draft GEIS concludes that surface water use conflicts for plants with once through cooling systems is a Category 1 issue but that surface water use conflicts for plants with cooling ponds or towers is a Category 2 issue. The Draft GEIS is not explicit on why these issues, which are the same environmental impact from a different plant design, can be assigned different Categories.

The factors that the Draft GEIS relies on to conclude surface water use conflicts for plants cooling tower systems must be Category 2 could just as easily apply to surface water use conflicts for plants with once through cooling system.[64] This suggests that both issues should be Category 2.

[64] Draft GEIS at 4-31 ("differing site-specific factors, such as makeup water requirements, water availability (especially in terms of varying river flow rates), changing or anticipated changes in population distributions, or changes in agricultural or industrial demands."); *see also* Draft GEIS at 4-32 ("factors such as plant-specific design characteristics affecting consumptive water use, the characteristics of the water body serving as the source for makeup water, and the amount of competing use for that water. Because the impact could vary among nuclear plants, this is a Category 2 issue.").

If the NRC continues to believe that surface water use conflicts for plants with once through cooling systems can be Category 1, then the agency must clarify the reasons why it believes that once-through and cooling tower systems deserve different treatment. Based on the discussion in the Draft GEIS, a possible reason is that "thermoelectric plant once-through cooling systems return most of their withdrawn water to the same surface water body, with evaporative losses of approximately 1 percent, compared to 57 percent for closed-cycle (recirculating) cooling systems."[65] But because far less water goes through a closed-cycle system than a once-through cooling system, losing 57 percent of that smaller total amount may well be smaller than losing 1 percent of the larger amount. The vague discussion by the Draft GEIS fails to acknowledge or address this possibility. The NRC must provide estimates of the quantity of water not simply a percentage, similar to how the Draft GEIS differentiates groundwater use conflicts by the amount of water used--less than 100 Gallons per Minute versus more than 100 gallons per minute.

[65]Draft GEIS at 4-29. (**32-5-3** [Reiser, Caroline])

Response: *The NRC agrees in part and disagrees in part with these comments. The NRC agrees that the LR GEIS should be clear about why the categorization and significance levels for the issues, "Surface water use conflicts (plants with once-through cooling systems)" and*

"Surface water use conflicts (plants with cooling ponds or cooling towers using makeup water from a river)" differ (see Sections 4.5.1.1.8 and 4.5.1.1.9, respectively, in this LR GEIS). The NRC disagrees that the LR GEIS does not provide sufficient reasoning for why the former issue is Category 1 and the latter Category 2. As discussed in Section 4.5.1.1.9, reasons for the differences between the findings for the two issues include the fact that State and Federal regulatory agencies, other than the NRC, have found it necessary to impose surface water withdrawal limits on a number of operating nuclear power plants that use cooling towers and cooling ponds. Additionally, as described in Section 3.5.1.1 and shown in Table 3.5-1, on a per-unit energy production basis, once-through cooling systems have lower overall consumptive water loss than closed-cycle systems. Section 3.1.3 of this LR GEIS describes the cooling water systems and sources of water used at existing nuclear power plants along with their comparative performance characteristics, and Section 3.5.1.1 further provides a comparative analysis of the rates of water withdrawal and consumptive water use by cooling water system design at operating nuclear plants (see Table 3.5-1).

The discussion in Section 3.5.1.1 describes water use differences among the various cooling systems including once-through and closed-cycle systems. The differing findings between the two issues are supported by lessons learned and knowledge gained from conducting initial LR and SLR environmental reviews since the LR GEIS was first published in 1996. This latest revision of the LR GEIS considers nuclear power plant environmental operating experience associated with once-through, closed-cycle, and hybrid cooling systems, including documented water withdrawals and consumptive use at operating nuclear plants. As a result, surface water use conflicts for once-through cooling systems are appropriately assigned Category 1 with an impact significance level of SMALL, while surface water use conflicts for plants with cooling ponds or cooling towers using makeup water from a river are assigned Category 2 with an impact level of SMALL or MODERATE. Nevertheless, even though an issue is considered to be a Category 1 issue in the LR GEIS, mechanisms are in place to conduct a full plant-specific review if new and significant information warrants such a review. The NRC has revised Sections 4.5.1.1.8 and 4.5.1.1.9 in this LR GEIS to clarify the NRC's rationale and to specifically provide appropriate cross references to Sections 3.1.3 and 3.5.1.1.

Comment: Scouring Caused by Discharged Cooling Water. The Draft GEIS states that, in the 1996 GEIS, scouring had been noted as a problem only at Calvert Cliffs, Connecticut Yankee, and San Onofre.[144] This section of the Draft GEIS is almost word for word that which was included in the 2013 GEIS.[145] Yet since 1996, scouring has been observed at Diablo Canyon.[146] The NRC did not address scouring in the 2013 GEIS, thus this information remains new and significant unless the NRC can explain why it did not need to consider it.

[144] Draft GEIS at 4-27.
[145] Compare 2013 GEIS at 4-38 with Draft GEIS at 4-27.
[146] Licensed to Kill, 6, 18 (2001) http://www.nirs.org/wp-content/uploads/reactorwatch/licensedtokill/LiscencedtoKill.pdf (**32-9-6** [Reiser, Caroline])

Response: *The NRC disagrees in part and agrees in part with this comment. The NRC disagrees that it has not considered new information relevant to the Category 1 issue, "Scouring caused by discharged cooling water." Similar to the NRC's 2013 rulemaking and associated LR GEIS update, this revised LR GEIS and rulemaking were informed by lessons learned and knowledge gained from conducting initial LR and SLR environmental reviews since development of the 2013 LR GEIS, as discussed in Section 4.1.3 of this LR GEIS. The NRC considered available new information regarding the impacts of physical scouring associated with the high-flow rate of water from nuclear power plant cooling system discharge structures. This*

included any new information provided in public comments submitted on the draft LR GEIS in 2009. The NRC has identified no new and significant information with respect to the scope of this issue at any nuclear plant. The information cited in the comment does not provide a sufficient basis to indicate that any scouring at Diablo Canyon constitutes new information for the NRC's consideration for this LR GEIS review and update. Separately, however, the NRC discusses documented environmental effects on the aquatic environment from Diablo Canyon's cooling system operations throughout this revised LR GEIS (see Sections 4.5.1.1.6, 4.6.1.1.3, and 4.6.1.2). To the extent that the comment suggests that the NRC must consider and evaluate the thermal impacts of once-through cooling systems on the aquatic environment, the NRC agrees. As described in Section 4.6.1.2.4 of this revised LR GEIS, "Effects of thermal effluents on aquatic organisms (plants with once-through cooling systems or cooling ponds)" is a Category 2 issue, requiring nuclear power plant-specific environmental analyses for impact determination. The NRC has not completed a license renewal environmental review for Diablo Canyon, as documented in either a draft and/or final plant-specific supplement to the LR GEIS. However, Pacific Gas and Electric submitted a license renewal application for Diablo Canyon in November 2023. As a result, the NRC will conduct an environmental review leading to the preparation of a plant-specific supplement (i.e., SEIS) to the LR GEIS. In addition to performing plant-specific analyses for all applicable Category 2 issues, the NRC staff will then consider any new information that might alter the NRC's conclusions related to Category 1 (generic) issues as part of this LR GEIS review and update, including those related to the issue "Scouring caused by discharged cooling water" as well as the thermal effects from the discharged cooling water. The NRC revised Section 4.5.1.1.5 of this LR GEIS to clarify the scope of the Category 1 issue, "Scouring caused by discharged cooling water." No other changes were made in the final rule or guidance as a result of this comment.

Comment: Surface Water use Conflicts (plants with once through Cooling Systems). The Draft GEIS acknowledges that climate change will result in new precipitation and temperature patterns, which will affect the availability of surface water.[147] Yet the Draft GEIS concludes that there is no new and significant information that would result in different impacts.

[147] Draft GEIS at 4-29 – 4-30. (**32-9-7** [Reiser, Caroline])

Response: *The NRC disagrees with this comment. This revision of the LR GEIS and rule, including the NRC's review of the findings for the Category 1 issue, "Surface water use conflicts (plants with once-through cooling systems)" presented in Section 4.5.1.1.8, was informed by lessons learned and knowledge gained from conducting initial LR and SLR environmental reviews since development of the 2013 LR GEIS (see Section 4.1.3 of this LR GEIS). The NRC's review of this new information did not provide any basis for the NRC to revise its impact finding for the issue in question. Specifically, in looking at this new information, the NRC concluded that the impact for "Surface water use conflicts (plants with once-through cooling systems)" remains SMALL because plant operations will not destabilize or noticeably alter surface water availability because most water withdrawn with such systems is returned to the surface waterbody. As stated in Section 4.5.1.1.8, the effects of climate change are of greater concern for water use conflicts associated with nuclear power plants that have closed-cycle cooling systems rather than once-through systems. Nevertheless, increased temperature and decreased rainfall resulting from climate change could adversely affect water availability across any watershed. Such changes could be considered new and significant information and, if so, would be evaluated in plant-specific environmental reviews. Separately, the NRC has designated "Climate change impacts on environmental resources" as a new, Category 2 issue in Section 4.12.2 of this LR GEIS and the final rule. Because the effects of climate change can vary regionally and climate change information at the regional and local scale is necessary to*

assess the impacts on environmental resources, climate change impacts will be evaluated in future plant-specific supplements to the LR GEIS, or similar analysis. The impacts of climate change on different resource areas will be evaluated through this category issue. No changes were made in the LR GEIS, final rule, or guidance as a result of this comment.

Comment: In the interest of brevity, I do not discuss the thermal power plant cycle at nuclear power plants since that is discussed in the proposed Revision 2 to NUREG-1437 and elsewhere. I note, however, that the thermal cycle requires that a significant amount of heat or thermal energy be discarded from the condenser of a power plant unit. Commonly, this heat is released to the ambient environment by using copious quantities of cooling water. Plants are generally located near large bodies of water such as near coastlines, lakes, rivers, impoundments, etc. to provide ready access to cooling water. I note that when the cooling water is discharged back to the environment, it is hotter than the intake water and, as a result, there is a thermal plume or impact in the receiving water body that impacts all biological organisms in the receiving waters. (**32-10-3** [Reiser, Caroline])

Comment: In addition to cooling water, nuclear power plants also generate non-cooling water waste streams which are also released to the ambient environment. (**32-10-5** [Reiser, Caroline])

Comment: Waste contaminants associated with water releases include conventional as well as radiological pollutants. (**32-10-6** [Reiser, Caroline])

Response: *The NRC acknowledges the comments. The effects of thermal discharges on receiving waterbodies from nuclear power plants during the license renewal term are described in Sections 4.5.1.1.11, 4.6.1.2.4, 4.6.1.2.5, and 4.6.1.2.6 of this LR GEIS. The effects of effluent discharges are described in Sections 4.5.1.1.1, 4.5.1.1.6, 4.5.1.1.7, and 4.6.1.2.11. The effects of nonradiological contaminants and radionuclides on aquatic resources are described in Sections 4.6.1.2.7 and 4.6.1.2.8, respectively. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.*

Comment: C. NRC's Classification of Surface Water Impacts as (Mostly) Category 1 is Unsupported

Here, the trigger for the environmental impact analysis under NEPA is the consideration of whether to renew a plant's license - either for the first time or for a subsequent time. As such, the import of this decision will be to allow the continued operation of the plant for multiple decades into the future. Thus, deeming an impact to be Category 1 means that its impact will be generic for multiple decades into the future at any plant site.

Yet, specifically for surface water, in every instance with one exception, the NRC has, in its proposal, deemed the impact to be SMALL. I therefore investigated how the NRC analytically supported its determination that the impacts would be SMALL for each of the many surface water issues that it addresses in the proposal. The lack of support in each instance became obvious.

C1. Types of surface water impacts

The proposal addresses the following types of surface water impacts during the initial or subsequent license renewal for a plant:

- surface water use and quality (non-cooling system impacts);

- altered current patterns at intake and discharge structures;
- altered salinity gradients;
- 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;
- surface water use conflicts (plants with once-through cooling systems);
- surface water use conflicts (plants with cooling ponds or cooling towers using makeup water from a river);
- effects of dredging on surface water quality; and
- temperature effects on sediment transport capacity.

These are addressed in Section 4.5 of the proposed Revision 2 to NUREG-1437.

In every single instance of these surface water impacts (with the single exception of surface water conflicts for Plants with Cooling Ponds or Cooling Towers Using Makeup Water from a River), the proposal deems the impacts to be Category 1, i.e., generic, impacts.
(**32-11-3** [Reiser, Caroline])

Comment: C2. Example of unsupported Category 1 classification

I will illustrate the lack of support for this Category 1 classification using the example of one specific surface water impact, altered current patterns at the intake and discharge structures. I stress that this example is not unique and that the same lack of support permeates the misclassification of Category 1 for each of the other surface water impacts.

Below is the entire discussion relating to altered current patterns at the intake and discharge structures, provided in Section 4.5.1.1.2 of the proposed Revision 2 to NUREG-1437.

"The large flow rates associated with cooling system water use have the potential to alter current patterns. The degree of influence depends on the design and location of the intake and discharge structures and the characteristics of the surface water body. The effect on currents near the intake and discharge locations is expected to be variable and localized, and any problems would have been mitigated during the early operational period of a nuclear power plant (NRC 1996). Most nuclear power plants are sited on large bodies of water to make use of the water for cooling purposes. The size of large rivers, lakes, or reservoirs precludes significant current alterations except in the vicinity of the structures. For ocean shore, bay, or tidally influenced river settings, the effect is further reduced when compared with the strong natural water movement patterns. For example, current patterns were modified at the Oyster Creek Nuclear Generating Station (Oyster Creek; which permanently shut down in September 2018). The plant site is located inland from Barnegat Bay in New Jersey. The once-through cooling system for this plant was created by modifying two small rivers originally flowing parallel into the bay. On the north side of the plant, the South Branch of the Forked River was enlarged between the plant and the bay to serve as an intake canal. On the south side of the plant, Oyster Creek was enlarged between the plant and the bay for use as a discharge canal. Near the plant, the

two waterways were joined. Bay water was pulled from the bay through the intake canal to the plant, against the original flow direction of the lowest reach of the South Branch of the Forked River. Flow at the mouth of this river was both reversed and significantly increased, while flow at the mouth of the Oyster Creek discharge canal significantly increased during plant operations. While current patterns in Barnegat Bay in the immediate vicinity of the intake and discharge canals were affected by operations, the effect on the overall Barnegat Bay system was minor (NRC 1996; NRC 2007b).

This issue has no relevance to nuclear power plants relying on cooling ponds or canal systems because such structures are human made (excavated earthworks or engineered impoundments) without natural currents.
Impacts from altered current patterns at intake and discharge structures during the license renewal term were considered to be SMALL for all plants and designated as Category 1 in the 2013 LR GEIS. The staff reviewed information from SEISs (for initial LRs and SLRs) completed since development of the 2013 LR GEIS and identified no new information or situations that would result in different impacts for this issue for either an initial LR or SLR term. On the basis of these considerations, the impact of altered current patterns at intake and discharge structures would be SMALL during the initial LR and SLR terms for all nuclear plants. This is a Category 1 issue." (emphasis added)

The NRC 1996 citation in the discussion above is the 1996 GEIS. The NRC 2007b reference is to Supplement 28 of the GEIS, specifically dealing with Oyster Creek. It is clear from the discussion above that while the NRC admits that this impact has the potential to alter current patterns and that the "degree of influence depends on the design and location of the intake and discharge structures and the characteristics of the surface water body..." nonetheless, and with no justification, the NRC simply states that "[T]he effect on currents near the intake and discharge locations is expected to be variable and localized, and any problems would have been mitigated during the early operational period of a nuclear power plant (citing to the 1996 GEIS)."[4] We will examine the discussion in the 1996 GEIS shortly below. The rest of the discussion focuses on a single example plant, Oyster Creek, which has now shutdown, before concluding in the last paragraph that the impacts will be SMALL "for all plants" referencing the same determination in the 2013 LR GEIS and unspecified staff review of other SEIS completed since the 2013 LR GEIS. On this basis, this impact is deemed to be Category 1 for all plants.

[4] Proposed Revision 2 to NUREG-1437, p. 4-25.

Since the proposed Revision 2 to NUREG-1437 cites to the prior 2013 LR GEIS, I provide the entire discussion on this same impact from that document below:

"The large flow rates associated with cooling system water use have the potential to alter current patterns. The degree of influence depends on the design and location of the intake and discharge structures and the characteristics of the surface water body. The effect on currents near the intake and discharge locations is expected to be localized, and any problems would have been mitigated during the early operational period of a plant (NRC 1996). Most nuclear power plants are sited on large bodies of water to make use of the water for cooling purposes. The size of large rivers, lakes, or reservoirs precludes significant current alterations except in the vicinity of the structures. For ocean shore or bay settings, the effect is further reduced when compared with the strong natural water movement patterns. For example, current patterns have been modified at the Oyster Creek plant, which is located inland from Barnegat Bay in New Jersey. The once-through cooling system for this plant was created by modifying two small rivers originally flowing parallel into the bay. On the north side of the plant, the South Branch of

the Forked River was enlarged between the plant and the bay to serve as an intake canal. On the south side of the plant, Oyster Creek was enlarged between the plant and the bay for use as a discharge canal. Near the plant, the two waterways were joined. Bay water is pulled from the bay through the intake canal to the plant, against the original flow direction of the lowest reach of the South Branch of the Forked River. Flow at the mouth of this river is therefore both reversed and significantly increased, while flow at the mouth of the Oyster Creek discharge canal is significantly increased. While current patterns in Barnegat Bay in the immediate vicinity of the intake and discharge canals are affected by operations, the effect is minor on the overall Barnegat Bay system (NRC 1996, 2007b). (**32-12-1** [Reiser, Caroline])

Comment: This issue has no relevance to plants relying on cooling ponds because they are man-made features without natural currents.

Impacts from altered current patterns at intake and discharge structures during the license renewal term were considered to be SMALL for all plants and were designated as a Category 1 issue in the 1996 GEIS. No new information has been identified in plant-specific SEISs or associated literature that would change this conclusion. On the basis of these considerations, the impact of altered current patterns at intake and discharge structures would be SMALL for all nuclear plants and remains a Category 1 issue."[5] (emphasis added)
[5] 2013 GEIS, Volume 1, p. 4-36.

The 2013 text is almost identical to the proposed 2023 text, with the exception of changing the reference in the last paragraph from the 2013 LR GEIS in the proposal to the 1996 GEIS in the 2013 LR GEIS. Naturally, the next logical step was to review the 1996 GEIS to see if that document had any sort of analysis supporting the Category 1 (or 2) determinations for this specific surface watery impacts. Unfortunately, that is not the case. The "analysis" in the 1996 GEIS on this impact is equally lacking, as I walk through in the next paragraphs.

While admitting that "[O]peration of the cooling system usually causes changes in water currents in the immediate vicinity of both the intake and the outfall. The extent of the changes depends on the design and siting of the intake and discharge and the nature of the body of water (citation omitted)...." the 1996 GEIS simply states that "[B]ecause many nuclear plants are located on large rivers, lakes, reservoirs or on the seacoast, such localized altered current patterns are minor." It goes on to admit that "...plants sited near small bodies of water may have marked effects on current patterns...." providing an example of such impacts at the Oyster Creek Nuclear Generating Station (NGS), which the 1996 GEIS admits "...changed the flows of the lower portions of Oyster Creek and South Branch Forked River from alternating flows typical of estuarine streams to unidirectional flows with constant salinity..." Sticking with Oyster Creek as the one and only example, the 1996 GEIS notes that "[A]lthough substantial changes to the hydrology and water quality of these small streams have been documented, there have been only minor effects on nearby Barnegat Bay (citation omitted, 1984)." It then simply generalizes to conclude that "[C]hanges to current patterns are of small significance if they are localized near the intake and discharge of the power plant and do not alter water use or hydrology in the wider area."[6]
[6] 1996 GEIS, p. 4-4, 4-5.

None of this "analysis" is quantitative. Terms like "small" and "large" or "local" and "wider area" are not defined. Nor is the impact itself quantified by any metric before concluding that they are "small."

The 1996 GEIS then simply sweepingly states that "[B]ased on a review of the published literature and operational monitoring reports, operation of the cooling system is expected to cause only small, localized changes to current patterns near the power plant and would not contribute to the cumulative impacts." No citations relating to this review are provided. And, as its basis for the Category 1 determination, the 1996 GEIS states, "[F]urther, consultation with the utilities and regulatory agencies during preparation of the draft GEIS, as well as their comments on the draft GEIS, revealed no concerns about the individual or cumulative impacts of cooling system operations on current patterns. The impacts of altered current patterns will continue to be localized and of small significance. No change in operation of the cooling system is expected during the license renewal term, so no change in effects on current patterns is anticipated."[7]

[7] Id.

The 1996 GEIS also summarily dismisses, with no analysis, mitigation measures like cooling towers or other closed-cycles to reduce surface water impacts. The 1996 GEIS simply nots that "...these measures would be costly and are not reasonable in light of the small benefits that might be gained from their implementation."

Summing up, the 1996 GEIS states that "[F]or these reasons, the effect of once-through cooling system operation on current patterns is a Category 1 issue." (**32-12-2** [Reiser, Caroline])

Comment: C.2 Conclusions from this example

The purpose of my long exposé above using this one example of changes to the current near the intake and outfall is to show that: (i) there is no analysis to support the NRC's Category 1 determination for "all plants," tracing this all the way back from the 2023 proposal to the previous 2013 LR GEIS and back to the initial 1996 GEIS; and (ii) that on its face, the NRC has provided no basis for its Category 1 determination for "all plants" (i.e., for all plants where there are likely to be changes to the current patterns).

I will not make these comments even longer by doing the same exercise above (i.e., tracing back from the 2023 proposal through the 2013 LR GEIS and back to the 1996 GEIS) for each of the other surface water impacts that are noted in these documents. However, I have reviewed each of them, and each and every one suffers from the same deficiency - namely that the NRC's Category 1 determination in the proposed Revision 2 to NUREG-1437 is accompanied by no analysis, other than some sporadic examples,[8] followed by references to the similarly-lacking 2013 LR GEIS, which then points to the deficient 1996 GEIS.

[8] Such as Oyster Creek for the example above; Oyster Creek as well as Calvert Cliffs and Surry for how there is little impact due to altered salinity gradients; Oconee, McGuire, and Point Beach for thermal stratification of lakes and how this is addressed in the NPDES permitting process; Calvert Cliffs and two non-operating plants for scouring and how that is minimal; Byron and Diablo Canyon for how metal impacts are small; Fermi for how its NPDES permit protected against biocide discharges; and finally Oyster Creek and Surry for how dredging is not an issue and handled properly via other permits. (**32-13-1** [Reiser, Caroline])

Comment: First, a plain reading of the 1996 GEIS makes it clear that the purpose of many of the discussions was to conclude that mitigation of surface water impacts by using closed-cycle cooling or cooling towers was simply unnecessary because they were costly. This conclusion was reached with little to no analysis. It is problematic because closed-cycle cooling using cooling towers can be a very effective mitigation to minimize all aspects of surface water

impacts, including adverse impingement and entrainment impacts on aquatic species in the intake water as well as adverse thermal impacts on the discharge cooling water from the plant. There are numerous instances of thermal power plants where plant-specific NPDES permits have shirked applying closed-cycle cooling and continued adverse impacts on the source/receiving waters by granting variances for many years. A site-specific review of incorporating closed-cycle cooling is imperative as an overall mitigation to surface water quantity impacts in each instance where closed-cycle cooling is not fully implemented at a plant. (**32-13-2** [Reiser, Caroline])

Comment: Third, in a few instances (such as the impacts due to non-cooling water impacts; impacts due to altered thermal stratification of lakes; the discharge of metals in cooling system effluents; and discharge of biocides, sanitary wastes, and minor chemical spills) the discussions in the proposed Revision 2 to NUREG-1437 as well as the prior 2013 and 1996 discussions take the position that, since nuclear power plants are subject to Clean Water Act NPDES permitting, these permits and their conditions would ensure that impacts are small or minimal. Similarly adverse impacts due to dredging are dismissed as being properly addressed by other permits such as Army Corps Section 404 permits etc.

These are simply assumptions without foundation. Just because a thermal power plant has a permit does not mean that it is in compliance with the permit at all times based on my experience and consulting practice for the last 20 years. As an example, EPA's ECHO database notes that there were Clean Water Act violations for the Browns Ferry plant in the second quarter of 2020 and also in the second quarter of 2022.[10] Further, even though many nuclear power plants have been operating for decades, their permits do not assess their impacts properly. As an example of this, consider the permit for the Edwin Hatch plant. Even though the plant has been in operation since 1974, its 2017 NPDES permit required a temperature study to designate its thermal mixing zone within six months of issuance of the permit. Further, in addition, based on my over 20 years of experience in dealing with NPDES permits for a wide variety of dischargers, it is my opinion that such permits contain little by way of analysis to support NRC's contention that these impacts are properly evaluated in those permits and that therefore the mere requirement to obtain such a permit is sufficient to conclude that the impacts are small.

[10] https://echo.epa.gov/detailed-facility-report?fid=110000589355&ej_type=EJ
(**32-13-4** [Reiser, Caroline])

Comment: The 2023 proposal fails to support its conclusions that surface water quality impacts are Category 1. Simply including a summary statement containing the same language harking back to the 2013 and 1996 GEIS is insufficient. (**32-13-5** [Reiser, Caroline])

Response: *The NRC disagrees with these comments. The underlying purpose of this revised LR GEIS and rulemaking was to determine if the findings presented in the 2013 LR GEIS, as codified in Table B-1 of Appendix B to Subpart A of 10 CFR Part 51, remain valid for initial LR and support SLR. To make this determination, the NRC reviewed changes to applicable laws and regulations, new data in its possession from scientific literature and ongoing plant operations, collective experience, and lessons learned and knowledge gained from conducting environmental reviews for initial LR and SLR since development of the 2013 LR GEIS. The NRC has stated its methods and criteria for environmental issue identification, categorization, and definitions in Section 1.5 of this LR GEIS as well as in the footnotes to Table B–1 in Appendix B to Subpart A of 10 CFR Part 51, as revised pursuant to this final rule. This includes the significance definitions of SMALL, MODERATE, and LARGE and the criteria for a Category 1 or*

a Category 2 determination. While the NRC staff may use qualitative terms to promote plain language for characterizing the environmental effects (impacts) of nuclear power plant operations, the qualitative descriptions of these impacts are informed by quantitative data for operating nuclear power plants, where appropriate (e.g., water withdrawal and consumptive use rates, plant effluent parameters compared to permit conditions, documented changes in plant operations or plant site conditions, etc.).

Additionally, to ensure that the LR GEIS and rule can continue to be efficiently used and remain comprehensible to the public, the NRC has summarized the vast body of collected technical information about operating nuclear power plants and includes reference citations to detailed information contained in completed plant-specific supplements to the LR GEIS. With regard to the comments that this LR GEIS lacks adequate detail about nuclear power plant cooling water systems and site characteristics sufficient to inform Category 1 determinations for surface water issues, the summary information presented in Section 3.1.3 of this LR GEIS is further supported by more detailed information in Appendix C and G in addition to literature cited and referenced in this LR GEIS.

During preparation of plant-specific supplements to the LR GEIS, the NRC staff considers changes in nuclear power plant operating parameters and new and potentially significant information provided by the applicant or identified through public comments, or resulting from the NRC's due diligence in reviewing relevant information. As part of these plant-specific environmental reviews, the NRC staff specifically considers an applicant's compliance with environmental quality standards and requirements imposed by permitting and other authorities, as required by the NRC's regulations (10 CFR 51.71(d)). The NRC staff then documents relevant findings in the plant-specific supplements to the LR GEIS. The NRC's review of this information in plant-specific supplements to the LR GEIS, in combination with a review of related scientific literature and any new data from ongoing plant operations, did not provide any basis for the NRC to revise its impact findings for any of the 10 Category 1 and one Category 2 surface water issues cited in the comments.

For this review and update, the NRC appropriately considered nuclear power plant environmental operating experience based on plant-specific environmental reviews and nuclear plants' compliance with relevant environmental quality standards, permits, and authorizations issued by appropriate Federal, State, and local regulatory agencies. While the NRC cannot ensure a licensee's compliance with other regulatory authorities' requirements under the CWA or with applicable State water quality standards, the NRC can consider nuclear power plant operational impacts and environmental compliance metrics to determine whether differing levels of impact warrant changing a Category 1 (generic) issue with an impact of SMALL to Category 2 (plant-specific). The NRC did not, however, make a category determination for any surface water issues based solely on the fact that nuclear plant licensees hold CWA or State-equivalent permits.

In summary, as stated in Section 1.7.1 of this LR GEIS, each nuclear power plant licensee must obtain a NPDES permit and a State water quality certification pursuant to CWA provisions. The NPDES permitting authority, either the U.S. Environmental Protection Agency (EPA) or delegated State agency, specifies limits on the discharge of pollutants in the NPDES permit. As part of the NPDES permit approval or renewal, the effects of nuclear plant discharges to surface waterbodies are evaluated. In many cases, the location and extent of the discharge plume in the receiving waterbody are evaluated quantitatively to assess its impacts on surface water resources and aquatic life. The NPDES permits require monitoring and reporting of pollutants in the receiving waterbodies to the relevant authorities. When exceedances of the permitted limits

are detected, the responsible regulatory authorities are notified, and corrective actions are taken. CWA Section 404 permits are required for dredge and fill activities. As stated in Section 4.5.1.1.10 of this LR GEIS, the effects of dredge and fill activities have been localized and temporary and are expected to remain so during an initial LR or SLR term. Dredging has been an infrequent activity at operating nuclear power plants and best management practices are employed by the licensees to mitigate adverse effects on aquatic resources, as cited in Section 4.6.1.2.9 of this LR GEIS.

Furthermore, designation of an issue as a Category 1 issue does not mean that potential impacts are not considered. During preparation of plant-specific supplements to the LR GEIS, the NRC staff considers changes in nuclear power plant operating parameters and new and potentially significant information provided by the applicant or identified through public comments, or resulting from the NRC's due diligence in reviewing relevant information. Data are reviewed, in part, for information that could change the conclusion in the LR GEIS with regard to an issue. Thus, for a Category 1 issue, mechanisms are in place to conduct a full plant-specific review if new and significant information warrants such a review.

With regard to the comments that suggest that the NRC must consider closed-cycle cooling as a mitigation measure at operating plants that use once-through or hybrid cooling systems, the NRC does not have the authority to require its licensees to use a particular type of cooling system, nor can the NRC ensure a licensee's compliance with other regulatory authorities' requirements under the CWA or with applicable State water quality standards. Such limitations on the NRC's authority do not prevent the authorized CWA regulatory authorities from requiring licensees to undertake additional mitigation measures, such as in conjunction with the renewal of a nuclear power plant NPDES permit. Such limitations, however, have no bearing on the NRC's findings with respect to Category 1 surface water issues, where the impacts of continued operations during the license renewal term have been determined to be SMALL. In plant-specific supplements to the LR GEIS, the NRC staff impact evaluations focus on the cooling system infrastructure that the nuclear power plant was licensed to operate with and for which an initial LR or SLR is being sought. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.

Comment: E. Incomplete Description of the Plants for Surface Water Impacts

I have noted earlier that an assessment of a specific environmental impact depends on the source of that impact (i.e., the discharge of a certain volume of water, and/or its temperature, or an intake of a certain volume of water, etc.) as well as the supply/receiving water body which I have called the surrounding ambient.

This analysis can only be done, however, if the source and the surrounding ambient are thoroughly described.

In the proposed Revision 2 to NUREG-1437, relevant to surface water impacts, the document groups the current nuclear plants via their cooling water source, as summarized in the following tables which I have excerpted for ease of reference below.

[See ML23123A412 for tables 3.1-2, 3.1-3, and 3.1-4]

While these tables are helpful, they do not provide details that are relevant for the environmental impact analysis of surface water. More details should be provided.

As an example of a document that provides adequate details, I quote extensively below from a 2010 review[12] of cooling water issues and opportunities which classified the universe of plants that were operational at that time per the table below. When this level of additional detail is considered, it becomes clear that generic impact assessments such as Category 1 are improper given the variations of situations even for "similar" plants as assumed by the NRC in its non-analysis.

[12] https://www.energy.gov/ne/articles/cooling-water-issues-and-opportunities-us-nuclear-power-plants-december-2010
[See ML23123A412 for table 4-2: Number of U.S. Nuclear Plant Sites, Organized by Cooling Water Situation]
This report then provided additional details for each of the "Situations" noted in the first column of the table above.

Unlike the proposed Revision 2 to NUREG-1437, this report notes[13] that EPA distinguishes between facilities that withdraw more than 5% of mean annual flow in a river, and facilities that withdraw less than 5% of mean annual flow. Facilities that used more than 5% of the mean annual flow tend to be on small rivers. EPA also differentiates between rivers and reservoirs based on retention time of a water particle flowing down stream. If the retention time exceeds seven days it is considered a reservoir and if it is less than seven days it is a river. These are important, quantitative details that are directly pertinent for surface water impact analysis because they distinguish between different types of receiving waters (i.e., small versus large rivers, with different capacities for accommodating the impacts from the plant's intake needs and effluents) as opposed to such receiving waters being deemed to be "similar" because they are rivers.

[13] Id., p. 4-4.

The 2010 report discusses the plants in the various Situation groups in the table above as follows (omitting citations): (**32-14-1** [Reiser, Caroline])

Comment: Situation 1A:

A number of sites with cooling towers are not listed in this category because their cooling towers are "helper towers," that are used primarily during summer months and are not capable of providing 100% of the cooling of the plant at full power. Rather, they augment or assist a once-through system, especially during summer months (high cooling water temperatures and/or low river flow.) Helper towers are typically used in-line with circulating water exiting the condenser to cool that water prior to discharge to the source water body, without recirculation to the intake side of the condenser. This configuration does not reduce intake flow rates, as occurs in closed-cycle cooling.

Co-located reactors Hope Creek (Sit. 1A) and Salem (Sit. 5) are listed as separate sites because of different NPDES permitting and ownership history.

Situation 1B:
Four sites with man-made cooling ponds (or equivalent) have been granted an exemption by their state permitting authority from § 316(b) requirements, at the request of the owner/operator. These four sites are: Turkey Point, South Texas, LaSalle, and Braidwood. Turkey Point uses a unique system of man-made canals (instead of an open pond) that is appropriate to the hydrology and geology of Southern Florida. The other man-made cooling ponds in this situation

were previously open lands (no significant rivers or creeks within the impounded pond area). After creating the embankment for the man-made pond, it was filled over time from a nearby river. Although full condenser flow-rate equivalent to a once- through cooling system is maintained for reactors on these sites, aquatic life is minimal (or never introduced) inside the pond, making concerns for impingement, entrainment, and thermal impacts largely irrelevant. Makeup water to these sites, if needed, does come from nearby "waters of the U.S." (a river or ocean) subject to § 316(b), but makeup flow rates are equal to or less than the amount of makeup water required to support a closed-cycle cooling tower site.

Situation 2:
These sites are similar to sites in Situation 1B, but differ from situation 1B in that the permitting authority has judged that the cooling pond is "waters of the U.S.". Most of the water bodies used to cool the sites in this situation were created by damming a small river or creek at its headwaters, and filling it over a period of months or years, similar to how it was done for cooling ponds in Situation 1B. Also, the inflow to these ponds from local rain and runoff (e.g., feeder creeks) is typically too small to maintain pond level, so makeup from a nearby river that is off-stream from the cooling pond is sometimes pumped into the pond to augment natural pond inflows (same as in Situation 1B). In most cases, aquatic life was not preexisting in these ponds, but was often introduced artificially for the purpose of providing sports fisherman expanded access to fishing sites in the region.

One site in this situation, North Anna, is unique, in that the cooling lake is divided into a warm side and cool side by small dams on three fingers of Lake Anna. The nuclear plant is sited on the warm side of the lake, which functions as a cooling pond per above. The makeup water source for this cooling pond is the cool side of the lake. (If this site had been constructed without separating the warm and cold segments, then the resulting standard lake-cooled configuration would have been assigned to Situation 3.)

Also note that one site in this category (Dresden) employs cooling towers during summer months. The NRC defines a cooling pond as "a man-made impoundment that does not impede the flow of a navigable system and that is used primarily to remove waste heat from condenser water prior to recirculating the water back to the main condense" (ORNL/NUREG/TM-226). NRC specifies in NUREG-1437 that most of the sites in both Situation 1B and Situation 2 qualify as "Cooling Ponds."

One site in this category (VC Summer) operates in conjunction with a pumped storage facility on the same reservoir.

Situation 3:
These sites are on man-made lakes, but these lakes are "on-stream" with the source river and provide a range of public services and missions (e.g., recreation, municipal water supply, irrigation) - thus the label "multi-purpose reservoir." For these sites, the cooling function and the makeup water source are the same river (unlike Situations 1B and 2).

Three of the sites in this category have installed Helper towers that are used during summer months (Vermont Yankee, Browns Ferry, and Sequoyah). Another site, Peach Bottom, has Helper towers on site that were previously used, but are now inactive (retained operable for contingency only).

Two sites in this category operate in conjunction with a pumped storage facility on the same reservoir (Oconee, Peach Bottom).

Arkansas Nuclear One (ANO) Unit 1 uses once-through cooling on its reservoir; adjacent Unit 2 uses closed-cycle (wet) cooling, based on a natural draft tower.
Watts Bar has cooling towers that are capable of supporting 100% reactor power at all times of the year. It was originally designed and operated as a closed-cycle cooling site. (The site has two large hyperbolic towers - one operational on Unit 1, and one ready to operate when Unit 2 is ready to start operation.) Approximately ten years ago, TVA took advantage of an existing water permit it holds for a nearby non- operating fossil plant, which receives cooling water upstream of the Watts Bar Dam. TVA utilizes water from that fossil plant and mixes it with the Watts Bar Unit 1 cooling tower basin inventory. This modification was performed to reduce condenser circulating water temperatures and improve plant efficiency. This "supplemental CCW" comprises about 1/3 of total condenser circulating flow, when in operation. However, for purposes of this report, Watts Bar is considered a closed-cycle plant, since it could discontinue use of Supplemental CCW, if § 316(b) requirements make its use problematic.
(**32-14-2** [Reiser, Caroline])

Comment: Situation 4:

These sites are on the open ocean or a bay off the open ocean with full open-ocean salinity levels (no fresh water dilution). Four of these seven sites are on the Atlantic, two on the Pacific, and one on the Gulf of Mexico. Most of these sites have taken extraordinary measures to minimize adverse environmental impact on marine life or provide extensive remediation programs to compensate for losses. None of them have incorporated cooling towers into their systems, largely because salt-water cooling tower operations are challenging (e.g., particulate emissions from towers, including salt drift, can impact switchyard reliability, local ecology, etc.; other challenges include corrosion issues, brine blowdown, etc.).

Note that this category of nuclear sites is the only one for which corresponding sites in an equivalent cooling water situation are not contained within Situation 1A - i.e., all nuclear plants on coastal sites in the U.S. use once-through cooling - nuclear power plants have no experience with salt water cooling towers at an ocean site. This observation not only applies to the U.S. - it applies globally. All nuclear plants in other countries that are sited on the ocean also use once-through cooling. We do have limited experience with cooling towers at ocean sites for a few fossil plants (e.g., two coal units at Crystal River in Florida use natural draft cooling towers). This limited experience suggests that salt-water cooling towers are not infeasible, but present major challenges as discussed above. The State of California the home of two of these sites, has adopted a policy requiring 19 coastal power plants to begin phasing out once-through cooling systems, in order to better protect marine life. This policy has involved extensive analysis of the pros and cons of requiring cooling towers on coastal sites, and impacts two nuclear sites in California (Diablo Canyon and San Onofre). (New York and New Jersey are considering similar policies; see "Situation 5," below.) ...

Situation 5:
These sites are located on a river-fed estuary (e.g., Chesapeake Bay) or a Tidal River (e.g., Hudson River). In either case, the site experiences both freshwater flow from up-river and saline inflow from an ocean.

A tidal river site typically experiences varying salinity levels based on tides or seasonal differences driven primarily by spring runoff. Note that some of the sites in Situation 1A or 1B are also located in a similar aquatic environment (e.g., Turkey Point, South Texas, Hope Creek), but since makeup flow from their nearby estuary or tidal river is minimal compared to once-

through cooled sites, these sites are binned based on their effective closed-cycle configuration (i.e., 1A or 1B) and their exemption from § 316(b).

Retrofitting cooling towers at Situation 5 sites would be problematic for reasons similar to Situation 4, since most of these sites experience significant salinity, especially during months when river flows are low. The Hope Creek reactor (a Situation 1A plant) uses cooling towers on an estuary, demonstrating that cooling tower operations in this environment, although challenging, are feasible. Finally, as with Situation 4 above, some States are taking preemptive action (prior to EPA issuing its revised draft Phase II Rule) to require cooling tower retrofitting at plants in this situation. The State of New Jersey issued a new draft NPDES permit in January 2010 for Oyster Creek that required the retrofitting of a closed cycle cooling system on that plant, with a seven-year compliance schedule. Then in March 2010, the State of New York issued a draft policy requiring closed-cycle cooling at most state power plants. New York subsequently denied the water quality certificate for the license renewal of the Indian Point plant, based in this draft policy.

Situation 6:
Two of these sites on rivers (Prairie Island, Monticello) employ cooling towers in a closed cooling cycle mode during summer months. These two sites use sluice gates to restrict intake and discharge flow from/to the Mississippi River from May through September, when high temperatures and/or low flow conditions exist on the river. (This design is different than the typical "helper tower" arrangement used at a few other sites that reduces discharge temperatures without reducing intake flow rate.) During other months, Prairie Island and Monticello operate in an open cycle/once-through mode.

Situation 7:
One of these sites, Nine Mile Point, uses once-through cooling for its older Unit 1, and closed-cycle cooling (natural draft tower) for its newer Unit 2. Note that the new draft policy issued by the State of New York also applies to three New York reactors on Lake Ontario: Ginna, Fitzpatrick and Nine Mile Point-1.

This report also provides additional details in summary tables like the ones below, both about the plant as well as the intake structures.

[See ML23123A412 for summary tables.]

While some of this information is provide in NUREG-1437, these types of summary tables in the main body of the text would be more informative. Information on the condenser cooling water flow rates are an important parameter for assessing surface water impacts. In addition, details on the locations and designs of the intake and discharge structures, as noted in the excerpted tables above, are also critical for assessing the surface water impacts from specific plants.

As can be seen from the examples above, the proposed Revision 2 to NUREG-1437 as well as prior GEIS lack detail about the plants and their cooling water systems, which are important determinants of surface water environmental impacts. It is improper to not provide the detail, and then baselessly conclude that plants are similar when they are not, or that their source/receiving waters are similar when they are not. The proposed Revision 2 to NUREG-1437 does not justify the generic Category 1 classification. (**32-15-1** [Reiser, Caroline])

Response: *The NRC disagrees with these comments. The NRC's license renewal environmental review process, which this revised LR GEIS and final rule support, has been effective in ensuring that the NRC takes the necessary "hard look" under NEPA while focusing associated environmental reviews on important site-specific issues and concerns at each nuclear power plant site. The NRC has performed a thorough analysis of the potential impacts of continued nuclear power plant operations on surface water resources during the license renewal term. These analyses are presented in Sections 4.5.1.1.1 through 4.5.1.1.11 of this LR GEIS and justify the findings for each of the 10 Category 1 (generic) surface water issues considered. Specifically, a Category 1 determination is appropriate for the surface water issues identified in the comments, because the environmental impacts were found to be the same or similar at all plant sites based on previous license renewal environmental reviews, in combination with related scientific literature and any new data from ongoing plant operations. The NRC's analysis determined that impacts for the cited surface water resources issues during the license renewal term (initial LR or SLR) would be SMALL.*

However, a designation of an issue as a Category 1 issue does not mean that potential impacts are not considered. During preparation of plant-specific supplements to the LR GEIS, the NRC staff considers changes in nuclear power plant operating parameters and new and potentially significant information provided by the applicant or identified through public comments, or resulting from the NRC's due diligence in reviewing relevant information. Data are reviewed in part for information that could change the conclusion in the LR GEIS with regard to an issue. Thus, even though an issue is a Category 1 issue, mechanisms are in place to conduct a full plant-specific review if new and significant information warrants such a review.

To ensure that the LR GEIS and rule can continue to be efficiently used and remain comprehensible to the public, the NRC has summarized the vast body of collected technical information about operating nuclear power plants and includes reference citations to detailed information contained in completed plant-specific supplements to the LR GEIS. With regard to the comments that this LR GEIS lacks adequate detail about nuclear power plant cooling water systems and site characteristics sufficient to inform Category 1 determinations for surface water issues, the summary information presented in Section 3.1.3 of this LR GEIS is further supported by more detailed information in Appendix C.

The NRC also acknowledges the comments concerning information provided from the U.S. Department of Energy commissioned report, "Cooling Water Issues and Opportunities at U.S. Nuclear Power Plants," December 2010 (DOE 2010). While this report uses a cooling water system classification system for then-operating nuclear power plants that differs from that used in this LR GEIS (Section 3.1.3, Tables 3.1-2 through 3.1-4), the report does not provide any new information that would challenge the findings in the 2013 LR GEIS or this revised LR GEIS. The NRC's cooling system configuration descriptions and nomenclature were adopted in the 1996 LR GEIS and their continued use will ensure consistency for the purposes of environmental impacts determinations in future LR GEIS updates and in the preparation of future plant-specific supplements to the LR GEIS, or similar analysis. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.

A.2.4 Water Resources: Groundwater Resources

Comment: (vii) Groundwater Resources
(20) Groundwater contamination and use (non-cooling system impacts). - 1. Is site specific (2) because Turkey Point sits inside the boundaries of Biscayne National Park, local geology

allows rapid lateral drift of groundwater, and any accidental discharges will have significant adverse effects on the adjacent environment. (**7-6** [Stoddard, Philip])

Comment: 24) Groundwater quality degradation resulting from water withdrawals. - 1. Is site specific (2). Water withdrawals at Turkey Point alter freshwater flows into the Southeast Coastal Everglades and interfere with some of the goals of Everglades restoration (BBSEER). (**7-7** [Stoddard, Philip])

Comment: Groundwater Resources: Groundwater contamination and use (non-cooling system impacts) are unique, significant site specific considerations. Is site specific because Turkey Point is adjacent to the boundary of Biscayne National Park, local geology allows rapid lateral drift of groundwater in all directions, and discharges have significant adverse effects on the adjacent environment, including but not limited to the degradation of nearshore seagrass meadows. Groundwater quality degradation resulting from the concentration of salt and other contaminants in a plume that is about 10 miles wide which is less than 1 mile of the Newton wellfield to the west and is under Biscayne National Park. Additionally, It Is site specific because water withdrawals at Turkey Point alter freshwater flows into the Southeast Coastal Everglades and interfere with some of the goals and objectives of Everglades restoration (BBSEER). (**26-4** [Casals, Rafael])

Comment: The draft document claims that the impacts of continued operations and refurbishment activities on groundwater quality resulting from water withdrawals would be SMALL. Further, it assumes that groundwater withdrawals at operating nuclear power plants would not significantly degrade groundwater quality.

This is an incorrect assumption based on the operations at Turkey Point Power Plant and is a site-specific issue. Due to south Florida's local geology, surface water from the CCS and underlying groundwater moves freely through the porous bedrock and beyond the boundaries of the facility as evidenced by the presence of Tritium above background levels in groundwater and surface water. Monitoring data indicate that operation of the Cooling Canal System (CCS) has a large impact on groundwater quality contrary to the assumptions in the draft document. Data collected since the commencement of operations of the Turkey Point Power Plant and more recently since the Uprate of Units 3 & 4 demonstrate that there are long term effects on the groundwater that were not considered and that have been exacerbated over time with increased groundwater withdrawals. The NRC should consider and analyze all available data including the most recent post Uprate data, to fully evaluate the function of the CCS over the next 34 to 35 years, including plans for the addition of external sources of fresh or low saline water, and its impact on water resources in the area. The changes caused by these groundwater withdrawals are not static and given the data that currently exist, it is not reasonable to assume that groundwater impacts from continued operations are small from current or future operations. (**30-4** [Spadafina, Lisa])

Comment: Groundwater Resources: Groundwater contamination and use (non-cooling system impacts) are unique, significant site specific considerations. It is site-specific because Turkey Point is adjacent to the boundary of Biscayne National Park, local geology allows rapid lateral drift of groundwater in all directions, and discharges have significant adverse effects on the adjacent environment, including but not limited to the degradation of nearshore seagrass meadows. Groundwater quality degradation resulting from the concentration of salt and other contaminants in a plume that is about 10 miles wide which is under 1 mile of the Newton wellfield to the west, and is under Biscayne National Park. Additionally, it Is site specific because water withdrawals at Turkey Point alter freshwater flows into the Southeast Coastal

Everglades and interfere with some of the goals and objectives of Everglades restoration (BBSEER). Specifically, by blocking all freshwater groundwater and surface water that would otherwise be reaching the nearshore of Biscayne National Park. One of the primary goals in this area is to reestablish mesohaline conditions in the nearshore. This will be nearly impossible to achieve along this section of coastline as long as the CCS is in operation.
(**36-4** [Reynolds, Laura])

Response: *The NRC agrees in part and disagrees in part with these comments. The NRC agrees with the comments that suggest that the NRC needs to consider unique and site-specific issues and impacts at nuclear power plant sites as part of the NRC's license renewal environmental reviews. Plant- or site-specific environmental issues and concerns associated with operating nuclear power plants, such as those raised in the comments, are considered in a plant-specific supplement to the LR GEIS in accordance with the NRC's regulations in 10 CFR Part 51.*

The NRC disagrees with the comments that environmental conditions and continued operations associated with the Turkey Point plant, including its cooling canal system (CCS), provide justification to modify the LR GEIS and rulemaking and their characterization of two groundwater resources-related issues from Category 1 (generic) to Category 2 (plant-specific). Specifically, as cited in the comments, the NRC has concluded that the issues of "Groundwater contamination and use (non-cooling system impacts)" and "Groundwater quality degradation resulting from water withdrawals" are properly designated as Category 1 issues, because the environmental impacts were found to be the same or similar at all plant sites. The NRC has stated its methods and criteria for environmental issue identification, categorization, and definitions in Section 1.5 of this LR GEIS as well as in the footnotes to Table B–1 in Appendix B to Subpart A of 10 CFR Part 51, as revised pursuant to this final rule.

The evaluation of groundwater issues in this LR GEIS and final rule included a review of changes to applicable laws and regulations, new data available to the NRC, collective experience, and lessons learned and knowledge gained from conducting environmental reviews for initial LR and SLR since 2013. This includes new information and conditions identified by the NRC staff during the SLR environmental review for Turkey Point Nuclear Generating Units 3 and 4 (NRC 2019a).

A generic, Category 1 grouping is appropriate for the groundwater resources issues referenced above because the environmental impacts were found to be the same or similar at all plant sites based on previous license renewal environmental reviews. Specifically, the NRC has determined in this LR GEIS and final rule that continued nuclear plant operations and refurbishment on groundwater contamination and use (non-cooling system impacts) and on groundwater quality degradation resulting from water withdrawals during the license renewal term (initial LR or SLR) would be SMALL. The findings are supported by the NRC's analysis presented in Sections 4.5.1.2.1 and 4.5.1.2.5 of this LR GEIS. As described in Section 4.5.1.2.1, the Category 1 issue, "Groundwater contamination and use (non-cooling system impacts)," focuses on routine groundwater uses such as dewatering as well as facility site industrial and waste disposal practices and potential groundwater quality concerns, other than those associated with a nuclear power plant's cooling water withdrawals and discharges. The NRC did not identify any information during the SLR environmental review for Turkey Point (NRC 2019a) contrary to a Category 1 (generic) determination with an impact of SMALL for this issue. The scope of this issue does not consider the operational impacts of cooling ponds, such as the Turkey Point CCS. Separately, however, as stated in Section 1.11 of this LR GEIS, the SLR environmental review for Turkey Point resulted in the identification of new and significant

information related to CCS operation. Accordingly, the LR GEIS now includes a revised, consolidated Category 2 issue, "Groundwater quality degradation (plants with cooling ponds)," that consolidated a previously listed Category 1 issue, "Groundwater quality degradation (plants with cooling ponds in salt marshes)," and a previously listed Category 2 issue, "Groundwater quality degradation (plants with cooling ponds at inland sites)." The basis for this revised issue is described in Section 4.5.1.2.6 of this LR GEIS.

For the Category 1 issue, "Groundwater quality degradation resulting from water withdrawals," the issue focuses on the action of groundwater production wells at operating nuclear plants and the potential for those wells to induce the flow of lower quality surface water or groundwater into a water supply aquifer. As described in Section 4.5.1.2.5 of this LR GEIS, the NRC carefully considered information from the SLR environmental review for Turkey Point (NRC 2019a) regarding the effects of Turkey Point's marine wells, site production wells, CCS "freshening wells," and hypersaline plume recovery wells. Based on the information considered and referenced in NRC 2019a, the NRC staff determined that groundwater withdrawals in accordance with cited regulatory requirements at Turkey Point would have SMALL impacts overall. In addition, operation of the recovery well system would in fact have beneficial water quality impacts by mitigating the CCS hypersaline plume and expansion of the regional saltwater interface. This would serve to mitigate harm to the waters of Biscayne Bay and nearshore areas to the east and the Everglades to the west.

Finally, the designation of an issue as a Category 1 issue does not mean that potential impacts are not considered. During the preparation of plant-specific supplements to the LR GEIS, the NRC staff considers changes in nuclear power plant operating parameters and new and potentially significant information provided by the applicant or identified through public comments, or resulting from the NRC's due diligence in reviewing relevant information. Data are reviewed, in part, for information that could change the conclusion in the LR GEIS with regard to an issue. Thus, for a Category 1 issue, mechanisms are in place to conduct a full plant-specific review if new and significant information warrants such a review. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.

Comment: It's more of a comment on the radionuclides released to groundwater. It's indicating in the chart that it's a small to moderate risk.

But as I already mentioned, and in my examples, we've already had two of those happen here in Illinois, Braidwood and Dresden. So, the question I have here -- and again, this would be an important one of those qualitative and quantitative measures, of how do you account for materials degradation and aging on these plants? I mean, all those pipes were underground. How do you evaluate that? What do you have in place that would make that determination? I don't know, and that would be an important piece in order for us to give meaningful input back to you as to whether this process is really valid or not. (**8-3-3** [Kraft, David])

Comment: Section 4.5.1.2.1 states: "Groundwater monitoring programs, including monitoring of onsite drinking water quality in accordance with safe drinking water regulations, would be expected to identify problems before contaminated groundwater reached receptors; however, monitoring wells need to be present and in proper locations in order to detect contaminants." (page 4-35, lines 28-31)

* EPA recommends that NRC clearly define the requirements for monitoring wells at nuclear plant sites and detail any specific requirements NRC follows for monitoring well construction. (**15-7** [Tomiak, Robert])

Response: *The NRC acknowledges these comments. With regard to radionuclides released to groundwater in general, the NRC's regulations set forth in 10 CFR 20.1406(c) in part require that licensees conduct their operations to minimize the introduction of residual radioactivity to the plant site. Violations are subject to NRC enforcement action and possible increased oversight, as cited in Section 4.5.1.2.7 of this LR GEIS.*

While outside the scope of this LR GEIS and associated rulemaking, the integrity and aging management of buried piping within the scope of license renewal is addressed as part of the NRC's plant-specific safety review of license renewal applications. The NRC's oversight of the buried piping within the scope of the plant-specific safety review focuses on ensuring that licensees and operators properly monitor and, when necessary, repair or replace buried piping.

Nevertheless, inadvertent (abnormal) releases of radionuclides to the environment do occur at operating nuclear power plants, and differ from those that might be conducted in a planned and monitored manner, as described in Section 4.5.1.2.7 of this LR GEIS. Consequently, "Radionuclides released to groundwater" is a Category 2 issue, requiring nuclear power plant-specific environmental analyses for impact determination. The scope of the issue considers potential contamination of groundwater from the inadvertent (abnormal) release of liquids containing radioactive material from nuclear power plant systems, including buried piping, into the environment. This encompasses inadvertent releases from spent fuel pools, storage tanks, and any other nuclear power plant equipment.

As presented in Section 4.5.1.2.7, the NRC has considered in its technical basis for the issue the range of historical inadvertent release events at operating plants and their impacts on site groundwater quality, including at the Dresden and Braidwood nuclear power plants as cited in the comments. The NRC has determined from these events that the potential exists for SMALL to potentially MODERATE impacts on site groundwater quality, based on the definitions provided in Section 1.5.2.3 of this LR GEIS. The impact level would depend on the leak or spill, radionuclides involved, hydrogeologic factors, the distance to receptors, and the response time of plant personnel to identify and stop the leak in a timely fashion. In rendering an impact finding from its analysis, the NRC staff will consider whether the release has caused or could cause substantial impairment or noticeable alteration of groundwater quality in an aquifer with respect to designated use classification or applicable drinking water or other applicable standards. The NRC has revised Section 4.5.1.2.7 of this LR GEIS to provide this clarification. To date, no plant site has resulted in tritium contamination in offsite groundwater in excess of the EPA standard (20,000 picocuries per liter). Additional information about the NRC's response to the release of radionuclides to groundwater during plant operations is described in Section 3.5.2.2 of this LR GEIS.

As described in Section 3.5.2.2 of this LR GEIS, under the Nuclear Energy Institute's (NEI's) Groundwater Protection Initiative (NEI 07-07, NEI 2019a), each member company voluntarily committed to develop and implement a plant-specific groundwater protection program for operating or decommissioning nuclear power plants. These programs cover the assessment of plant systems and components, site hydrogeology, and implementation of groundwater monitoring programs. More specifically, each site-specific groundwater protection program was developed based on an assessment of plant systems, components, buried piping, and site hydrology. The program is designed to provide early indication of a leak of radioactive liquid from a plant system or buried pipe in order for plant personnel to take corrective action. Typically, licensees have installed a series of groundwater monitoring wells near the plant systems, components, and buried piping containing radioactive liquids. To monitor the actions of the nuclear industry, the NRC updated its inspection procedure to include this issue as part of

its routine radiological inspection at all nuclear power plants. A groundwater protection program conforming to NEI 07-07 must identify credible mechanisms for radionuclide releases to groundwater and the associated methods used to detect inadvertent releases, describe the parameters of a groundwater monitoring program to ensure timely detection, and establish a remediation protocol to prevent migration of radionuclides offsite. An applicant for license renewal must also include in its environmental report under 10 CFR 51.53(c)(3)(ii)(P) a description of any groundwater protection program and any past inadvertent releases. The NRC also requires licensees to conduct subsurface (i.e., subsurface soil and groundwater) monitoring in accordance with 10 CFR 20.1501 to ensure compliance with radiation dose limits.

With regard to the construction of groundwater protection wells associated with industry's implementation of NEI 07-07 and licensee implementation of groundwater monitoring in general, the NRC's regulations do not specify requirements for monitoring well construction. However, NEI 07-07 specifies that licensees when developing groundwater protection programs for their nuclear plants use the Electric Power Research Institute's (EPRI's) technical guideline, "Groundwater Protection Guidelines for Nuclear Power Plants" (EPRI 2008). The EPRI document specifies placement, construction, and maintenance standards for groundwater protection monitoring wells. Furthermore, the NRC expects that its licensees adhere to all applicable Federal, State, and local regulations and industry standards in conducting licensed activities.

Comment: The Turkey Point complex is located in a highly sensitive area of the watershed: at the shores of the Biscayne Bay Aquatic Preserve (a State of Florida designation to conserve a waterbody's natural and cultural heritage); abutting the Biscayne National Park; approximately 12 miles from Everglades National Park; above a sole-source drinking water aquifer; less than ten miles from several municipal wellheads; and adjacent to the Model Lands (an undeveloped area of Miami-Dade County that is designated as "environmentally-endangered"). It occupies traditional Miccosukee land. Now, the complex is abutting an area contemplated for Everglades restoration under state and federal auspices.

Cooling Canal System

In the early 1970s, a consent decree between the Federal Government and Florida Power and Light (FPL) stipulated that FPL build a recirculating multichannel system to prevent thermal pollution from entering the adjacent Biscayne Bay.[1] When the U.S. Atomic Energy Commission prepared a 1972 environmental impact statement (EIS) for the planned cooling canal system (CCS), the EIS acknowledged that water from the unlined CCS could emerge via groundwater into Biscayne Bay to the east,[2] even while acknowledging that available information was extremely limited[3] regarding the environmental impacts from the construction and operation of the proposed CCS. The agency also concluded that environmental impacts from the 5,900 acre CCS would be insignificant on subsurface flows to the west.[4]

[1] Final Environmental Statement Related to Operation of Turkey Point Plant, 1972, Dockets No, 50-250 and 50-251, at III-5 and III-7. Included as Attachment 1.
[2] Id., at ii.
[3] Id., at iii.
[4] Id., at VI-2.

FPL, through the original consent decree, agreed to seek ways of improving on the CCS by investigating the feasibility of a mechanical draft cooling tower and water spray modules as a replacement or supplemental cooling system for the CCS.[5] FPL also agreed to investigate alternate sources of water, such as brackish, deep groundwater, and surface water sources for either the CCS or mechanical cooling devices.
[5] Id., XI-2

CCS Temperature and Salinization

The environmental impacts on groundwater are, in fact, clearly noticeable and significant. Dense, saline water circulating through the unlined cooling canal system migrates radially from the CCS[6] because the porous geology of the underlying Biscayne Aquifer allows water from the CCS to move freely through the ground beyond the limits of the Turkey Point property.
[6] McThenia, A.W, Martin, W. K., Reynolds, J., 2017. Rising Tides and Sinking Brines: Managing the Threat of Salt Water Intrusion. Florida Water Resources Journal 68, at 36. Included as Attachment 2.

As hot water exiting the reactor circulates around the CCS, the water evaporates in the shallow canals, concentrating its salt content. Salinity has increased in the CCS by around 5% per decade since 1973,[7] resulting in present-day hypersaline conditions. Given that the shallow, unlined CCS was excavated into highly porous limestone, water migrates beyond the limits of the cooling canal system and off the FPL property. Due to its density, the hypersaline water sinks through the strata and to the bottom of the Biscayne aquifer where it spreads in all directions. Hypersaline water has been tracked spreading west at a rate of up to around one foot per day.[8] Over time, the CCS has emitted a hulking mass of hypersaline (<19,000 mg/L chloride concentration) groundwater that has extended as far as 2 miles west of the property.[9]

[7] Chin, D. A. (2015). The Cooling Canal System at the FPL Turkey Point Power Station, at 2. Included as Attachment 3.
[8] McThenia, A.W, Martin, W.K., Reynolds, J., 2017. Rising Tides and Sinking Brines: Managing the Threat of Salt Water Intrusion. Florida Water Resources Journal 68, at 36.
[9] Id., at 36.

To be sure, the CCS is not the only driver of saltwater contamination into the aquifer. Saline water is encroaching into the fresh Biscayne Aquifer as a phenomenon of sea level rise. However, the CCS-driven hypersaline plume in the area of Turkey Point presents an additional concern, because is influencing the movement of the saline water interface within the Biscayne Aquifer more than 4 miles inland.[10]

[10] McThenia, A.W, Martin, W.K., Reynolds, J., 2017. Rising Tides and Sinking Brines: Managing the Threat of Salt Water Intrusion. Florida Water Resources Journal 68, at 36.

Moreover, cooling canal waters are warming. A 2014 uprate that increased the plant's power-generating capacity correlated to increasing water temperatures in the CCS,[11] so much so that FPL requested approval from the NRC to increase the maximum limit on cooling waters.[12] In addition to the hotter temperatures yielded by the increased power-generating capacity, waters in the CCS are also subject to a warming climate.

[11] Chin, D. A., 2015. The Cooling Canal System at the FPL Turkey Point Power Station, at 1.
[12] Turkey Point Generating Unit Nos. 3 and 4 -Issuance of Amendments No. 261 and 256 (TAC Nos. M4392 and MF 4393). (**31-2** [Silverstein, Rachel])

Comment: Cooling Canal Freshwater Augmentation and Surface Water Impacts

Concerns regarding the unusually high temperatures and salinity in the CCS reached a flashpoint following the uprate. In August of 2014, the plant operator reduced power at Turkey Point Units 3 and 4 due to excessive ultimate heat sink temperature in the CCS.[13] Likewise, the South Florida Water Management District (SFWMD, or "District") issued an emergency order approving the use of water from the nearby L-31E canal to freshen the CCS.[14] Following the emergency order, the District approved a separate authorization in 2015 to allow the plant operator to pump up to 18,300 million gallons annually (up to 100 million gallons per day) of L-31E fresh water into the CCS.[15]

[13] NUREG-1437, Volume 1, Revision 2 GEIS -Draft Report for Comment, February 2023, at 3-42.
[14] Miami Dade County, March 7, 2016. Report on Recent Biscayne Bay Water Quality Observations associated with Florida Power and Light Turkey Point Cooling Canal System Operations, at 4. Included as Attachment 4.
[15] SFWMD Permit Number 13-05856-W, issued June 1, 2015.

The canal freshening was evaluated by a third-party academic reviewer who posited that additions to the CCS may have adverse impacts.[16] The reviewer stated that under the SFWMD-approved pumping protocol, the cooling canal stage would rise while the stage of the L-31E canal would be held constant. This could result in a decreased, or potential reversal of, the seaward piezometric-head gradient - leading to a potential saline plume advecting from the CCS towards the L-31E canal and creating a circulation cell in which the salinity of the water in the L-31E Canal is increased as the saline plume enters the L31E Canal.[17] The reviewer additionally found that "elevated water levels in the CCS resulting from pumping 100 mgd from the L-31E will increase the (seaward) piezometric-head gradient between the CCS and Biscayne Bay, resulting in the increased discharge of higher-salinity water from the CCS into the Bay via the Biscayne Aquifer."[18]

[16] Chin, D. A., 2015. The Cooling Canal System at the FPL Turkey Point Power Station.
[17] Id., at 3.
[18] Id., at 40.

Under current authorization, water is taken from the brackish Floridan Aquifer and pumped into the CCS.[19] However, no matter the source of the water used to freshen the canals, there exists the possibility of a decreased or reversed piezometric head gradient if the CCS water level exceeds the stage of the L-31E, resulting in advection of hypersaline water into the L-31E. Figure 1, below, shows measured spikes in specific conductance - indicating that significant salinity events in the L-31E have occurred as recently as March 2023.

[19] Stantec, August, 2022. FPL Turkey Point Annual Monitoring Report. Retrieved at https://prodenv.dep.state.fl.us/DepNexus/public/electronic-documents/FL0001562/facility!search

[See ML23123A404 for line graph of specific conductance over time]
Figure 1: March 8, 2023 salinity event on L-31E canal, at approximately 3:00AM. Source: Miami-Dade County Department of Regulatory and Economic Resources.

In addition to high chloride levels, the CCS contains high levels of radionuclides. Per a 2016 county memorandum, tritium concentrations have been measured as high as 16,500 pCi/L in the cooling water.[20]

[20] Miami Dade County, March 7, 2016. Report on Recent Biscayne Bay Water Quality Observations associated with Florida Power and Light Turkey Point Cooling Canal System Operations, at 4.

Sampling in the nearshore waters adjacent to the CCS found evidence of polluted water leakage from the canals by way of tritium, which acts as an excellent tracer for the fate of CCS water. Miami-Dade County conducted surface water sampling in Biscayne Bay near the CCS and found that all samples contained tritium concentrations higher than background levels typical for Biscayne Bay surface waters (where the baseline is 20 pCi/L).[21] In areas closest to the CCS, bottom samples contained tritium concentrations ranging from 2,652 to 4,317 pCi/L - indicating that water originating from the CCS is reaching tidal waters outside of the CCS.
[21] Id., at 4.

Far beyond the nearshore waters of the Turkey Point plant, the approximate limit of the 20 pCi/L contour has been reported as far as 3.8-4.7 miles west of the CCS and 2.1 miles east of the CCS.[22]
[22] Chin, D. A., 2015. The Cooling Canal System at the FPL Turkey Point Power Station, at 2. (**31-3** [Silverstein, Rachel])

Comment: Cooling Canal System Groundwater Contamination Remediation Plan

Given the *significant* surface water and groundwater contamination, FPL was sued by the county and the state. To settle litigation, FPL entered into a consent agreement with Miami-Dade County in October 2015, and entered into a consent order with the Florida Department of Environmental Protection (FDEP) in June 2016. These instruments compelled FPL to install a recovery well system to remediate the hypersaline plume. Per the FDEP consent order, FPL is required to confirm by Year 5 that the recovery well system will retract the westward extent of the hypersaline plume to the L-31E canal within 10 years.[23]

[23] State of Florida Department of Environmental Protection v. Florida Power & Light Company, Consent Order OGC No. 16-024 (June 20, 2016), at 10.

The recovery well system was installed in May, 2018 and has been monitored by the plant operator on an annual basis. Each Remedial Action Annual Status Report provides the results of aerial electromagnetic surveys, groundwater monitoring, and groundwater modeling. FPL's Year 3 Status Report[24] includes modeling results depicting the hypersaline groundwater in the lower aquifer falling far short of reaching the L-31E Canal at the 10-year mark.[25]

[24] FPL, November 15, 2021. Remedial Action Annual Status Report, Turkey Point Clean Energy Center, Year 3. Included as Attachment 5.
[25] Id., at 5-22., Figure 5.3-1c included as Attachment 6

In its most recent (November 15, 2022) Year 4 Status Report,[26] FPL predicts that at the 10-year mark that the plume in Layer 13 will not have retracted far enough to reach its target.[27] Moreover, FPL's modeling predicts that the hypersaline interface in layer 16 will have expanded in some areas.[28] FPL posits that their models over-simulates the edge of the hypersalinity in deep layers such as layer 16, and that "perceived over-simulation is an area that continues to be investigated with sensitivity analysis and alternative conceptual models".[29] To that end, FPL conducted several sensitivity simulations in its Year 4 report, and sensitivity simulations still model the plume in lower aquifer layers *not* retracting to the boundary prescribed in the consent agreement and consent order by the 10-year mark. [30]

[26] FPL, November 15, 2022. Remedial Action Annual Status Report, Turkey Point Clean Energy Center, Year 4. Included as Attachment 7.
[27] Id., at 5-25. Reference Figure 5.3-1c, included as Attachment 8.
[28] Id., at 5-26. Reference Figure 5.3-1d, included as Attachment 9
[29] Id., at 5-13.
[30] Id., at 5-30. Reference Figure 5.3-3, included as Attachment 10, Figure 5.3-4, included as Attachment 11, Figure 5.3-6 included as Attachment 12, and Figure 5.3-7, included as Attachment 13.

The consent agreement and consent order both specify that at the Year 5 remediation mid-point, which falls on May 16, 2023, FPL must assess the effectiveness of the recovery well system in retracting the hypersaline plume to achieve the goals of the orders.[31-32] With the two latest consecutive annual reports showing by way of modeling that the remediation system is unlikely to achieve hypersaline plume retraction to the L-31E canal by Year 10, FPL may be required to consider refinement of, or an alternative to, the remediation plan.

[31] State of Florida Department of Environmental Protection v. Florida Power & Light Company, Consent Order OGC No. 16-024 (June 20, 2016), at 10.
[32] Miami-Dade County v Florida Power & Light Company, Consent Agreement (October 7, 2015), at 6. (**31-4** [Silverstein, Rachel])

Comment: Local Wellfields

Within the vicinity of the plant, there are several municipal wellfields that extract water from the freshwater Biscayne Aquifer, a sole source aquifer that provides drinking water for southeast Florida. A map of major public water supply wellfields for major utilities is included as Attachment 15.[41] The Florida Keys Aqueduct Authority relies on a wellfield approximately 9.5 miles west of the CCS for the entire Keys archipelago. Therefore, the failure to retract the plume could pose a significant threat to the sole source of drinking water to the Florida Keys and to existing municipal wellfields nearby, and to any new wellfield that may be contemplated in the area.

[41] Map of major public water supply wellfields for major utilities, retrieved from https://www.arcgis.com/home/item.html?id=4713b7c6529e4a53b2092a19d21f4090
(**31-8** [Silverstein, Rachel])

Comment: Our comments relate to proposed environmental review rule and category changes in Document ID NRC -2018-0296-0017, Article II, Section D Proposed Actions and Basis for Changes to 10 CFR Part 51, Appendix B to Subpart A of 10 CFR Part 51:

Site Specific Historical Information on the Groundwater Cooling Canal System at Turkey Point

The Applicant uses a unique, open, and unlined cooling canal system (CCS) constructed in 1976 to cool water used to operate the two nuclear reactors at Turkey Point. After more than 40 years of operation, the CCS is still not used in any other nuclear facility in the U.S.

The CCS network comprises 168 miles spanning 5,900 acres. The Applicant's permit to operate the CCS is issued by the State of Florida for five years, and the CCS is classified as an *industrial wastewater facility" . The CCS is excavated into the native porous limestone and within the underlying surficial Biscayne aquifer (BA) which is the federally designated *sole

source drinking water aquifer" for the Florida Keys and South Florida. The CCS, which is essentially at mean sea level on the coast, was not designed as a closed loop system, and uses a high/low tide seawater exchange from Card Sound Bay which is part of Biscayne Bay. Its performance is weather dependent, relying on sufficient and regular rainfall to make up for water lost through evaporation and seepage. The evaporative cooling method which is used in the CCS causes salt to concentrate at the bottom of the canals, making the water leaking from the CCS into the Biscayne Aquifer much saltier than seawater. Over time, because of evaporation and poor maintenance practices by the Applicant , salt and decayed organic matter from vegetation on the berms flanking the CCS were allowed to accumulate in the canals causing a hypersaline and nutrient-polluted water quality condition. By 2014, a massive hypersaline plume created by the leakage from the CCS was identified 2-4 miles to the north, south and west beyond the Turkey Point Plant property line in the Biscayne Aquifer. The plume was moving in all directions out from the TP plant site and also westward towards the FKAA and the MDC wellfields in Florida City, which supply drinking water for Monroe County and South Miami-Dade County.

Although the CCS was designed to be a weather- dependent system, from 2011 to the present the Applicant has had to pump millions of gallons a day of supplemental water into the CCS, first from the SFWMD L31E freshwater Canal and now from the brackish and salty Floridan Aquifer to dilute the hypersaline condition in the CCS and to enhance cooling capacity of the CCS to meet NRC permit requirements. Although the Floridan is the major source of freshwater in central and northern Florida where it is used for potable water , it becomes brackish and salty as it runs under the Biscayne Aquifer in South Florida. It is dependent on recharge from springs and rainfall n central and northern Florida.

In 2016, before the initial license renewal (LR) and the subsequent license renewal (SLR) for Turkey Point in 2019 to year 2052, the Florida Department of Environmental Protection (FDEP) acted on these serious environmental pollution issues and entered a Consent Order (CO) with the applicant. In 2016, Miami Dade County acted on the issues created by the CCS and entered into a Consent Agreement (CA) with applicant to remediate the groundwater pollution caused by poor operation and maintenance of the CCS. The FDEP CO required FPL to:

*to halt the westward migration of the massive hypersaline plume from the TP canal system (CCS) into the Biscayne Aquifer within three years from the start of the agreed remediation plan activities, and *to withdraw the entire defined volume of hypersaline plume leaked from the CCS back to east side of the SFWMD L-31E canal within 10 years from the start of the agreed remediation plan activities.

The 2016 Miami-Dade Consent Agreement (MDC CA) required Applicant to demonstrate over ten (10) year period valid reductions in the salt mass and volume of hypersaline water in groundwater west and north of FPL's property without lowering the groundwater table and creating adverse environmental impacts. Hypersaline groundwater is defined in both the FDEP CO and MDC CA as groundwater with a chloride concentration greater than that of seawater (19,000 milligrams per liter [mg/L]).

To accomplish the requirements of the CO and CA, the Applicant constructed a Recovery Well System (RWS comprised of ten (10) groundwater extraction wells along the western edge of the CCS which capture and pump the hypersaline water from the Biscayne Aquifer after it flows out of the CCS and then pumps it through a conveyance pipeline system to a permitted Deep Injection Well (DIW) located near the center of the CCS for disposal into the Boulder Zone located 3,000 ft below the ground surface of the Biscayne Aquifer.

The RWS became operational on May 15th, 2018, and May 16th, 2018, became the start date for the applicable 5 year and 10 year compliance deadlines in the CO and the CA. The Applicant is required by FDEP and MDC to prepare and file a Remedial Action **Annual Status Report on the Recovery Well System** (RAASR) with FDEP and MDC. The fourth year RAASR was filed with FDEP and MDC in November 2022. **Neither FDEP nor MDC have completed their review of the RAASR as of May 2nd, 2023, and submitted written comments approving the contents of this document.**

The Applicant states in the 4th year RAASR that it has completed all CA and CO compliance actions required to be completed by the Year 4 milestone, and that it is on track implementing all CA and CO compliance actions required to be completed by the Year 5 and Year 10 milestones, **Our concern is that in reviewing the 4th Year RAASR, it appears to indicate that it cannot achieve full retraction/removal of the hypersaline water plume in the "State of FL designated compliance area" in the middle and lower modeled layers of the Biscayne Aquifer by 2028, the date for the 10 year compliance. Partial, not complete, retraction of hypersaline water plume edge within the "compliance area" by 2028 fails to meet the FDEP Consent Order requirement. The CO and the CA do provide that the Applicant can recalibrate the model in the 5th year to attempt to achieve compliance by 2028.The fifth year RAASR is due May 16th, 2023, and a report 60 days thereafter.** (**37-1** [Rippingille, Bonnie])

Comment: Section 51.53 (C)(3)(ii)(D): Post-Construction Environmental Reports

We agree with the proposed language changes and consolidation of the groundwater quality degradation issues into a single consolidated Category 2 level. The revised LR GEIS in 2013 "based on new information" was correct in its finding that cooling ponds or cooling canals at both inland and both coastal plant sites can and have impacted groundwater and surface water quality because of the migration of contaminants discharged to the cooling ponds or cooling canals. We would add as a fact that contaminants, through the negligent operation and maintenance of the cooling ponds or canals, can be created in said cooling ponds and canals and, through migration in the aquifer and surrounding groundwater, and can result in an adverse impact to the groundwater and surface water in the environment around the nuclear power plant site.

In support of the 2013 LR GEIS finding and to reaffirm this subject is a Category 2 environmental issue, we would cite the Turkey Point Nuclear Power Plant, Homestead, FL as an example of what can occur when the State and County and the NRC do not monitor the performance of all critical plant components. It was not until 2016, that the State and County finally issued groundwater quality violations caused by polluted, hypersaline water which had been migrating from the cooling canal system over decades after completion of construction of the CCS and finally required the Applicant to clean it up. The NRC relied upon the projected success of the RWS to issue the LR and SLR in 2019 but it appears that the Applicant may not be able to achieve compliance by 2028. The cooling canal system is an integral nuclear power plant component under the NRC license whose performance as designed is vital to the safe and efficient operation of the nuclear reactors, not just an industrial wastewater basin.

There are other issues that interfered with the operation of the RWS, and its success and they are included in other comments we have submitted we have submitted in this filing.

Exhibit 1 - **4th Remedial Action Annual Status Report by FPL filed in November 2022** in support of the Section 51.53 (C)(3)(ii)(D rule change to move this issue to a Category 2 for your consideration.
Exhibit 2 - **DERM Memorandum to MDC Commission dated March 7th, 2016**
Exhibit 3 - **United States Department of the Interior, Letter to Frank Astulewicz, Director New Reactor Licensing dated December 19th, 2016.** (**37-2** [Rippingille, Bonnie])

Comment: Our comments relate to proposed environmental review rule and category changes in Document ID NRC -2018-0296-0017, Article II, Section D Proposed Actions and Basis for Changes to 10 CFR Part 51, Appendix B to Subpart A of 10 CFR Part 51:
"nutrient-polluted water quality condition. By 2014, a massive hypersaline plume created by the leakage from the CCS was identified 2-4 miles to the north, south and west beyond the Turkey Point Plant property line in the Biscayne Aquifer. The plume was moving in all directions out from the TP plant site and also . westward towards the FKAA and the MDC wellfields in Florida City, which supply drinking water for Monroe County and South Miami-Dade County.

Although the CCS was designed to be a weather- dependent system, from 2011 to the present the Applicant has had to pump millions of gallons a day of supplemental water into the CCS, first from the SFWMD L31E freshwater Canal and now from the brackish and salty Floridan Aquifer to dilute the hypersaline condition in the CCS and to enhance cooling capacity of the CCS to meet NRC permit requirements. Although the Floridan is the major source of freshwater in central and northern Florida where it is used for potable water , it becomes brackish and salty as it runs under the Biscayne Aquifer in South Florida. It is dependent on recharge from springs and rainfall in central and northern Florida.

In 2016, before the initial license renewal (LR) and the subsequent license renewal (SLR) for Turkey Point in 2019 to year 2052, the Florida Department of Environmental Protection (FDEP) acted on these serious environmental pollution issues and entered a Consent Order (CO) with the applicant.

We submit the following comments to the NRC: Section 51.53 (C)(3)(ii)(D): Post-Construction Environmental Reports

We agree with the proposed language changes and consolidation of the groundwater quality degradation issues into a single consolidated Category 2 level. The revised LR GEIS in 2013 "based on new information" was correct in its finding that cooling ponds or cooling canals at both inland and both coastal plant sites can and have impacted groundwater and surface water quality because of the migration of contaminants discharged to the cooling ponds or cooling canals. We would add as a fact that contaminants, through the negligent operation and maintenance of the cooling ponds or canals, can be created in said cooling ponds and canals and, through migration in the aquifer and surrounding groundwater, and can result in an adverse impact to the groundwater and surface water in the environment around the nuclear power plant site.

In support of the 2013 LR GEIS finding and to reaffirm this subject is a Category 2 environmental issue, we would cite the Turkey Point Nuclear Power Plant, Homestead, FL as an example of what can occur when the State and County and the NRC do not monitor the performance of all critical plant components. It was not until 2016, that the State and County finally issued groundwater quality violations caused by polluted, hypersaline water which had been migrating from the cooling canal system over decades after completion of construction of the CCS and finally required the Applicant to clean it up. The NRC relied upon the projected

success of the RWS to issue the LR and SLR in 2019 but it appears that the Applicant may not be able to achieve compliance by 2028. The cooling canal system is an integral nuclear power plant component under the NRC license whose performance as designed is vital to the safe and efficient operation of the nuclear reactors, not just an industrial wastewater basin. (**42-1** [Rippingille, Bonnie])

Comment: There are other issues that interfered with the operation of the RWS, and its success and they are included in other comments we have submitted we have submitted in this filing.

Exhibit 1 - 4th Remedial Action Annual Status Report by FPL filed in November 2022 in support of the Section 51.53 (C)(3)(ii)(D rule change to move this issue to a Category 2 for your consideration.
Exhibit 2 - Miami Herald Article dated April 21, 2016 by Jenny Staletovich
Exhibit 3 - DERM Memorandum to MDC Commission dated March 7th, 2016
Exhibit 4 - United States Department of the Interior, Letter to Frank Astulewicz , Director New Reactor Licensing dated December 19th , 2016 (**42-2** [Rippingille, Bonnie])

Response: *The NRC agrees in part and disagrees in part with these comments. The majority of these comments provide a narrative description of the hydrologic environment, environmental regulatory matters, and effects on water resources from past and ongoing operations of Turkey Point Nuclear Generating Units 3 and 4, while expressing concerns about the continued operation of that plant. The comments also reference several reports that focus on operations and remediation activities associated with the Turkey Point CCS.*

The NRC agrees with the comments to the extent that they suggest that the NRC needs to consider unique issues and impacts at nuclear power plant sites as part of the NRC's license renewal environmental reviews. Plant- or site-specific environmental issues and concerns associated with operating nuclear power plants, such as those raised in the comments, are considered in a plant-specific supplement to the LR GEIS in accordance with the NRC's regulations set forth in 10 CFR Part 51. This revision to the LR GEIS was informed by lessons learned and knowledge gained from conducting initial LR and SLR environmental reviews since development of the 2013 LR GEIS, as discussed in Section 4.1.3 of this LR GEIS. This includes new information identified by the NRC staff during the SLR environmental review for Turkey Point, as documented in NUREG-1437, Supplement 5, Second Renewal (NRC 2019a). The Turkey Point SLR plant-specific review included consideration of relevant new information related to groundwater quality, including operations of the plant's CCS, that supported reconsideration of the generic impacts of the Category 1 issue, "Groundwater quality degradation (plants with cooling ponds in salt marshes)," from the 2013 LR GEIS, as noted in the comments. In this revised LR GEIS and rule, this issue was consolidated with a related issue, "Groundwater quality degradation (plants with cooling ponds at inland sites)," into the single Category 2 issue, "Groundwater quality degradation (plants with cooling ponds)," as described in Section 4.5.1.2.6 of this LR GEIS. The NRC acknowledges the comments that agree with this consolidation. Any future license renewals referencing this LR GEIS will address the potential environmental impacts on groundwater quality from operations of a cooling pond as a Category 2 (plant-specific) issue.

The NRC disagrees with the comments that suggest that the technical basis for the Category 2 issue, "Groundwater quality degradation (plants with cooling ponds)," needs to be revised to include the Turkey Point CCS hypersaline plume and its effects as an illustrative example of a situation where neither local authorities nor the NRC require performance monitoring of a plant

system. Section 4.5.1.2.6 of this LR GEIS provides a substantial discussion of the remediation activities and regulatory requirements surrounding the licensee's activities to address hypersalinity in the Turkey Point CCS and surrounding environment. Additionally, the NRC's technical basis discussion for the Category 2 issue, "Groundwater use conflicts (plants that withdraw more than 100 gallons per minute [gpm])," in Section 4.5.1.2.3 of this LR GEIS describes the NRC's consideration of potential groundwater use conflicts associated with sitewide groundwater withdrawals at Turkey Point, including those associated with operation of production wells to supply groundwater for salinity management (freshening) of the CCS as well as for hypersaline groundwater extraction.

As described in the Turkey Point SLR plant-specific supplement (NRC 2019a), the Turkey Point CCS is an industrial wastewater facility, subject to regulation by the State of Florida in accordance with a CWA Section 402 National Pollutant Discharge Elimination System (NPDES) permit. With respect to NPDES permit enforcement and the regulatory agreements that govern remediation of the Turkey Point CCS and groundwater, the NRC does not have the authority to ensure compliance with other regulatory authorities' requirements under the CWA, and cannot make compliance with permits, agreements, and orders issued by other agencies a condition of the NRC license. Therefore, these plant-specific regulatory considerations are outside the scope of this LR GEIS and rulemaking, as well as the technical bases for Category 1 and Category 2 issues. Furthermore, the NRC expects its licensees to adhere to all applicable Federal, State, and local regulations and industry standards in conducting licensed activities.

As referenced in the comments, new information regarding the progress of groundwater remediation efforts at Turkey Point is appropriately considered in a plant-specific supplement to the LR GEIS or similar analysis rather than in this LR GEIS revision and associated rulemaking. In completing the Turkey Point SLR plant-specific supplement (NRC 2019a), the NRC staff considered the best available information that existed at that time and predicated its findings regarding the timeline for achieving remediation of the hypersaline groundwater plume emanating from the Turkey Point CCS on the performance objectives and regulatory oversight of the responsible State and local regulatory agencies, including the Florida Department of Environmental Protection and Miami-Dade County Department of Regulatory and Economic Resources. New information or developments regarding the progress of remediation activities at Turkey Point would be appropriately considered by the NRC in a plant-specific supplement to the LR GEIS. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.

Comment: (22) Groundwater Use Conflicts (plants that withdraw more than 100 gallons per minute)

We agree that this issue should remain a "2". We further assert that significance at Turkey Point must be considered as "large".

The NRC documented in the draft LR GEIS that they believe there is the potential for groundwater use conflicts imparted by the site recovery well system and the marine well operation on existing groundwater quality. The draft LR GEIS further documents that "Based on the NRC staff's review of groundwater modeling performed by the licensee and State regulators, it is likely that operation of the recovery well system will have beneficial water quality impacts by retracting the CCS hypersaline plume and the westward expansion of the regional saltwater interface, while providing reasonable assurance that any impacts on groundwater resources and users would be mitigated".[43]

[43] NUREG-1437, Volume 1, Revision 2 GEIS -Draft Report for Comment, February 2023, at 4-40 and 4-41.

In contrast, FPL's two latest consecutive annual reports show by way of modeling that the remediation system is unlikely to achieve hypersaline plume retraction by Year 10 in all layers of the aquifer. A peer reviewer, Groundwater Tek Inc., posited that the hypersaline plume in the lower layers will likely remain a source of pollution and the salt will likely diffuse back to the layers above due to the concentration gradient if the recovery well pumps were shut off.[44] The consent agreement and consent order both specify that at the Year 5 remediation mid-point, which falls on May 16, 2023, FPL must assess the effectiveness of the recovery well system in retracting the hypersaline plume. The specific language in the FDEP consent order states that, at the conclusion of the fifth year of operation of the remediation project, FPL shall evaluate and report to the Department, within 60 days, the effectiveness of the system in retracting the hypersaline plume to the L-31E canal within 10 years.[45] The NRC should ascertain whether state and county regulators will require FPL to alter its remediation plan or use an alternate source of water, such as a reverse osmosis plant. The NRC should also obtain peer review reports to understand the success of the recovery well system in meeting the objective of the consent agreement and consent decree.

[44] Groundwater Tek, Inc., July 2020. Review of FPL's Groundwater Flow and Salt Transport Models and Assessment of the First Year Operation of the RWS, at 34. Included as Attachment 16.
[45] State of Florida Department of Environmental Protection v. Florida Power & Light Company, Consent Order OGC No. 16024 (June 20, 2016), at 10. (**31-12** [Silverstein, Rachel])

Comment: (25) Groundwater Quality Degradation (plants with cooling ponds)

We agree that this issue should remain a "2". We further assert that significance must be elevated from "small/moderate" up to "moderate/large". In the February 2023 NUREG-1437, Volume 1, Revision 2 GEIS Draft Report for Comment, the NRC concedes that in the SEIS for the second renewal of Turkey Point, new information for the generic issue of "Groundwater Quality Degradation (Plants with Cooling Ponds in Salt Marshes) was both new and significant for the initial LR term".[46]
[46] Id., at 1-19.

According to the Florida Power and Light's latest (Year 4) remediation status report, modeling shows that the hypersaline plume at Turkey Point is unlikely to be remediated by year 10 of the consent order and consent agreement. Clearly, the Atomic Energy Commission's original finding that environmental impacts from subsurface flow would be "insignificant" did not bear out. Fifty years later, Florida Power and Light has spent considerable resources on remediation after it was sued by Miami-Dade County and the Florida Department of Environmental Protection due to significant concerns about groundwater pollution. As shown in the Year 4 remediation status reports, Figures 5.31-c and 5.31-d (included as Attachments 8 and 9 to this letter), the plume has far from retracted and, via modeling, appears to be expanding in some areas of the lower aquifer.

The hypersaline plume is clearly noticeable and has locally destabilized the Biscayne Aquifer in the vicinity of Turkey Point. Therefore, the NRC must evaluate the significance of this issue as "large". The NRC must evaluate whether the continued existence of the hypersaline plume poses an unacceptable threat to drinking water supplies drawn from nearby wellfields. (**31-13** [Silverstein, Rachel])

Comment: (26) Radionuclides released to groundwater

We agree that this issue should remain a "2". We further assert that significance must be elevated from "small/moderate" up to "moderate/large". Tritium persists in groundwater beyond the FPL property, as found in nearshore sampling conducted by the County.[47]

[47] Miami Dade County (March 7, 2016). Report on Recent Biscayne Bay Water Quality Observations associated with Florida Power and Light Turkey Point Cooling Canal System Operations, at 4. (**31-14** [Silverstein, Rachel])

Response: *The NRC disagrees with these comments. For a Category 2 issue, the NRC has concluded that the impacts of continued operations and refurbishment would not necessarily be the same at all nuclear plant sites because of site-specific factors. For the issue, "Groundwater use conflicts (plants that withdraw more than 100 gallons per minute [gpm])," the NRC determined that impacts could be SMALL, MODERATE, or potentially LARGE depending on plant-specific characteristics and other site-specific factors (see Section 4.5.1.2.3 of this LR GEIS). As previously referenced in this appendix, this revision to the LR GEIS and rule considered lessons learned and knowledge gained from conducting initial LR and SLR environmental reviews since development of the 2013 LR GEIS. This environmental operating experience included the 2019 SLR environmental review for Turkey Point (NRC 2019a). The NRC's technical basis for this Category 2 issue specifically considered information regarding the NRC staff's assessment of potential groundwater use conflicts associated with Turkey Point groundwater withdrawals from the Biscayne and Upper Floridan Aquifers, including those associated with the recovery well and marine well systems.*

As stated in the NRC's responses to similar comments in this appendix, new information regarding the progress of groundwater remediation efforts at Turkey Point is appropriately considered in a plant-specific supplement to the LR GEIS or similar analysis rather than in this LR GEIS revision and associated rulemaking. Nevertheless, in completing the Turkey Point SLR plant-specific supplement (NRC 2019a), the NRC staff considered the best available information that existed at that time and predicated its findings regarding the timeline for achieving remediation of the hypersaline groundwater plume emanating from the Turkey Point CCS on the performance objectives and regulatory oversight of the responsible State and local regulatory agencies, including the Florida Department of Environmental Protection and Miami-Dade County Department of Regulatory and Economic Resources. New information or developments regarding the progress of remediation activities at Turkey Point would be appropriately considered by the NRC in a future plant-specific supplement to the LR GEIS, or similar analysis.

For the issue, "Groundwater quality degradation (plants with cooling ponds)," the NRC determined that impacts could be SMALL or MODERATE depending on site-specific differences in the cooling pond's construction and operation; water quality; site hydrogeologic conditions (including the interaction of surface water and groundwater); and the location, depth, and pump rate of any water supply wells contributing to or affected by outflow or seepage from a cooling pond. To reach its conclusion, as with other issues in the LR GEIS, the NRC considered nuclear power plant operational impacts on groundwater quality documented in plant-specific environmental reviews, as described in Section 4.5.1.2.6 of this LR GEIS. This review included consideration of the groundwater quality impacts at the Turkey Point site attributable to CCS operations, as described in the Turkey Point SLR plant-specific supplement (NRC 2019a). In that plant-specific review, the NRC staff determined that the plant-specific impacts on groundwater quality at Turkey Point were MODERATE for operations during the initial LR term but were projected to be SMALL during the SLR term as a result of ongoing remediation

measures and State and county regulatory oversight. As stated above regarding the NRC's findings supporting the Category 2 issue, "Groundwater use conflicts (plants that withdraw more than 100 gallons per minute [gpm])," new information regarding the progress of groundwater remediation efforts at Turkey Point would be appropriately considered by the NRC in a future plant-specific supplement to the LR GEIS, or similar analysis.

For the issue, "Radionuclides released to groundwater," the NRC determined that impacts could be SMALL or MODERATE depending on the magnitude of the leak, radionuclides involved, hydrogeologic factors, the distance to receptors, and the response time of plant personnel to identify and stop the leak in a timely fashion (see revised Section 4.5.1.2.7 of this LR GEIS). To reach its conclusion, the NRC reviewed the history of radionuclide releases at operating reactors, several of which have had maximum tritium activities in groundwater significantly greater than the drinking water standard (20,000 picocuries per liter), as discussed in Section 3.5.2.2 of this LR GEIS. This review also included consideration of historical inadvertent radionuclide releases and effects on groundwater quality at Turkey Point, as documented by the NRC staff in the Turkey Point SLR plant-specific supplement (NRC 2019a). Related to this Category 2 issue, tritium concentrations in groundwater beneath and adjacent to the Turkey Point site have been documented by the plant licensee to be less than the drinking water standard. In the Turkey Point SLR plant-specific supplement, the NRC concluded that groundwater quality impacts from inadvertent releases of radionuclides were SMALL. As previously stated with respect to the other Category 2 issues addressed in this response, any new information or developments regarding groundwater quality related to the inadvertent release of radionuclides would be appropriately considered by the NRC in a future plant-specific supplement to the LR GEIS, or similar analysis. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.

Comment: <u>Subsection vii Groundwater Resources- (22) Groundwater Use Conflicts for Plants Withdrawing More than 100 gpm of Make-up Water from a River:</u>

This proposed rule should be modified/expanded to include those plants that withdraw more than 100 gpm of make-up water from a state identified drinking water aquifer for a closed-loop or non-closed loop cooling water system. Alternatively, the NRC could create a new Sub-Section vii Category (26) for those nuclear power plants that withdraw more than 100 gpm of make-up water from an aquifer for a closed-loop or non-closed loop cooling water system.

As a site specific example, the Applicant at Turkey Point now indicates that it reduced the amount of water usage from the Floridan in the 4th year using only an average of 15 plus million gallons per day of water. This water was removed from the brackish and salty Floridan aquifer and pumps it into the Cooling Canal System to dilute the hyper salinity and cool the water in the CCS and remediate the massive hypersaline plume in the Biscayne Aquifer. (We have no independent verification of this amount)

The Floridan, which is Florida's largest aquifer, lies beneath most of Florida and underpins life in Florida by providing most of the drinking water and water for other uses in the state except in South Florida. South Florida and Monroe County relies instead upon the Biscayne Aquifer for its drinking water. Florida's demand for water is increasing and water levels in the Floridan are dropping caused by population growth and development, contamination, over extraction, saltwater intrusion, and the effects of climate change. Recharge of the Floridan Aquifer in central and north Florida through rainfall is impeded by developments which have paved over it. Rapidly rising sea levels, coupled with storm surges, King Tides and increasingly stronger hurricanes are increasing saline intrusion into both the Floridan and the Biscayne aquifers, and

the Florida Everglades wetlands. T**he RAASR reports increasing level of saline intrusion in the Biscayne from sources other than FPL.**

See Exhibit 1 : Recharging the Floridan Aquifer: Threats to the Floridan Aquifer, August 22, 2022, www.nflt.org

Exhibit 2: **The Floridan Aquifer: Why one of our rainiest states is running out of water**, National Geographic.com, July 29th, 2020.

For these reasons, the proposed modified rule or new rule should also include the following requirements. For an initial or subsequent term renewal application for a nuclear power plant planning to withdraw over 100 gpm (140,000 gpd) make-up water from a State-identified irrigation water and/or drinking water aquifer for any on-site purpose, the Applicant must be required to provide in its site-specific environmental report to the NRC a comprehensive review of all other known available water supply resources in the surrounding environment, including, but not limited to, advanced- treated municipal or industrial waste water effluent sources. The applicant shall also be required to include in the site-specific environmental report a complete qualitative and quantitative analysis of the water demand for the entire nuclear power plant. This analysis shall include, but not be limited to, the ultimate destination of all used water discharges. (**37-3** [Rippingille, Bonnie])

Comment: Subsection vii Groundwater Resources- (22) Groundwater Use Conflicts for Plants Withdrawing More than 100 gpm of Make-up Water from a River:

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See Exhibit 1 : Recharging the Floridan Aquifer: Threats to the Floridan Aquifer, August 22, 2022, www.nflt.org

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For these reasons, the proposed modified rule or new rule should also include the following requirements. For an initial or subsequent term renewal application for a nuclear power plant planning to withdraw over 100 gpm (140,000 gpd) make-up water from a State-identified irrigation water and/or drinking water aquifer for any on-site purpose, the Applicant must be required to provide in its site-specific environmental report to the NRC a comprehensive review of all other known available water supply resources in the surrounding environment, including, but not limited to, advanced- treated municipal or industrial waste water effluent sources. The applicant shall also be required to include in the site-specific environmental report a complete qualitative and quantitative analysis of the water demand for the entire nuclear power plant. This analysis shall include, but not be limited to, the ultimate destination of all used water discharges. (**42-3** [Rippingille, Bonnie])

Response: *The NRC understands the comments to refer to item (22), "Groundwater use conflicts (plants that withdraw more than 100 gallons per minute [gpm])," as included in the NRC's list of changes to Table B-1 contained in the proposed rule. The NRC agrees in part and disagrees in part with these comments. The NRC agrees that license renewal applicants should provide in their environmental report a complete qualitative and/or quantitative analysis of the water demand for the entire nuclear power plant. This proposed revision is already captured in the LR GEIS and rule by the cited Category 2 issue and considers potential groundwater use conflicts that result from a nuclear plant withdrawing more than 100 gpm from any aquifer for any purpose (see Section 4.5.1.2.3 of this LR GEIS). The NRC has determined that impacts could be SMALL, MODERATE, or LARGE. Specifically, under the NRC's current regulation in 10 CFR Part 51.53(c)(3)(ii)(C), which remains unchanged in this final rule, an applicant must include in its environmental report an assessment of the impact of the proposed action on groundwater, if the plant pumps more than 100 gpm (total onsite) of groundwater. The NRC's guidance for applicants is contained in Regulatory Guide 4.2, Supplement 1, Revision 2 (NRC 2024a), which has been issued in support of this LR GEIS and final rule. Section 4.5.2 of the Regulatory Guide provides applicants with an acceptable methodology for completing the required assessment for the Category 2 issue, "Groundwater use conflicts (plants that withdraw more than 100 gallons per minute [gpm])."*

In the plant-specific supplement to the LR GEIS, the NRC staff will document its independent analysis of each applicable Category 2 issue. Staff guidance regarding how to prepare plant-specific analyses is provided in NUREG-1555, Supplement 1, Revision 2 (NRC 2024b), which has been issued in support of this LR GEIS and final rule. For the subject Category 2 issue, Section 4.5.6 of NUREG-1555, Supplement 1, Revision 2 provides NRC staff with acceptance criteria and procedures for conducting the groundwater use conflicts analysis.

The NRC also agrees that license renewal applicants should provide in their environmental report the ultimate destination of all used water discharges. The NRC understands this comment to encompass all used waters that are discharged from the nuclear power plant site to the surrounding environment as wastewater, effluent, or runoff. This proposed revision is already addressed in the rule and LR GEIS. Under the NRC's current regulation set forth in 10 CFR Part 51.53(c)(2), which remains unchanged in this final rule, an applicant's environmental report "must describe in detail the affected environment around the plant, the modifications directly affecting the environment or any plant effluents…." Further, the LR GEIS and final rule comprehensively consider the management of wastewater discharges, spills, and runoff from nuclear power plant sites. Their consideration is included under the following

Category 1 (generic) issues: "Surface water use and quality (non-cooling system impacts)," "Discharge of metals in cooling system effluent," "Discharge of biocides, sanitary wastes, and minor chemical spills," and "Groundwater contamination and use (non-cooling system impacts)," as well as under the Category 2 issue, "Groundwater quality degradation (plants with cooling ponds)." The NRC's technical bases for these issues are presented in Section 4.5 of this LR GEIS.

The NRC disagrees with the comment that the rule be modified to require license renewal applicants to include in their environmental report a review of all other known available water supply resources in the surrounding environment, including, but not limited to, advanced- treated municipal or industrial wastewater effluent sources. In accordance with 10 CFR 51.53(c)(3) of the NRC's regulations, license renewal applicants must, in part, include in their environmental reports a description of the proposed action, plans to modify the facility or its administrative control procedures, a detailed description of the affected environment around the plant, modifications directly affecting the environment or any plant effluents, and any planned refurbishment activities. The NRC does not regulate water use permitting for nuclear power plants and has no authority to allocate a State's surface water or groundwater resources or to mandate the use of alternate sources of makeup water. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.

A.2.5 Ecological Resources: Terrestrial Resources

Comment: (viii) Terrestrial Resources
(28) Exposure of terrestrial organisms to radionuclides. - 1. Is site specific (2). Turkey Point lies immediately upwind of Everglades National Park, home to numerous endangered and threatened terrestrial organisms. We are especially concerned about these radionucleotide effects on these organisms (humans are terrestrial organisms, too) because FPL does not measure radionucleotide release during refueling of the reactors at Turkey Point and prevailing winds half the year push air from Turkey Point into Everglades National Park.
(**7-8** [Stoddard, Philip])

Comment: Terrestrial Resources: Exposure of terrestrial organisms to radionuclides are unique, site-specific considerations. It is site specific because Turkey Point lies between two national parks, Everglades National Park, and Biscayne National Park home to numerous endangered and threatened organisms. (**26-5** [Casals, Rafael])

Comment: Terrestrial Resources: Exposure of terrestrial organisms to radionuclides are unique, site-specific considerations. It is site-specific because Turkey Point lies between two national parks, Everglades National Park, and Biscayne National Park, both of which are home to numerous endangered and threatened organisms. We are especially concerned about these radionuclide effects on these organisms, many of which are terrestrial, because FPL does not measure radionuclide release during refueling of the reactors at Turkey Point and prevailing winds half the year push air from Turkey Point into Everglades National Park.
(**36-5** [Reynolds, Laura])

Response: *The NRC disagrees with these comments. As stated in Section 4.6.1.1.2 of this revised LR GEIS, the NRC has concluded that the issue of "Exposure of terrestrial organisms to radionuclides" is properly designated as a Category 1 issue, because the environmental impacts were found to be the same or similar at all nuclear power plant sites based on previous license renewal environmental reviews. This finding was based on an updated and expanded analysis in which the NRC staff reviewed effluent release reports, performed additional RESRAD-BIOTA*

dose calculations, and analyzed dose to biota using the International Commission on Radiological Protection (ICRP) biota dose calculator. All calculated dose estimates were well below the U.S. Department of Energy exposure guidelines. The NRC has stated its methods and criteria for environmental issue identification, categorization, and definitions in Section 1.5 of this LR GEIS as well as in the footnotes to Table B–1 in Appendix B to Subpart A of 10 CFR Part 51, as revised pursuant to this final rule. The NRC's update of the LR GEIS included a review of changes to applicable laws and regulations, new data in its possession, collective experience, and lessons learned and knowledge gained from conducting environmental reviews for initial LR and SLR since development of the 2013 LR GEIS, including the SLR review for Turkey Point Nuclear Generating Units 3 and 4 (NRC 2019a).

However, a designation of an issue as a Category 1 issue does not mean that potential impacts are not considered. During preparation of plant-specific supplements to the LR GEIS, the NRC staff considers changes in nuclear power plant operating parameters and new and potentially significant information provided by the applicant or identified through public comments, or resulting from the NRC's due diligence in reviewing relevant information. Data are reviewed in part for information that could change the conclusion in the LR GEIS with regard to an issue. Thus, even though an issue is a Category 1 issue, mechanisms are in place to conduct a full plant-specific review if new and significant information warrants such a review. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.

Comment: (31) Bird collisions with plant structures and transmission lines. - 1. Is site specific (2). The Florida 3rd DCA, in ruling against FPL's request for transmission lines on the edge of the Everglades, made it clear that risk of bird collisions is site specific. The court's opinion specifically mentioned the risk of transmission lines to young Wood Storks. Since Turkey Point is unique in being adjacent to wading bird nesting areas, the assessments of risk have been legally determined to be site specific. See: 3rd Florida DCA Miami-Dade County, et al., vs. In Re: Florida Power & Light Co., etc., et al., 2016. (**7-9** [Stoddard, Philip])

Comment: The draft document claims that the impacts of bird collisions with plant structures and transmission lines would be SMALL. Bird mortalities from collisions with nuclear power plant structures and in-scope transmission lines would be negligible for any species and are unlikely to threaten the stability of local or migratory bird populations or result in noticeable impairment of the function of a species within the ecosystem. These impacts are not expected to be significant issues during the license renewal term.

This is a site-specific issue. Some transmission corridors approved for the Turkey Point Power Plant are located within and immediately adjacent to Everglades National Park. There are documented nesting colonies of the federally listed wood storks near these transmission corridors and the entire area is known as a core foraging area for these wood stork populations. In addition, the federally listed Everglades snail kite utilizes these areas for foraging and construction of transmission lines in the approved corridors would result in degradation of habitat and increased likelihood of listed species bird collisions with transmission lines. Based on these facts, Miami-Dade County was able to successfully demonstrate in the District Court of Appeals that the installation of transmission lines in these corridors would result in an increase in bird collisions and that habitat would be degraded. It should be noted that the USFWS is currently considering removing the wood stork from the protections currently provided under the ESA. If this were to occur, these potential impacts to the wood stork would no longer be reviewed under the plant specific environmental impacts for threatened and endangered species. (**30-6** [Spadafina, Lisa])

Comment: This area is on the Atlantic Flyway and Bird collisions with plant structures and transmission lines is a site-specific issue, as well as impacts to bird food sources by degrading the ecosystem in the nearshore of Biscayne National Park. The Florida 3rd DCA, in ruling against FPL's request for transmission lines on the edge of the Everglades, made it clear that risk of bird collisions is site specific. The court's opinion specifically mentioned the risk of transmission lines to young Wood Storks. Since Turkey Point is unique in being adjacent to wading bird nesting areas, the assessments of risk have been legally determined to be site specific. See 3rd Florida DCA Miami-Dade County, et al., vs. In Re: Florida Power & Light Co., etc., et al., 2016. (**36-8** [Reynolds, Laura])

Response: *The NRC disagrees with these comments. As stated in Section 4.6.1.1.5 of this LR GEIS, the NRC has concluded that the issue of "Bird collisions with plant structures and transmission lines" is properly designated as a Category 1 issue, because the environmental impacts were found to be the same or similar at all plant sites based on previous license renewal environmental reviews. This finding was based on an analysis of estimated annual bird collision mortality in the United States for various human-made objects as well as available bird mortality surveys conducted at nuclear power plants. The available data show that nuclear power plant structures cause a small number of bird mortalities annually. Because the transmission lines relevant to initial LR or SLR include only those lines that connect the nuclear power plant to the first substation, which is usually on the plant property, any impacts from transmission lines beyond the first substation are not within the scope of this LR GEIS. Additionally, any impacts on federally protected ecological resources are a Category 2 issue, which requires a plant-specific analysis in consultation with the U.S. Fish and Wildlife Service under Section 7 of the Endangered Species Act. The NRC has stated its methods and criteria for environmental issue identification, categorization, and definitions in Section 1.5 of this LR GEIS as well as in the footnotes to Table B–1 in Appendix B to Subpart A of 10 CFR Part 51, as revised pursuant to this final rule.*

However, a designation of an issue as a Category 1 issue does not mean that potential impacts are not considered. During preparation of plant-specific supplements to the LR GEIS, the NRC staff considers changes in nuclear power plant operating parameters and new and potentially significant information provided by the applicant or identified through public comments, or resulting from the NRC's due diligence in reviewing relevant information. Data are reviewed in part for information that could change the conclusion in the LR GEIS with regard to an issue. Thus, even though an issue is a Category 1 issue, mechanisms in place to conduct a full plant-specific review if new and significant information warrants such a review.

The reference to the Miami-Dade County, et al. v. In Re: Florida Power and Light case (State of Florida 2016) concerns Florida Power and Light's site certification application to the Florida Department of Environmental Protection for approval for the Turkey Point Units 6 and 7 project, including the installation of new transmission lines. The question before the court was whether the applicant, Florida Power and Light, complied with the applicable State and local regulations and procedures attendant to the site certification application process. The subject of the State litigation and information specific to the Turkey Point plant is outside the scope of this LR GEIS and rulemaking. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.

Comment: 2. Natural Heritage Resources. The GEIS (page 3-50) notes that operating commercial nuclear power plants are located in a variety of terrestrial habitat types. These habitats will have been affected by the initial construction of the plants and subsequent operations. Natural successional changes will have occurred in vegetation communities. Non-industrial use portions of nuclear power plant sites may include natural areas, such as forest or shrubland, in various degrees of disturbance.

2(a) Agency Jurisdiction.

2(a)(i) The Virginia Department of Conservation and Recreation's (DCR) Division of Natural Heritage (DNH). DNH's mission is conserving Virginia's biodiversity through inventory, protection and stewardship. The Virginia Natural Area Preserves Act (Virginia Code §10.1-209 through 217), authorized DCR to maintain a statewide database for conservation planning and project review, protect land for the conservation of biodiversity, and the protect and ecologically manage the natural heritage resources of Virginia (the habitats of rare, threatened and endangered species, significant natural communities, geologic sites, and other natural features).

2(a)(ii) Virginia Department of Agriculture and Consumer Services (VDACS): The Endangered Plant and Insect Species Act of 1979 (Virginia Code Chapter 39 §3.1-1020 through 1030) authorizes VDACS to conserve, protect and manage endangered and threatened species of plants and insects. Under a Memorandum of Agreement established between VDACS and the DCR, DCR represents VDACS in comments regarding potential impacts on state-listed threatened and endangered plant and insect species.

2(b) Recommendations. DCR has reviewed the GEIS for License Renewal of Nuclear Plants and provided the following recommendations.

2(b)(i) Invasive Species Management. DCR recommends the development and implementation of an invasive species plan to be included as part of the maintenance practices for right-of-ways (ROWs) and other nuclear infrastructure development. The invasive species plan should include an invasive species inventory for the project area based on a current invasive species list for the state and methods for treating the invasives. DCR also recommends the ROW restoration and maintenance practices planned include appropriate revegetation using native species in a mix of grasses and forbs, robust monitoring and an adaptive management plan to provide guidance if initial revegetation efforts are unsuccessful or if invasive species outbreaks occur.

2(b)(ii) Right-of-Way Maintenance Guidelines. DCR recommends the following right-of-way (ROW) maintenance guidelines in sensitive areas with documented natural heritage resources

1. DCR recommends documenting and avoiding Natural Heritage Resources (Rare, Threatened and Endangered) within the ROW. The maintenance of the ROW as early-successional habitats with open canopy provide suitable habitat for many rare resources.

2. All rare plant sites are marked with signs just outside the rare plant populations so that the population(s) are contained entirely within the defined area.

3. Chemical Control of Vegetation: DCR recommends maintenance of vegetation using annual mowing in the non-growing season between 15 October and April 1 and minimal to no use of chemicals especially in sensitive areas with documented natural heritage resources.

4. When woody plant management is required, the woody species at these sites are carefully treated with herbicide. This treatment is conducted under a different contract than used on non-rare plant lines. The rate set up for this contract helps insure precise herbicide application with less accidental overspray.

5. When transmission lines intersect Virginia Natural Area Preserves, the same maintenance regime as defined in numbers 1-3 above is used and Natural Heritage staff are notified before management takes place.

6. A subset of rare plant populations are monitored carefully to make sure that this management prescription is effective in maintaining the rare plant populations.
2(b)(iii) Ecological Cores. If tree removal is proposed outside of the existing ROW for maintenance of the transmission line associated with the nuclear plant, it could impact an Ecological Core(s) as identified in the Virginia Natural Landscape Assessment (https://www.dcr.virginia.gov/natural-heritage/vaconvisvnla). Mapped cores in the project area can be viewed via the Virginia Natural Heritage Data Explorer, available here: http://vanhde.org/content/map.

Ecological Cores are areas of at least 100 acres of continuous interior, natural cover that provide habitat for a wide range of species, from interior-dependent forest species to habitat generalists, as well as species that utilize marsh, dune, and beach habitats. Interior core areas begin 100 meters inside core edges and continue to the deepest parts of cores. Cores also provide the natural, economic, and quality of life benefits of open space, recreation, thermal moderation, water quality (including drinking water recharge and protection, and erosion prevention), and air quality (including sequestration of carbon, absorption of gaseous pollutants, and production of oxygen). Cores are ranked from C1 to C5 (C5 being the least significant) using nine prioritization criteria, including the habitats of natural heritage resources they contain.

Impacts to cores occur when their natural cover is partially or completely converted permanently to developed land uses. Habitat conversion to development causes reductions in ecosystem processes, native biodiversity, and habitat quality due to habitat loss; less viable plant and animal populations; increased predation; and increased introduction and establishment of invasive species.

DCR recommends avoidance of impacts to cores. When avoidance cannot be achieved, DCR recommends minimizing the area of impacts overall and concentrating the impacted area at the edges of cores, so that the most interior remains intact. (**11-2** [Rayfield, Bettina])

Response: *NRC agrees with this comment to the extent that invasive species management, right-of-way maintenance guidelines, and habitat loss should be evaluated when determining the impacts of license renewal (initial LR or SLR) on ecological resources. These topics are described in Sections 3.6 and 4.6 of NUREG-1555, Supplement 1, Revision 2 (NRC 2024b). No changes were made in the LR GEIS, final rule, or guidance as a result of this comment.*

Comment: 9. Section/Page 4.6.1.3 Ecological Resources 44, Comment/Recommendation: The relationship between plant operation and ecological resource attributes to be examined is described as follows, "Risk hypotheses may be very simple, predicting the potential effect of one stressor on one receptor, or extremely complex." No acceptance criteria or bounds to this review are provided. This comment also applies to NUREG-1555 (p4-35).
(**19-2-16** [Uhle, Jennifer])

Comment: 10. Section/Page 4.6.1.4 Ecological Resources 45, Comment/Recommendation: The discussion on assessing and characterizing potential impacts is broad and acceptance criteria in NUREG-1555 repeats the exact wording provided herein. The statement "examine several lines of evidence" does not provide bounds for this issue. (**19-2-17** [Uhle, Jennifer])

Response: *The NRC disagrees with these comments. The quoted text in these comments refers to Section 4.6.3, Review Procedures (General for Ecological Resources Issues), of NUREG-1555, Supplement 1, Revision 2 (NRC 2024b). Acceptance criteria or bounds are not provided for the statement "Risk hypotheses may be very simple, predicting the potential effect of one stressor on one receptor, or extremely complex" because hypotheses will be dependent upon the specific risks and receptors at a site, and professional judgment and available information about the specific ecosystem are used to develop risk hypotheses (EPA 1998). As discussed in Section 5.2.1 (of EPA 1998), the statement "examine several lines of evidence" is intended to be an inclusive approach for the evaluation of all relevant information, including qualitative information. Discussion of acceptance criteria and example lines of evidence for Category 2 issues identified for Terrestrial Resources are described in Sections 4.6.5 and 4.6.6 of NUREG-1555, Supplement 1, Revision 2. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.*

Comment: The draft document claims that cooling system impacts on terrestrial resources for plants that have once-through cooling systems or cooling ponds would be SMALL. Continued operation of nuclear power plant cooling systems during license renewal could cause thermal effluent additions to receiving water bodies, chemical effluent additions to surface water or groundwater, impingement of waterfowl, disturbance of terrestrial plants and wetlands by maintenance dredging, and erosion of shoreline habitat. However, plants where these impacts have occurred successfully mitigated the impact, and it is no longer of concern. The draft document states that that these impacts are not expected to be significant issues during the license renewal term.

This is an incorrect assumption based on the site-specific situation at Turkey Point Power Plant. The Turkey Point Power Plant is located immediately adjacent to the Everglades Mitigation Bank (EMB) which is owned and operated by FPL. Miami-Dade County has documented terrestrial resource impacts in certain wetland areas in close proximity to the plant and within the EMB. This includes the die off of sawgrass in large areas within the EMB immediately adjacent to the CCS. Over the past several years, FPL has collected Continuous Surface Electromagnetic (CSEM) data in the areas of the west of the plant in efforts to map the groundwater plume. These data have shown the migration of the groundwater plume into the area where the sawgrass die off has occurred. (**30-5** [Spadafina, Lisa])

Response: *The NRC disagrees with this comment. The NRC has concluded that the issue of "Cooling system impacts on terrestrial resources (plants with once-through cooling systems or cooling ponds)" is properly designated as a Category 1 issue, because the environmental impacts were found to be the same or similar at all plant sites based on previous license renewal environmental reviews. As discussed in Section 4.6.1.1.3 of this LR GEIS, this finding was based on an analysis of available information indicating that nuclear power plants that have had cooling system impacts, such as from thermal or chemical effluent additions to receiving waterbodies, have successfully mitigated the impact on terrestrial resources. The NRC has stated its methods and criteria for environmental issue identification, categorization, and definitions in Section 1.5 of this LR GEIS as well as in the footnotes to Table B–1 in Appendix B to Subpart A of 10 CFR Part 51, as revised pursuant to this final rule. The NRC's update of the LR GEIS included a review of changes to applicable laws and regulations, new data in its*

possession, collective experience, and lessons learned and knowledge gained from conducting environmental reviews for initial LR and SLR since development of the 2013 LR GEIS, including the SLR environmental review for Turkey Point Nuclear Generating Units 3 and 4 (NRC 2019a). For this issue, the NRC considered information related to the flow of hypersaline groundwater from the cooling canals toward the Everglades. The NRC concluded that based on ecological monitoring data the movement of the hypersaline water had not had discernable ecological impacts including on wetlands (see Section 4.6.1.1.3 of this LR GEIS).

However, a designation of an issue as a Category 1 issue does not mean that potential impacts are not considered. During preparation of plant-specific supplements to the LR GEIS, the NRC staff considers changes in nuclear power plant operating parameters and new and potentially significant information provided by the applicant or identified through public comments, or resulting from the NRC's due diligence in reviewing relevant information. Data are reviewed in part for information that could change the conclusion in the LR GEIS with regard to an issue. Thus, even though an issue is a Category 1 issue, mechanisms are in place to conduct a full plant-specific review if new and significant information warrants such a review. The information provided in these comments specific to the Turkey Point plant is appropriately considered in a plant-specific supplement to the LR GEIS or similar analysis rather than in the LR GEIS and this rulemaking. No changes were made in the LR GEIS, final rule, or guidance as a result of this comment.

Comment: 2(b)(v) Other Agency Coordination. DCR supports coordination with the United States Fish and Wildlife Service (USFWS) and National Oceanic and Atmospheric Administration (NOAA) for actions associated with nuclear relicensing that may affect federally endangered and threatened species as well as coordination with state agencies/natural heritage programs for potential impacts to state-listed species and rare habitats including natural heritage resources. Under a Memorandum of Agreement established between the Virginia Department of Agriculture and Consumer Services (VDACS) and the DCR, DCR represents VDACS in comments regarding potential impacts on Virginia state-listed threatened and endangered plant and insect species.

2(b)(vi) Natural Heritage Resource Update. New and updated information is continually added to Biotics, the natural heritage program's database. DCR recommends any proposed nuclear relicensing project be screened using this database for potential impacts to natural heritage resources. If six months passes before this information is utilized, DCR also recommends the natural heritage information be updated. (**11-4** [Rayfield, Bettina])

Comment: 2. Natural Heritage Resources. Contact DCR-DNH, Rene Hypes at (804) 371-2708, to secure updated information on natural heritage resources if the scope of the project changes and/or six months has passed before the project is implemented, since new and updated information is continually added to the Biotics Data System.

Contact Allison Tillett (804-238-8620) with questions regarding DCR's recommendations related to invasive species, ROW maintenance, and ecological cores. (**11-9** [Rayfield, Bettina])

Response: *The NRC agrees with this comment to the extent that important terrestrial species and habitats, including natural heritage resources, should be evaluated when determining the impacts of license renewal (initial LR or SLR) on ecological resources. As discussed in Sections 3.6 and 4.6 of NUREG-1555, Supplement 1, Revision 2 (NRC 2024b), information about important terrestrial species and habitats, including natural heritage areas, should be described in the affected environment and considered for potential effects of continued*

operation of a nuclear power plant during the license renewal term. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.

Comment: Habitat Decline

Adjacent to Turkey Point nuclear plant are remnants of sawgrass prairie, which once sprawled to the west in endless expanse. Sawgrass (*Cladium jamaicense*), the most common and dominant plant of the Everglades, requires fresh to brackish water and is not commonly found growing in or directly abutting marine waters.[36] In the vicinity of Turkey Point, the Miami-Dade County Department of Environmental Resource Management documented declining sawgrass height over time,[37] which suggests that the plant could be imparting hydrologic impacts that are affecting nearby habitat.

[36] Loveless, C. M. 1959. "A study of the vegetation in the Florida Everglades". Ecology 40: 1-9
[37] Miami-Dade County Memorandum, April 8, 2015. FPL Units 3&4 Ecological Monitoring - Sawgrass Effects. Included as Attachment 14. (**31-6** [Silverstein, Rachel])

Comment: (32) Water use conflicts with terrestrial resources (generating plants with cooling ponds or cooling towers)

We agree that this issue should remain a "2". We further assert that significance must be elevated from "small/moderate" up to "moderate/large".

As noted above, Everglades restoration is planned in the area. Re-establishing healthy ecosystems that resemble the historic coastal Everglades requires reestablishing similar hydrologic conditions. Healthy, freshwater sheet flow will revitalize coastal wetlands and nearshore receiving waters that are currently choked with salinity. Therefore, any license extension renewal should evaluate the plant's water consumption from surface and groundwater sources, CCS operations, and whether such activities significantly affect the Everglades restoration planned in the region. For instance, the NRC must understand whether freshening of the CCS is causing salinizing events in the L-31E, and if so, how might these events conflict with BBSEER restoration. The NRC should also analyze whether a cooling tower with alternative water sources is feasible, as described in the 1972 EIS, to determine if these alternatives would have less environmental impact than the present system.

Additionally, the causes of declining sawgrass height in the vicinity of the plant and cooling canal system need to be considered in any license extension renewal application. The NRC should understand whether the impacts to habitat are the result of excess salinity stunting sawgrass growth. (**31-21** [Silverstein, Rachel])

Response: *The NRC agrees in part and disagrees in part with this comment. The NRC understands the comment to refer to item (32), "Water use conflicts with terrestrial resources (plants with cooling ponds or cooling towers using makeup water from a river)," as included in the NRC's list of changes to Table B-1 contained in the proposed rule. The NRC agrees that the issue is properly designated as Category 2.*

The NRC disagrees that the significance level for this issue should be changed from "SMALL to MODERATE" to "MODERATE to LARGE." As discussed in Section 4.6.1.1.6 of this LR GEIS, water use conflicts for terrestrial resources can arise when the water that supports the terrestrial resources is diminished through consumptive use by nuclear power plants. The consumptive use of water at nuclear power plants that have cooling ponds or cooling towers using makeup

water from a river is not expected to change during the license renewal term (initial LR or SLR), unless power uprates occur and more water is consumed, which requires NRC approval. This issue primarily concerns whether a nuclear power plant's water consumption affects downstream terrestrial habitats and animals. This issue does not apply to Turkey Point Nuclear Generating Units 3 and 4 because Turkey Point does not withdraw makeup water from a river. Nevertheless, the NRC has addressed comments regarding the impacts of Turkey Point CCS operations on wetlands and sawgrass previously in this section in association with the Category 1 issue, "Cooling system impacts on terrestrial resources (plants with once-through cooling systems or cooling ponds)." In addition, the NRC has addressed comments received regarding the operational effects of the Turkey Point CCS on surface water and groundwater resources in Sections A.2.3 and A.2.4, respectively, of this appendix.

However, during preparation of plant-specific supplements to the LR GEIS, the NRC staff considers changes in nuclear power plant operating parameters and new and potentially significant information provided by the applicant or identified through public comments, or resulting from the NRC's due diligence in reviewing relevant information. No changes were made in the LR GEIS, final rule, or guidance as a result of this comment.

A.2.6 Ecological Resources: Aquatic Resources

Comment: Pumping the large volumes of cooling water into a plant or unit also has collateral adverse impacts on various forms of aquatic life in the source waters.
(**32-10-4** [Reiser, Caroline])

Comment: <u>Subsection ix, Aquatic Resources (35), Impingement Mortality and Entrainment of Aquatic Organisms:</u>

We agree that this proposed new rule must be a Category 2 for nuclear power plants where the environment around the plant site contains "aquatic resources". This rule should contain a specific definition of and examples of "aquatic resources" covered by the rule, i.e., wetlands, coastal estuaries, streams, lakes, rivers, springs, seeps, ponds, groundwater. The scope of the rule should be modified / expanded to include "cooling canals". This following additional text should be added to this proposed rule.

*An Applicant seeking a LR or SLR for a nuclear power plant located next to a coastal bay or ocean waters and expects to continue using non-closed loop (unlined) cooling ponds or canals that utilize seawater for make-up and (1) leak into the groundwater and /or (2) experiences a daily tidal exchange of seawater with said coastal bay or ocean waters must include in its Site Specific Environmental Report a qualitative and quantitative evaluation of the impacts on the aquatic resources contained within the environment around the plant site during the SLR term.

*Furthermore, the Site- Specific Environmental report must describe how the Applicant intends to mitigate any predicted adverse impacts and how it will monitor the status of the health of the aquatic resources during the renewal term to determine the level of success of the mitigation measures. The Applicant shall be required to include this information in the annual plant report to the NRC. (**37-5** [Rippingille, Bonnie])

***Response:** The NRC agrees in part and disagrees in part with these comments. The NRC agrees to the extent that the issue of "Impingement mortality and entrainment of aquatic organisms (plants with once-through cooling systems or cooling ponds)" should be a Category 2 issue, as discussed in Section 4.6.1.2.1 of this LR GEIS. The scope of this issue encompasses*

the impingement and entrainment of finfish and shellfish from the aquatic environment by operating nuclear power plants. As shown in Table 4.6-4 of the LR GEIS, the cooling canal system at Turkey Point Nuclear Generating Units 3 and 4 is considered a "cooling pond," thus the scope of this issue already covers cooling canals. The NRC also agrees that the rule should contain a specific definition or examples of aquatic resources covered by the rule, which is covered under the discussion for each aquatic resource issue. Section 3.6.2 of the LR GEIS describes the types of aquatic resources that are found near nuclear power plants, and these resources will also be described in plant-specific supplements to the LR GEIS prepared as part of each plant-specific license renewal environmental review.

The NRC disagrees with the suggested language to be added to the final rule. The NRC's regulations under 10 CFR 51.53(c)(3) already require that an applicant provide in its environmental report a plant-specific analysis for applicable Category 2 issues, including for associated aquatic resources impacts. Further, in accordance with 10 CFR 51.53(c)(2), an applicant's environment report "must describe in detail the affected environment around the plant…." Any license conditions or mitigations would be plant-specific and discussed in the plant-specific supplement to the LR GEIS. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.

Comment: (ix) Aquatic Resources
(41) Effects of nonradiological contaminants on aquatic organisms. – 1. Is site specific (2). Leaching of phosphate and nitrogen-laden water or hyper-saline water from cooling canals at Turkey Point has the potential to damage adjacent sea grass beds in Biscayne National Park. (**7-10** [Stoddard, Philip])

Comment: Aquatic Resources: Effects of non-radiological contaminants on aquatic organisms are unique, site specific considerations because the leaching of hypersaline, phosphorus and nitrogen laden water from the cooling canals at Turkey Point has damaged adjacent seagrass meadows in Biscayne National Park. This has occurred first by fertilization and then by replacement with more nutrient loving species of seagrasses and finally macroalgae. This in turn impacts fish and wildlife by degrading ecosystem function impacting community structure, abundance and diversity of fish and their prey opportunity. (**26-6** [Casals, Rafael])

Comment: The draft document claims that the effects of nonradiological contaminants on aquatic organisms would be SMALL. Heavy metal leaching from condenser tubes was an issue at several operating nuclear power plants. These plants successfully mitigated the issue, and it is no longer of concern. Cooling system effluents would be the primary source of nonradiological contaminants during the license renewal term. Implementation of BMPs and adherence to NPDES permit limitations would minimize the effects of these contaminants on the aquatic environment.

This is an incorrect assumption based on the operations at the Turkey Point Power Plant. The matter of the Turkey Point's boundaries is important to note as the groundwater emanating from the CCS has been documented by the County to have moved beyond the FPL property boundaries altogether into surface water and groundwater including the L-31 E canal, as well as the County's Environmentally Endangered Lands Preserve where wetland habitat and associated fauna can be impacted. Contrary to the claim above that cooling system effluents including heavy metals leaching from condenser tubes would be the primary source of contaminants, chlorides from evaporation are the primary source of contamination to the surrounding ground and surface waters. Other impacts have included but not been limited to increases in salinity in freshwater wetland environments as a result of seepage fluxes caused by

exchange of water and salt between the CCS and the groundwater beneath and adjacent to it, as well as nutrient inputs to surrounding areas from the CCS documented over time, specifically nitrogen. Increased nutrients in groundwater and surface waters can lead to impairments of Outstanding Florida Waters. Additionally, nitrogen and phosphorus as a result of decay from seagrass and mangrove die-offs within the cooling canal system has been documented in groundwater beyond the CCS and is a potential source of nitrogen impacting water quality in adjacent surface waters such as the L-31 E canal and Biscayne National Park. (**30-7** [Spadafina, Lisa])

Comment: (41) Effects of non-radiological contaminants on aquatic organisms

This issue must be reclassified as a "2" and elevated in significance to "moderate". Given the plant operator's past use of copper sulfate, and given that algae-inducing phosphorus, as well as chlorophyll-a concentrations, in the CCS show no trend of decline, a license extension environmental review should analyze the impacts of the plant operators past, present, and future use of copper sulfate on aquatic life in the CCS. Furthermore, and as previously established, water in the CCS migrates radially through the porous limestone geology. Therefore, the NRC should also analyze whether copper sulfate, a bioaccumulative compound, is present in surface and groundwater around the plant to discern how any copper sulfate leaking from the CCS may be harming aquatic organisms. (**31-15** [Silverstein, Rachel])

Comment: Aquatic Resources: Effects of non-radiological contaminants on aquatic organisms are unique, site-specific considerations because the leaching of hypersaline, phosphorus, and nitrogen-laden water from the cooling canals at Turkey Point has damaged adjacent seagrass meadows in Biscayne National Park. This has occurred first by fertilization and then by replacement with more nutrient-loving species of seagrasses and finally macroalgae. This in turn impacts fish and wildlife by degrading ecosystem function impacting community structure, abundance, and diversity of fish and their prey opportunity. (**36-6** [Reynolds, Laura])

Response: *The NRC disagrees with these comments. The NRC has concluded that the issue of "Effects of nonradiological contaminants on aquatic organisms" is properly designated as a Category 1 issue, because the environmental impacts were found to be the same or similar at all plant sites based on previous license renewal environmental reviews. The NRC has stated its methods and criteria for environmental issue identification, categorization, and definitions in Section 1.5 of this LR GEIS as well as in the footnotes to Table B-1 in Appendix B to Subpart A of 10 CFR Part 51, as revised pursuant to this final rule. The NRC's update of the LR GEIS included a review of changes to applicable laws and regulations, new data in its possession, collective experience, and lessons learned and knowledge gained from conducting environmental reviews for initial LR and SLR since development of the 2013 LR GEIS. This included the SLR environmental review for Turkey Point Nuclear Generating Units 3 and 4 (NRC 2019a). This finding is further supported by the NRC's analysis presented in Section 4.6.1.2.7 of the LR GEIS, which found that impacts of nonradiological contaminants on aquatic organisms during the license renewal term (initial LR or SLR) would be SMALL. The affected environment for aquatic resources from past, present, and reasonably foreseeable actions is addressed under a cumulative effects analysis in Section 4.13 of the LR GEIS.*

However, a designation of an issue as a Category 1 issue does not mean that potential impacts are not considered. During preparation of plant-specific supplements to the LR GEIS, the NRC staff considers changes in nuclear power plant operating parameters and new and potentially significant information provided by the applicant or identified through public comments, or resulting from the NRC's due diligence in reviewing relevant information. Data are reviewed in

part for information that could change the conclusion in the LR GEIS with regard to an issue. Thus, even though an issue is a Category 1 issue, mechanisms are in place to conduct a full plant-specific review if new and significant information warrants such a review. For instance, during the NRC staff's SLR environmental review for the Turkey Point plant, the staff reviewed ecological monitoring data collected to analyze changes in ecological characteristics in and around the site over time. Sections 3.6 and 3.7 of the SLR supplement (NRC 2019a) describe these monitoring efforts and results in detail. The NRC staff then considered this information when forming its conclusions related to the impacts of license renewal on the ecological environment. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.

Comment: Under the, or what is a consolidated Category 1 issue, effects of thermal effluents, and does the term infrequently reported thermal impacts, what exactly does that mean, like it's an event that happens infrequent or it's reported infrequently? Because there have been, at the Prairie Island site, fish kills over the years because of thermal impacts, so I'm just trying to understand what does that mean, infrequently reported? (**3-2-1** [Westra, Heather])

Comment: Okay, I'm just --it's occurring at the Prairie Island Plant, maybe not every year, maybe it's infrequently, but when it does occur, quite a lot of fish are killed because it's a thermal impact and people are concerned, and so I guess what you're saying is it will remain a Category 1. (**3-2-2** [Westra, Heather])

Response: *The NRC acknowledges the comments and questions. The phrase "infrequently reported thermal impacts" include 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 effects are grouped together into one license renewal environmental issue in the LR GEIS because each of them is related to the effects of a nuclear power plant's thermal effluent, but each has rarely been found to be an issue at operating nuclear power plants. Thus, due to the rare frequency of occurrence or observation, the NRC has used the term "infrequently" to characterize this particular set of impacts. Section 4.6.1.2.6 of the LR GEIS describes each of these potential impacts and discusses instances in which these impacts have been observed, if any. Notably, the comments mention fish kills resulting from thermal effluent discharges. For plants with once through cooling systems and cooling ponds, these impacts will be addressed site-specifically for each plant-specific license renewal environmental review as part of the Category 2 issue, "Effects of Thermal Effluents on Aquatic Organisms," which would include the Prairie Island Nuclear Generating Plant. Specific information related to the Prairie Island Nuclear Generating Plant is appropriately considered in a plant-specific supplement to the LR GEIS or similar analysis rather than in this LR GEIS and associated rulemaking. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.*

Comment: (46) Impacts of transmission line right-of-way (ROW) management on aquatic resources. – 1. Sheet flow of water through the Southeast Coastal Everglades would be altered by ROWs elevated above the water table for access or maintenance. (**7-11** [Stoddard, Philip])

Response: *The NRC disagrees with this comment suggesting that the issue, "Impacts of transmission line right-of-way (ROW) management on aquatic resources," should be a Category 2 issue. The NRC concluded that this issue is properly designated as a Category 1 issue. The NRC has stated its methods and criteria for environmental issue identification,*

categorization, and definitions in Section 1.5 of this LR GEIS as well as in the footnotes to Table B–1 in Appendix B to Subpart A of 10 CFR Part 51, as revised pursuant to this final rule. A generic, Category 1 grouping is appropriate for the issue, because the environmental impacts were found to be the same or similar at all plant sites based on previous license renewal environmental reviews. This finding is further supported by the NRC's analysis presented Section 4.6.1.2.12 of the LR GEIS, which found that in-scope transmission lines (i.e., transmission lines that connect the nuclear power plant to the substation where electricity is fed into the regional power distribution system and transmission lines that supply power to the nuclear power plant from the grid) tend to occupy only industrial-use or other developed portions of nuclear power plant sites, and therefore the effects of ROW maintenance on aquatic plants and animals during the license renewal term (initial LR or SLR) would be negligible. In addition, the application of best management practices would reduce the potential for impacts.

However, a designation of an issue as a Category 1 issue does not mean that potential impacts are not considered. During preparation of plant-specific supplements to the LR GEIS, the NRC staff considers changes in nuclear power plant operating parameters and new and potentially significant information provided by the applicant or identified through public comments, or resulting from the NRC's due diligence in reviewing relevant information. Data are reviewed in part for information that could change the conclusion in the LR GEIS with regard to an issue. Thus, even though an issue is a Category 1 issue, mechanisms are in place to conduct a full plant-specific review if new and significant information warrants such a review. No changes were made in the LR GEIS, final rule, or guidance as a result of this comment.

Comment: 2(b)(iv) Aquatic Ecosystem. To minimize adverse impacts to the aquatic ecosystem as a result of the proposed activities associated with the relicensing of nuclear plants, DCR recommends the implementation of and strict adherence to applicable state and local erosion and sediment control/storm water management laws and regulations, establishment/enhancement of riparian buffers with native plant species and maintaining natural stream flow. (**11-3** [Rayfield, Bettina])

Response: *This NRC agrees with this comment to the extent that each nuclear power plant licensee must conduct its operations in accordance with all applicable Federal, State, and local permits and regulations. The issue discussed in Section 4.6.1.2.11 of the LR GEIS, "Non-cooling system impacts on aquatic resources," includes activities such as landscape and ground maintenance, stormwater management, and ground-disturbing activities that could directly disturb aquatic habitat or cause runoff or sedimentation. The application of best management practices and other conservation initiatives would reduce potential impacts. As discussed in the executive summary of NUREG-1555, Supplement 1, Revision 2 (NRC 2024b), the NRC staff reviewer must evaluate the applicant's commitments to use practices to minimize, reduce, or avoid adverse impacts. No changes were made in the LR GEIS, final rule, or guidance as a result of this comment.*

Comment: I note, however, that the thermal cycle requires that a significant amount of heat or thermal energy be discarded from the condenser of a power plant unit. Commonly, this heat is released to the ambient environment by using copious quantities of cooling water. Plants are generally located near large bodies of water such as near coastlines, lakes, rivers, impoundments, etc. to provide ready access to cooling water. I note that when the cooling water is discharged back to the environment, it is hotter than the intake water and, as a result, there is a thermal plume or impact in the receiving water body that impacts all biological organisms in the receiving waters. (**32-10-8** [Reiser, Caroline])

Response: *The NRC agrees with this comment. The issue of "Effects of thermal effluents on aquatic organisms (plants with once-through cooling systems or cooling ponds)" has been designated as a Category 2 issue. As a Category 2 issue, it was determined that one or more of the criteria for Category 1 cannot be met and, therefore, an additional plant-specific review is required. The rationale for designating this issue as a Category 2 issue is described in Section 4.6.1.2.4 of the LR GEIS. No changes were made in the LR GEIS, final rule, or guidance as a result of this comment.*

A.2.7 Ecological Resources: Federally Protected Ecological Resources

Comment: I was just told to repeat my question during the comment period, and again, it's on the Endangered Species Act, Magnuson, et cetera, et cetera, and it seems to limit, based on the supplementary information, the consideration under those acts during the NRC review to what are called, quote, action areas, unquote, and there's no explanation of what an action area is. So, my question is, and my comment, I guess, is that when you're going out with the final rule, please explain what the action item is, okay? (**3-1-1** [Cameron, Chip])

Comment: On page 13,346, the Supplementary Information addresses "action areas" under the Endangered Species Act. Although these "action areas" are deemed significant in requiring an analysis, no explanation is given on what an "action area" is. This should be explained. (**14-4** [Johnson, Johnny])

Comment: 6. Section/Page 3.6 Federally Listed Species and Critical Habitat 28, Comment/Recommendation: The discussion on ESA action area is broad and acceptance criteria for determining the action area is ambiguous in NUREG-1555. "The action area is not limited to the footprint of the action nor is it limited by the Federal action agency's authority; rather, it is a biological determination of the reach of the proposed action on the listed species." Additional guidance for objectively determining the ESA action area would be helpful; otherwise this appears to be a fairly subjective determination. (**19-2-13** [Uhle, Jennifer])

Response: *The NRC acknowledges the comments and questions raised. As presented in Section 3.6.3 of the LR GEIS, the NRC must consider the effects of its actions on ecological resources protected under Federal statutes, including the Endangered Species Act (ESA; 16 U.S.C. § 1531 et seq.), Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. § 1801 et seq.), and National Marine Sanctuaries Act (16 U.S.C. § 1431 et seq.).*

The term "action area" is a regulatory term defined in 50 CFR 402.02 (regulations implementing the ESA) that includes all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action. The action area varies based on the species and/or habitat and the Federal action, and it must be defined through a site-specific evaluation. As part of ESA Section 7 Consultation, the NRC defines the action area for the proposed action. This step then informs the federally listed species and critical habitats relevant to the review and the potential impacts those species and habitats might experience. For instance, one component of an action area for license renewal would include all waters affected by impingement, entrainment, and thermal and chemical effluent discharges. Any federally listed species that may occur in these waters based on survey data, studies, and Federal and State agency records would then be evaluated to determine if effects on these species are possible. The Services (National Marine Fisheries Service and U.S. Fish and Wildlife Service) review the NRC's defined action area as part of the consultation, along with the NRC's species- and habitat-specific analyses and effect determinations.

The definition of "action area" appears in Section 3.6.3.1 of the LR GEIS, Section 3.6.1 of NUREG-1555, Supplement 1, Revision 2 (NRC 2024b), and Section 3.6 of Regulatory Guide 4.2, Supplement 1, Revision 2 (NRC 2024a). In response to these comments, the NRC added this definition to Section 4.6.1.3.1 of the LR GEIS. Additionally, the staff removed the term "action area" from Sections 4.6.1.3.3 and 4.6.1.3.4 of the LR GEIS. Because action area is a regulatory term that only applies to federally listed species and critical habitats protected under the ESA, the application of the term to essential fish habitat protected under the Magnuson-Stevens Fishery Conservation and Management Act and marine sanctuaries protected under the National Marine Sanctuaries Act is not appropriate. In these sections, "affected area" replaces previous uses of "action area."

Comment: Endangered Species Impacts

State and federally protected species historically found in the vicinity of Turkey Point include the American crocodile, Florida panther, eastern indigo snake, red knot, West Indian manatee, and wood stork.

The health of Turkey Point's CCS greatly affects the health and the numbers of crocodiles that use the CCS for nesting and foraging. The earthen banks along the cooling canal system, and the low-energy waters do provide suitable habitat for this species - the CCS has been a haven for the species - but only if ambient conditions are maintained. After the uprate, poor conditions in the CCS previously caused crocodiles to starve and experience stress, dehydration, and malnutrition, which, in turn, caused a reduction in numbers of crocodiles, as well as nesting and hatchling abundance.[38] Although FPL is currently required to conduct activities aimed at improving water quality within the CCS,[39] the Fish and Wildlife Service determined in 2019 that current conditions within the system are having an adverse impact on crocodiles and their critical habitat.[40]

[38] Letter from Roxanna Hinzman, U.S. Fish and Wildlife Serv., to Briana Grange, U.S. Nuclear Regulatory Comm'n, regarding formal consultation on subsequent renewed licenses for Units 3 and 4, 31, 32-33 (July 25, 2019) ("2019 Biological Opinion").
[39] Id. at 5-6, 34.
[40] Id. at 31, 33, 34, 40. (**31-7** [Silverstein, Rachel])

Comment: (47 and 48) Endangered Species Act: Federally listed species and critical habitats under U.S. Fish and Wildlife and National Marine Fisheries Service jurisdiction

The NRC must also consider new information regarding environmental impacts to endangered and threatened species within the action area, including the Turkey Point site, the CCS, adjacent wetlands, and areas in Biscayne Bay where barges may travel. While the NRC already considered these impacts in the 2019 FSEIS, as a Category 2 (site-specific) issue, the NRC must consider updated information available since 2019. For example, in considering how the relicensing will affect listed species, the NRC must consider the new information regarding FPL's groundwater remediation, discussed above, and how a failure to remediate the hypersaline plume could affect species.

The NRC must reconsider all effects of the license renewal on state and federally protected species, including but not limited to the Florida panther, eastern indigo snake, red knot, West Indian manatee, and wood stork. Many of these species rely on coastal and freshwater systems that will be significantly affected by the cumulative subsequent license renewal, changing climatic conditions over the coming decades, and potentially--a failed attempt at groundwater remediation. (**31-16** [Silverstein, Rachel])

Response: *The NRC agrees in part and disagrees in part with these comments. The majority of the comments provide a narrative description of the impacts on federally protected species and habitats from past and ongoing operations of Turkey Point Nuclear Generating Units 3 and 4 and cooling canal system (CCS), while expressing concerns about the continued operation of that plant. The comments also reference a recently issued report focusing on operations and remediation activities associated with the Turkey Point CCS.*

The NRC agrees with the comments to the extent that they suggest that the NRC needs to consider unique issues and impacts at nuclear power plant sites as part of the NRC's license renewal environmental reviews. Plant- or site-specific environmental issues and concerns associated with operating nuclear power plants, such as those raised in the comments, are considered in a plant-specific supplement to the LR GEIS in accordance with the NRC's regulations set forth in 10 CFR Part 51. This revision to the LR GEIS was informed by lessons learned and knowledge gained from conducting initial LR and SLR environmental reviews since development of the 2013 LR GEIS, as discussed in Section 4.1.3 of this LR GEIS. This includes new information identified by the NRC staff during the SLR environmental review for Turkey Point Nuclear Generating Units 3 and 4, as documented in NUREG-1437, Supplement 5, Second Renewal (NRC 2019a). The Turkey Point SLR plant-specific review included consideration of relevant new information related to federally protected species and habitats.

The NRC disagrees with the comments to the extent that they suggest that the NRC must reconsider all effects of the Turkey Point license renewal on State and federally protected species. The information provided in these comments specific to the Turkey Point Nuclear Generating Units 3 and 4 is appropriately considered in a plant-specific supplement to the LR GEIS, or similar analysis rather than in this LR GEIS and associated rulemaking; however, impacts on federally protected species will be analyzed as part of each plant-specific license renewal environmental review. As referenced in Section 4.6.1.3.1, the NRC considered the biological opinion issued for continued operation of the Turkey Point plant during an SLR term, which addresses the American crocodile, its critical habitat, and the eastern indigo snake. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.

Comment: Being from Ohio and our two nuclear plants being based on Lake Erie, also home to vigorous environmental improvement projects, I was impressed to see focus on endangered species and specific provisions for critical fish populations as they are critical to a portion of northern Ohio's economy and our international trade. (**5-3** [Anonymous, Anonymous])

Response: *The NRC acknowledges the comment. As described in the rule, and Section 1.11 of this LR GEIS, the Category 2 issue of "Threatened, endangered, and protected species and essential fish habitat" was divided into three Category 2 issues: "Endangered Species Act: federally listed species and critical habitats under U.S. Fish and Wildlife Service jurisdiction," "Endangered Species Act: federally listed species and critical habitats under National Marine Fisheries Service jurisdiction," and "Magnuson-Stevens Act: essential fish habitat." This change will promote clarity and consistency with the separate federal statutes and interagency consultation requirements that the NRC staff must consider. In addition, "National Marine*

Sanctuaries Act: sanctuary resources" was added as a Category 2 issue. As a Category 2 issue, the NRC staff determined that one or more of the criteria for Category 1 cannot be met and therefore, an additional plant-specific review is required. The rationale for designating these issues as Category 2 issues is described in Section 4.6.1.3 of the LR GEIS. No changes were made in the LR GEIS, final rule, or guidance as a result of this comment.

Comment: 4. Wildlife Resources, Fisheries, and Protected Species. According to the GEIS (page 4-53) environmental conditions at operating nuclear power plants have been well established during 30 the current licensing term. Continued operations are not expected to change substantially during the license renewal term, and therefore, existing conditions are expected to continue during the license renewal term. License renewal is unlikely to introduce new stressors on the ecological environment.

4(a) Agency Jurisdiction. The Virginia Department of Wildlife Resources, as the Commonwealth's wildlife and freshwater fish management agency, exercises enforcement and regulatory jurisdiction over wildlife and freshwater fish, including state-or federally-listed endangered or threatened species, but excluding listed insects (Virginia Code, Title 29.1). DWR is a consulting agency under the U.S. Fish and Wildlife Coordination Act (16 U.S. Code §661 *et seq*.) and provides environmental analysis of projects or permit applications coordinated through DEQ and several other state and federal agencies. DWR determines likely impacts upon fish and wildlife resources and habitat, and recommends appropriate measures to avoid, reduce or compensate for those impacts. For more information, see the DWR website at www.dwr.virginia.gov.

4(b) Agency Findings. DWR have reviewed the subject proposal that hopes to "further redefine the number and scope of the environmental issues that must be addressed by the NRC and applicants during license renewal environmental reviews." The two nuclear facilities located in Virginia are very different in terms of their impacts upon the environment. While the concerns DWR have related to both facilities center around their use of water for cooling and the impacts that use has on aquatic ecosystems, the location and operation of the facilities dictates how DWR expect each facility to address its concerns.

4(c) Agency Recommendation. DWR believe that each facility should prepare its own environmental analysis, in cooperation with state and federal resource agencies. It may not, therefore, be appropriate for a generic environmental impact statement concluding that these impacts are considered small to be applied to any or all nuclear plants, even if only for Category 1 environmental issues and whether used for the initial analysis or reissuance analysis. DWR support plant-specific analysis for all categories of environmental issues.
(**11-6** [Rayfield, Bettina])

Comment: 5. Wildlife Resources, Fisheries, and Protected Species. DWR recommend plant-specific analysis for all categories of environmental issues. Coordinate with DWR (Amy Martin, 804-481-5296) to discuss this recommendation. (**11-12** [Rayfield, Bettina])

Response: *The NRC agrees in part and disagrees in part with these comments. The NRC agrees with these comments to the extent that an environmental analysis should be conducted by the applicant and NRC for the license renewal (initial LR or SLR) of each nuclear power plant.*

The NRC disagrees with the comments to the extent that they assert a plant-specific analysis should be required for all categories of environmental issues for an impact determination. The

NRC has stated its methods and criteria for environmental issue identification, categorization, and definitions in Section 1.5 of this LR GEIS as well as in the footnotes to Table B–1 in Appendix B to Subpart A of 10 CFR Part 51, as revised pursuant to this final rule. The NRC's analysis and rationale for categorization of ecological issues determined to be generic are provided in Section 4.6 of the LR GEIS.

However, a designation of an issue as a Category 1 issue does not mean that potential impacts are not considered. During preparation of plant-specific supplements to the LR GEIS, the NRC staff considers changes in plant operating parameters and new and potentially significant information identified provided by the applicant or identified through public comments, or resulting from the NRC's due diligence in reviewing relevant information. Data are reviewed in part for information that could change the conclusion in the LR GEIS with regard to an issue. Thus, even though an issue is a Category 1 issue, mechanisms are in place to conduct a full plant-specific review if new and significant information warrants such a review.

Notably, the comments express concerns about the potential impacts of cooling water use on the aquatic ecosystem at nuclear power plants. The NRC staff has designated the issues of impingement mortality and entrainment and thermal impacts on aquatic organisms, among other impacts related to cooling water use, as Category 2 issues for plants that have once-through cooling systems or cooling ponds. Therefore, these impacts will be analyzed as part of each plant-specific license renewal environmental review for nuclear power plants with these cooling systems. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.

A.2.8 Historic and Cultural Resources

Comment: 4. Historic Resources. The NRC should coordinate directly with DHR (Roger Kirchen, 804-482-6091) pursuant to Section 106 of the National Historic Preservation Act (as amended) and its implementing regulations codified at 36 CFR Part 800 which require Federal agencies to consider the effects of their undertakings on historic properties.
(**11-11** [Rayfield, Bettina])

Response: *The NRC acknowledges the comment. The review and update of the LR GEIS and the associated rulemaking does not authorize NRC licensing actions for any specific nuclear power plant site that would trigger National Historic Preservation Act (NHPA) Section 106 consultation requirements that are normally conducted during plant-specific license renewal reviews. This rulemaking is not a licensing action; it does not authorize initial LR or SLR of any nuclear power plant. The NRC will continue to meet its NHPA Section 106 consultation requirements in plant-specific license renewal reviews, which would include contacting the appropriate State agency officials responsible for historic preservation. No changes were made in the LR GEIS, final rule, or guidance as a result of this comment.*

Comment: 7. Section/Page 3.7 Historic and Cultural Resources 31, Comment/ Recommendation: An addition has been made that a legal description will be required for the Area of Potential Effect. If there is any information that is needed above and beyond that covered through existing property records, then that should be specified. There is an industry recognized definition of the APE for HCR that we have used for a long time. Request clarification of what is meant by "legal description" and how that varies from past practice.
(**19-2-14** [Uhle, Jennifer])

Response: *The NRC acknowledges the comment. As stated in Section 3.7.2 of the LR GEIS, the license renewal (initial LR or SLR) area of potential effects (APE) includes lands within the nuclear power plant site boundary and the transmission lines up to the first substation that may be directly (e.g., physically) affected by land-disturbing or other operational activities associated with continued plant operations and maintenance and/or refurbishment activities. The APE may extend beyond the nuclear plant site when these activities may indirectly affect (e.g., visually and auditorily) historic properties. This determination is made irrespective of land ownership or control. Note that some State Historic Preservation Office guidance may require that the description of the APE include the legal location of the project (e.g., Public Land Survey System – township, range, and section information) or other public land survey information. The NRC clarified the text in Section 3.7 of the Regulatory Guide 4.2, Supplement 1, Revision 2 (NRC 2024a) to state that license renewal applicants should identify the proposed APE to be recommended to the NRC as a result of this comment.*

Comment: On page 13,331 of the Federal Register Notice on the proposed rule, the NRC states "in assessing the significance of environmental impacts for some environmental resources (e.g., federally protected ecological resources and historic properties that require interagency consultation with ... Indian Tribes") and then cites to 36 CFR 800.2 that covers the federal Historic Preservation Act. This is correct, but does not adequately cover a federal agency's responsibility to "consult" with Indian Tribes on any federal action that might have an impact on a Tribe. The consultation requirements stem from Executive Order 13175 (Consultation and Coordination with Indian Tribal Governments (November 5, 2000)) that requires such consultation. Consultation covers more than historic preservation issues and also would cover consultations on the NRC proposed rule under consideration.

Consultation under the Executive Order is not just giving Tribes the opportunity to comment on an action, but includes having a meaningful dialogue with the affected Tribe and seriously considering whether some part of the federal action should be changed in regard to Tribal concerns. This interpretation has been upheld by the Federal judiciary. See Quechan Tribe v. United States Department of Interior 10cv2241 LAB (CAB), 2010 WL 5113197 (S.D. Cal. Dec 15,2010), where a BLM permit for a solar installation was overturned because the agency did not perform "consultation" but only provided the Tribe with an opportunity to comment.

In summary, the consultation discussion should justify more than a mere mention in a footnote and, instead, be addressed comprehensively in the text of the Supplementary Information in the final rule. In addition, the Tribal consultation requirement also should contemplate more than historic properties and other environmental issues, but also apply to the NRC safety review of license renewal applications. The NRC's Tribal Policy also should be referenced in the final rule. (**14-1** [Johnson, Johnny])

Response: *The NRC acknowledges the comment and agrees in part and disagrees in part. The NRC agrees that Tribal consultation for environmental reviews covers more than historic preservation issues. Additionally, in accordance with its Tribal Policy Statement, the NRC consults in good faith with Indian Tribes on agency actions that have substantial direct effects on one or more Indian Tribes as well as those agency actions for which Tribal consultation is required under Federal Statute. The NRC's Tribal Policy Statement (82 FR 2402) established a set of principles to guide the agency's government-to-government interactions with federally recognized Indian Tribes and Alaska Native Tribes, promote effective government-to-government interactions with Indian Tribes, and to encourage and facilitate Tribal involvement in the areas over which the Commission has jurisdiction. The NRC's Tribal Policy Statement is consistent with the principles articulated in Executive Order 13175 (65 FR 67249). The Policy*

Statement also underscores the NRC's commitments to conducting outreach to Tribes, engaging in timely consultation, and coordinating with other Federal agencies.

The NRC disagrees that the LR GEIS should discuss the application of Tribal consultation requirements to NRC safety reviews for license renewal because that is outside the scope of this LR GEIS and associated rulemaking.

The NRC agrees that the LR GEIS would benefit from a more detailed discussion of the NRC's Tribal Policy Statement. The NRC has added a discussion (Section 1.8.7, Consultations) to Chapter 1 of the LR GEIS and a new section (Tribal Policy Statement) to the Executive Summary of NUREG-1555, Supplement 1, Revision 2 (NRC 2024b) as a result of this comment. The NRC acknowledges the comment that additional discussion of the NRC's Tribal Policy Statement is warranted. The NRC added a reference to the NRC's Tribal Policy Statement in the final rule.

Comment: [Draft Regulatory Guide] 11. Section/Page 4.7 Historic and Cultural Resources 62-63, Comment/Recommendation: The analysis content within 4.7 states that the applicant should engage with the SHPO, THPO, Indian Tribes and interested parties to develop and formalize protective measures and cultural resources management plans. However, this is likely not feasible as stated in Section 3.7 Footnote 12, "A federally recognized Indian Tribe is not obligated to consult with an applicant or share information about properties of religious and cultural significance with an applicant." Therefore, the analysis content may not be complete in spite of applicant actions. (**19-2-18** [Uhle, Jennifer])

Response: *The NRC acknowledges the comment. As discussed in Sections 3.7 and 4.7 of Regulatory Guide 4.2, Supplement 1, Revision 2 (NRC 2024a), NHPA Section 106 consultation is the responsibility of the NRC; consultation is not the responsibility of the applicant. The NRC recognizes that federally recognized Indian Tribes are not obligated to consult with or share information about properties of religious and cultural significance with a license applicant. Nevertheless, the NRC encourages applicants to engage tribes during the development of their applications to gather sufficient information to support its NHPA Section 106 consultation and assessment of effects for the proposed project. This assists the NRC by identifying potential concerns prior to the initiation of NHPA Section 106 consultation. No changes were made in the LR GEIS, final rule, or guidance as a result of this comment.*

Comment: These comments represent key concerns of TRMTC and should not be as viewed as representative of any specific Tribe, nor the views of all Tribes.

TRMTC offers the following comments on NRC's proposed rule on Renewing Nuclear Power Plant Operating Licenses — Environmental Review

1. **Sovereignty of Native American Tribes:** The NRC must recognize and abide by the unique trust obligations between the United States and federally recognized Native American Tribes (hereinafter referred to as Tribes). These obligations stem from the federal government's trust responsibility to Tribes, a legal principle originating from the unique relationship between Tribes and the federal government. Trust responsibility encompasses legal, fiduciary, and moral obligations to protect tribal treaty rights, lands, assets, and resources.

Numerous federal agencies have developed policies in accordance with federal law and regulations recognizing tribal sovereignty and affirming this trust responsibility, including the NRC's Tribal Protocol Manual and Tribal Policy Statement. Executive Order 13175 *Consultation*

and Coordination with Indian Tribal Governments requires federal agencies honor tribal sovereignty and consult with Tribes in development of policies when considering federal actions that impact Tribes. On January 26, 2021, the Biden Administration released a Presidential Memorandum on *Tribal Consultation and Strengthening Nation-to-Nation Relationships*, which reaffirmed the Administration's commitment to upholding Executive Order 13175 and restating the special relationship that still exists between the United States and tribal governments. (**35-1** [Arnold, Richard] [Hernandez, Laurie])

Response: *The NRC agrees with the comment. The NRC's Tribal Policy Statement (82 FR 2402), published in 2017, formally reflects the NRC's recognition of the Federal Trust Responsibility and NRC's commitment to a government-to-government relationship with federally recognized Tribes, which is distinct from interactions with members of the public. Under the Federal Trust Doctrine, the United States—and the individual agencies of the Federal government—owe a fiduciary duty to Indian Tribes. The nature of that duty depends on the underlying substantive laws (i.e., treaties, statutes, agreements) creating that duty. The NRC exercises its Trust Responsibility under its authorizing statutes including the Atomic Energy Act of 1954, the Energy Reorganization Act of 1974, the Nuclear Waste Policy Act of 1982, the Low-Level Radioactive Waste Policy Act of 1985, and the Uranium Mill Tailings Radiation Control Act of 1978, as amended.*

As an independent regulatory agency that does not hold in trust Tribal lands or assets or provide services to federally recognized Tribes, the NRC fulfills its Trust Responsibility through implementation of the principles of the Tribal Policy Statement, by providing protections under its implementing regulations, and through recognition of additional obligations consistent with other applicable treaties and statutory authorities (see Principle 1, NRC Tribal Policy Statement). Additionally, the NRC recognizes the right of each Indian Tribe to self-governance and supports Tribal sovereignty and self-determination. The NRC recognizes Tribal governments as dependent domestic sovereign nations, independent from State governments, with separate and distinct authorities with inherent sovereign powers over their members and territory, consistent with applicable statutes and authorities (see Principle 2, NRC Tribal Policy Statement).

As an independent regulatory agency, the NRC is exempt from the requirements of certain executive orders (EOs), including EO 13175 (65 FR 67249). However, the NRC acts in a manner consistent with the fundamental precepts expressed in EO 13175, and the NRC's Tribal Policy Statement is consistent with the principles articulated in EO 13175. Similarly, the Presidential Memorandum on Tribal Consultation and Strengthening Nation-to-Nation Relationships does not apply to the NRC. However, the NRC remains committed to following the principles set forth in its Tribal Policy Statement. The purpose of the Tribal Policy Statement is to promote effective government-to-government interactions with federally recognized American Indian and Alaska Native Tribes, and to encourage and facilitate Tribal involvement in the areas for which the NRC has jurisdiction. No changes were made in the LR GEIS, final rule, or guidance as a result of this comment.

Comment: 2. **Tribal Consultation:** TRMTC fully supports and reiterates the federal government Trust responsibility to Tribes that require consultation on a government-to-government basis. As sovereign nations, government-to-government consultation is required between the United States and federally recognized Tribal governments, ensuring this responsibility cannot be relegated to a site licensee. Federal consultation is unique and requires meaningful and timely dialogue in a good faith manner that is conducted on a government-to—government basis. Tribal consultation is distinct and must be sustained from the inception of

planning through effective outreach and engagement activities under the authority of federal agencies. Further, when conducting consultation, the NRC must recognize Tribal nation's interests are not confined to reservation boundaries; and may include culturally important locations including but not limited to Tribal Trust Lands, ceded territories, treaty rights areas, and culturally affiliated areas beyond reservation lands tied to the impacted area.

TRMTC urges NRC to recognize when its interactions and policies impact or potentially impact federally recognized Tribes and to acknowledge and understand that Tribal nations and their members have a unique relationship with the United States. The NRC must fulfill its Trust Responsibility to Tribes which are not classified as the public nor other interested community groups or stakeholders that may include other minority populations. Consultation with Tribal governments must be conducted in accordance with federal policy and reduce barriers to meaningful participation for a Tribe(s) including but not limited to scheduling meetings at times and venues convenient for Tribal leadership, their subject-matter experts or other interested parties. Public meetings are considered insufficient to fully engage Tribal governments who may not want to discuss their concerns or raise questions in a public forum and that diminishes productive interactions. Public meetings do not meet the standard of meaningful government-to-government consultation. Finally, correspondence such as a "Dear Tribal Leader" or similar correspondence implying opportunities for Tribal engagement or discussing project information, must be followed up with acceptable and corresponding outreach to individually impacted or interested Tribes to demonstrate a basis for meaningful interaction.
(**35-2** [Arnold, Richard] [Hernandez, Laurie])

Response: *The NRC acknowledges this comment and agrees to the extent that Tribal interests may go beyond reservation boundaries. The NRC's Tribal Policy Statement formally reflects the NRC's recognition of the Federal Trust Responsibility and the NRC's commitment to a government-to-government relationship with federally recognized Tribes that is distinct from interactions with members of the public. The NRC's Tribal Policy Statement articulates the agency's goals for conducting Tribal outreach and consultation on regulatory actions that have substantial direct effects on one or more Indian Tribes. Tribal officials may also request that the NRC engage in consultation with them on matters that have not been identified by the NRC to have substantial direct effects on one or more Indian Tribes as well as those regulatory actions for which Tribal consultation is not required under Federal statute. The NRC will make efforts to grant such requests, taking into consideration the nature of the activity at issue, past consultation efforts, available resources, timing issues, and other relevant factors.*

The following paragraphs summarize the NRC's outreach to federally recognized Tribes for this rulemaking. For this rulemaking, and in accordance with the Commission's Tribal Policy Statement, the staff notified federally recognized Tribes via State and Tribal Communications letter ([STC]-20-059, see NRC 2020c) that the NRC intended to review and potentially update the LR GEIS. Specifically, the NRC invited Tribal governments to review the results of the staff's preliminary review of the LR GEIS, which included addressing SLR, and provide comments and suggestions for other areas that should be updated. The staff conducted four webinars on August 19 and 27, 2020 (an afternoon and evening session each day). The public scoping summary report was prepared and distributed to federally recognized Tribes via STC letter in July 2021 (STC-21-045, see NRC 2021b).

After the first rulemaking plan was submitted to the Commission (SECY-21-0066, "Rulemaking Plan for Renewing Nuclear Power Plant Operating Licenses—Environmental Review (RIN 3150-AK32; NRC-2018-0296)" [see NRC 2021d]), the NRC staff provided a status overview to the Department of Energy's Nuclear Energy Tribal Working Group regarding the review and

potential update of the LR GEIS and associated rulemaking in September 2021. The NRC staff has provided periodic briefings to Nuclear Energy Tribal Working Group throughout this rulemaking.

On March 6, 2023, the NRC staff notified federally recognized Tribes via STC letter (STC-23-012, see NRC 2023b) that the proposed rule package had been issued for public comment. The NRC staff informed federally recognized Tribes on March 15, 2023, that the NRC staff planned to conduct six hybrid public meetings to provide an overview of the proposed rule and draft LR GEIS and to receive comments (STC-23-015, see NRC 2023c). The letter also provided notice that the NRC would hold an informational meeting with federally recognized Tribes in April 2023.

By letter dated March 24, 2023 (STC-23-018, see NRC 2023d), the NRC staff notified federally recognized Tribes that it would conduct an informational meeting with Tribal representatives on April 12, 2023, to provide an overview of the proposed rule and draft LR GEIS, and to afford Tribal representatives an opportunity to discuss the rule with NRC staff and ask questions. Owing to technical issues with the Teams webinar, the meeting was canceled and rescheduled to April 19, 2023. Notice of the rescheduled meetings was provided on April 13, 2023 (STC-23-024, see NRC 2023e). Topics raised at the April 19, 2023, meeting included severe accidents, environmental justice, Tribal treaty rights, settlement agreements, and Federal Trust Responsibility.

The NRC is committed to upholding the principles in the Tribal Policy Statement. Further information concerning how the NRC interacts with Tribes and prepares for Tribal meetings is contained in the Tribal Protocol Manual (NRC 2018a). No changes were made in the LR GEIS, final rule, or guidance as a result of the comment.

Comment: 3. **NHPA Section 106 Consultation and Analyses:** TRMTC recommends the NRC conduct early and ongoing government-to-government consultation with Tribal leadership or their designees when engaging in activities tied to Tribal governments including National Historic Preservation Act (NHPA) analysis. TRMTC agrees with the NRC's Category 2 designation which requires a plant-specific approach that evaluates Tribal input, rather than interacting in a generic fashion with all nuclear power plant license renewal applications that involve Tribal governments. (**35-3** [Arnold, Richard] [Hernandez, Laurie])

Response: *The NRC agrees with the comment. The review and update of the LR GEIS and the associated rulemaking does not authorize NRC licensing actions for any specific nuclear power plant site that would trigger NHPA Section 106 consultation requirements that are normally conducted during plant-specific environmental reviews. This rulemaking is not a licensing action; it does not authorize initial LR or SLR of any nuclear power plant. The NRC will continue to meet its NHPA Section 106 consultation requirements in plant-specific license renewal reviews, including consulting with State Historic Preservation Officers, Tribal Historic Preservation Officers, federally recognized Indian Tribes, and interested parties. No changes were made in the LR GEIS, final rule, or guidance as a result of this comment.*

Comment: 4. **Environmental Justice:** TRMTC agrees that disproportionate impacts associated with license renewals effecting Tribal nations should be administered as a Category 2 determination and be addressed on a plant-specific approach, rather than in a generic fashion in all nuclear plant license renewal applications. While TRMTC recognizes the importance of Executive Order 12898 Environmental Justice and its provisions for evaluating disproportionate impacts to minority and low-income communities, the Order is not intended to supplant or

diminish the federal trust doctrine and responsibilities to Tribal governments. Trust responsibility remains with regard to Tribal interests regardless of whether a community is ruled eligible for Environmental Justice protections. (**35-4** [Arnold, Richard] [Hernandez, Laurie])

Response: *The NRC agrees with the comment. The NRC considers environmental justice issues in all licensing and regulatory actions per the Commission's "Policy Statement on the Treatment of Environmental Justice Matters in NRC Regulatory and Licensing Actions" (69 FR 52040), which states "The Commission is committed to the general goals set forth in EO 12898 [59 FR 7629], and strives to meet those goals as part of the NEPA review process." The NRC classifies environmental justice as a Category 2 issue, and the NRC evaluates potential impacts on minority and low-income populations in plant-specific license renewal reviews.*

The NRC recognizes that the Federal Trust Responsibility is separate from the agency's environmental justice policy. The NRC's Tribal Policy Statement formally reflects the recognition of the Federal Trust Responsibility, and the NRC's commitment to a government-to-government relationship with Federally recognized Indian Tribes. The NRC exercises its Trust Responsibility in the context of its authorizing statutes, which include the Atomic Energy Act of 1954, the Energy Reorganization Act of 1974, the Nuclear Waste Policy Act of 1982, the Low-Level Radioactive Waste Policy Act of 1985, and the Uranium Mill Tailings Radiation Control Act of 1978, as amended, and fulfills its Trust Responsibility through implementation of the principles of the Tribal Policy Statement by providing protections under its implementing regulations and through recognition of additional obligations consistent with other applicable treaties and statutory authorities. No changes were made in the LR GEIS, final rule, or guidance as a result of this comment.

Comment: 5. **Offsite Storage and Disposal:** While we recognize that offsite storage, disposal, and transportation is beyond the scope of the GEIS, TRMTC encourages NRC to consider the transportation impacts of all modes of shipping spent nuclear fuel, high-level radioactive waste, and other radiologically contaminated waste offsite from nuclear power plants when making decisions. Impacts from shipments could be quite significant to cultural lifeways in the event of an accident or unexpected event during shipment on or near Tribal lands.
(**35-5** [Arnold, Richard] [Hernandez, Laurie])

Response: *The NRC acknowledges the comment. Department of Transportation and NRC regulations for radioactive material shipments and their transport packages protect public health and safety during all phases of transportation. Thus, the risks to public health from a transportation accident or unexpected event are very low in part due to the NRC regulatory requirements in 10 CFR Part 71 for the design and construction of robust transportation packages. The transportation and disposal of solid radioactive wastes are performed in accordance with the applicable requirements of 10 CFR Part 71 and 10 CFR Part 61, respectively. Additionally, federally recognized Tribes may apply to receive advance notification of irradiated reactor fuel and other nuclear wastes passing through their reservation. Further information can be obtained at https://www.nrc.gov/about-nrc/state-tribal/tribal-advance-notification.html. To date, no shipments of spent nuclear fuel have resulted in a release of radioactive material to the environment. No changes were made in the LR GEIS, final rule, or guidance as a result of this comment.*

A.2.9 Socioeconomics

Comment: The South County Chambers respectfully asks that you consider these important points when you consider the authorization to extend operations of the nuclear reactors at the plant at DCPP.

*DCPP employs approximately 1200 employees who live in our communities. Their children go to our schools. Their spouses also work in our business. They contribute greatly to the fabric of our community and the economic prosperity of the businesses in South SLO County. (**39-2** [McCorry, Kathy])

Response: *The NRC acknowledges the comment. The decision about whether to seek license renewal rests entirely with the owners of the nuclear power reactor and is outside the scope of the LR GEIS and associated rulemaking. Nevertheless, owners typically base such decisions on the plant's economic viability and whether it can continue to meet NRC safety and environmental requirements. The licensee (Pacific Gas and Electric) submitted a license renewal application for Diablo Canyon in November 2023. The NRC will conduct an environmental review leading to the preparation of a plant-specific supplement to the LR GEIS. When doing so, the NRC will consider any new and significant information related to Category 1 (generic) socioeconomic issues in plant-specific license renewal reviews. In addition to the environmental review, the NRC staff will conduct a safety review in accordance with 10 CFR Part 54, and will document the results in a safety evaluation report. The NRC will base its license renewal decision on those reviews. No changes were made in the LR GEIS, final rule, or guidance as a result of this comment.*

A.2.10 Human Health: Radiological

Comment: And I'm going to focus my comments this evening on the GEIS assessment of license extensions pertaining to human health at Section 4.9.1, which states, "Based on past environmental monitoring data and trends, no significant human health impacts are anticipated during the license renewal period --"term," I should say --"that would be different from those occurring during the current license term." So, Section 4.9.1.1, "the Environmental Consequences of Normal Operating Conditions," provides an evaluation of the impacts of radiological, chemical, microbiological, EMF, and physical hazards on occupational personnel and members of the public from continued operation and any refurbishment activities during the initial license renewal and subsequent license renewal terms. This evaluation extends to all U.S. nuclear power plants. So, Section 4.9.1.1.1 on "Radiological Exposure and Risks," discusses two environmental issues relating to radiation exposures to plant workers and radiation exposures to the public, both of which would result in continued operation and refurbishment activities during the initial license renewal or subsequent license renewal term. Given the time constraint --and I'm not sure exactly how much time I have; I'm assuming it's three to five minutes --but I'm going to focus my oral comments on the risk to public health and provide more details in written comments. So, for radiation exposures to the public, the GEIS discusses the radiological exposure pathways from current operations in nuclear power plants and calculating dose and radiological monitoring performed at each nuclear power plant site to assure that an unanticipated buildup of radioactivity has not occurred in the environment. The NRC conceded that, during the renewed operations, radioactivity will continue to be released to the environment, to both air and water. These public exposures from routine discharges of radioactive gas and liquid effluent include periodic purging of the reactor containment structures to the atmosphere and discharge of radioactive effluent to rivers, lakes, reservoirs, and coastal water. While the NRC acknowledges these exposures occur under controlled conditions, and in

accordance with as well as reasonably achievable principles, it should also be acknowledged, though, ALARA considers operator economics, and added to the radiation exposures are also unpredictable, abnormal occurrences. The NRC concedes that the concentration of these radioactive materials in soils and sediments increases in the environment at a rate that depends on the rate of release and the rate of radioactive decay, which, in our view, means that there will be higher levels of radioactive exposure from long-lived radioactive isotopes accumulating into the license extension periods. The GEIS concludes, on the basis of these considerations, the NRC concludes that the impact of continued operations and refurbishment activities on public radiological exposure during the initial license renewal and subsequent license renewal terms would be small for all nuclear power plants. This is a Category 1 issue. The public is, therefore, proposedly, to be barred from petitioning the NRC for hearings on site-specific health concerns and site-specific conditions. However, Beyond Nuclear argues that the NRC has not actually taken the necessary hard look in this GEIS for extended operations, now projected out to 80 years, on the human health under the National Environmental Policy Act. A closer look at potential health damage needs to be a prerequisite for operating license renewal. (**4-1-1** [Gunter, Paul])

Comment: # Site specific analysis (Category 2) should be required regarding the health risks and impacts of 20 more years of routine radiation releases on the community and environment, in addition to "cumulative emissions" as defined by the NRC. Radionuclides attach to particles in the air and damage human lungs. Additional years of exposure could increase health risks and bioaccumulation through the food chain. Please consider these factors as the GEIS update moves forward. (**18-8** [Hadden, Karen])

Comment: The health risks. Of course, you are mandated to deal with public health, but actually there is no environmental health studies in this country. I looked, and I'm not an expert, but there is no real studies of outbreaks of leukemia near nuclear reactors, except for a number of years ago. The technology is changed. The capabilities of investigation and tracking people as they move has changed. The most recent study comes out of France. I was fascinated with your annual radiological environmental operating report. And it seemed that that report needs to be included in your study. So, you've got a longitudinal type of an evaluation of things. You probably already do it, but it needs to be part of the evaluation. (**9-6-17** [Gosslee, Susybelle])

Response: *The NRC agrees in part and disagrees in part with the comments. The NRC agrees that human health risk should be considered during the license renewal environmental review process; however, the NRC disagrees that more research is needed on the impact of nuclear power plants on human health prior to issuing a license renewal. To the extent that these comments refer to the use of site-specific information to request that an issue be treated as a Category 2 issue rather than a Category 1, the NRC staff disagrees.*

The NRC has stated its methods and criteria for environmental issue identification, categorization, and definitions in Section 1.5 of this LR GEIS as well as in the footnotes to Table B–1 in Appendix B to Subpart A of 10 CFR Part 51, as revised pursuant to this final rule. The NRC's update of the LR GEIS included a review of changes to applicable laws and regulations, new data in its possession, collective experience, and lessons learned and knowledge gained from conducting environmental reviews for initial LR and SLR since development of the 2013 LR GEIS. A generic, Category 1 grouping is appropriate for the radiological human health issues, because the environmental impacts were found to be the same or similar at all plant sites based on previous license renewal environmental reviews. This

finding is further supported by the NRC's analysis presented Section 4.9.1.1 of the LR GEIS, which found that impacts of radiological impacts on human health during the license renewal term (initial LR or SLR) would be SMALL.

However, a designation of an issue as a Category 1 issue does not mean that potential impacts are not considered. During preparation of plant-specific supplements to the LR GEIS, the NRC staff considers changes in nuclear power plant operating parameters and new and potentially significant information provided by the applicant or identified through public comments, or resulting from the NRC's due diligence in reviewing relevant information. Data are reviewed, in part, for information that could change the conclusion in the LR GEIS regarding an issue. Thus, even though an issue is a Category 1 issue, mechanisms are in place to conduct a full plant-specific review if new and significant information warrants such a review.

Radiological emissions from reactors have not substantially changed since publication of the 1996 LR GEIS and no adverse trends have been identified by the NRC. The emission of radioactive materials is well regulated and characterized. As cited throughout Sections 3.9.1.2 and 3.9.1.3 of this LR GEIS, the NRC considered the latest available data on occupational and public radiological exposures to inform its Category 1 findings for radiological human health issues. These data included consideration of NRC summary data of radiation exposure at operating nuclear plants and licensee plant-specific annual effluent release reports. Annual effluent reports from all nuclear power plants in the United States can be found at https://www.nrc.gov/reactors/operating/ops-experience/tritium/plant-info.html (NRC 2023f). For example, a selection of effluent reports form the basis of Tables 3.9-21 to 3.9-24 in this LR GEIS. These tables demonstrate that annual emissions remain very low and will not adversely affect human health because the NRC's regulatory limits for radiological protection are set to protect workers and the public from harmful effects of radiation regardless of the number of years of nuclear power plant operation. The values reported are consistent with those found in the previous revisions of this LR GEIS. Based on the analysis contained in the previous revisions, it is logical to assume that the results of previous analyses continue to apply and the impacts on human health will not change.

For information about the biological effects of radiation and the NRC's exposure limits, please see the Backgrounder on Biological Effects of Radiation (NRC 2017a), which is available on the public website at https://www.nrc.gov/reading-rm/doc-collections/fact-sheets/bio-effects-radiation.html, and for additional information on radiation protection and radiation and its health effects visit https://www.nrc.gov/about-nrc/radiation.html (NRC 2021e). No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.

Comment: In 2010, the NRC sought to address these human health concerns by Contract Grant No. NRC-04-10-152, "Analysis of Cancer Risks in Populations Near Nuclear Power Facilities," signed with the National Academy of Sciences, to perform a state-of-the-art study on cancer risks for populations surrounding NRC-licensed facilities, including commercial nuclear power stations. Beyond Nuclear notes that the National Library of Medicine documents several accredited studies conducted around nuclear power stations in France, Great Britain, Germany, and Switzerland that have shown elevated rates of childhood leukemias above what was to be expected within the 5 kilometers, or 3.1 miles, of the commercial nuclear reactors. The NAS agreed to conduct the epidemiological study in two phases. The first phase of the study identified scientifically-sound approaches for carrying out an assessment of cancer risks that would inform the study's designs to be carried out in phase two. Phase one recommended examining seven pilot sites, six of which are operating or closed nuclear power plants and one nuclear fuel processing facility. In 2012, the NAS phase one also recommended two study

designs: an ecological study that would look at a variety of cancers among adults and children over the operational history of the facilities and a record-linkage-based case controlled study examining cancer risks for childhood exposures to radiation during the more recent operating histories. Because the case controlled study would focus on children, Beyond Nuclear supported this study type over the ecological study recommendation. NAS produced a cancer study model that would take 39 months at a cost of $8 million to examine those seven pilot sites. Followed (sic) that, the NAS would turn its attention to the other nuclear facilities throughout America. Five years and $1.5 million later, the NAS was ready to conduct the pilot study at the seven pilot sites to determine and advance the stronger methodology, and the NRC scuttled the project in 2015. The NRC justified its cancellation as costing too much, taking too long, and would not provide any useful human health data, including for children in the vicinity of these nuclear facilities. These are claims; they're still disputed, nor acknowledged by the NRC in this GEIS. No such study has been conducted in the United States to date. So, it's our concern that the NRC is actually suppressing a critical part of the Generic Environmental Impact Statement by not conducting a due diligence through NEPA on impacts of environmental releases of radiation to surrounding populations. (**4-1-2** [Gunter, Paul])

Comment: The issue that was recently raised by the previous speaker is a complex one. The release of effluents is a continually-monitored oversight operation under the NRC, and therefore, it is not appropriate to reconsider on a completely new basis when a new environmental impact assessment is done for a license renewal because it is continually monitored. I'll say the National Academy's report that was mentioned was not carried out, because even if carried out with the seven sites, would have lacked statistical power to show without bias whether there was Type 1 or Type 2 error in the results and could have shown incorrect results due to that. A much larger sample set over a much longer period of time would be necessary to conclude that. If you refer to SECY-15-0104, you will find the staff's assessment and justification for discontinuing that particular project. (**4-2-1** [Stein, Adam])

Comment: To identify cancer risks, I request that the most recent local cancer registry data be included in each site specific EIS. (**21-7** [Gosslee, Susybelle])

Response: *The NRC's mission is to protect public health and safety and the environment from the effects of radiation from nuclear reactors, materials, and waste facilities. Several studies have been performed to examine the health effects around nuclear power facilities. The NRC is not aware of any studies that are accepted by the scientific community that show a correlation between radiation dose from nuclear power facilities and cancer incidence in the general public. Some of the studies that have been recognized by the NRC, as referenced in Section 3.9.1.4 of this revised LR GEIS, are summarized below:*

- *In 1990, at the request of Congress, the National Cancer Institute conducted a study of cancer mortality rates around 52 nuclear power plants and 10 other nuclear facilities. The study covered the period from 1950 to 1984 and evaluated the change in mortality rates before and during facility operations. The study concluded there was no evidence that nuclear facilities may be linked with excess deaths from leukemia or from other cancers in populations nearby.*
- *In June 2000, investigators from the University of Pittsburgh (Talbott et al. 2000) found no link between radiation released during the 1979 accident at Three Mile Island power plant and cancer deaths among nearby residents. The study followed 32,000 people who lived within 5 miles of the plant at the time of the accident.*

- *The American Cancer Society in 2000 concluded that although reports about cancer clusters in some communities have raised public concern, studies show that clusters do not occur more often near nuclear plants than they do by chance elsewhere in the population. Likewise, there is no evidence that links strontium-90 with increases in breast cancer, prostate cancer, or childhood cancer rates. Radiation emissions from nuclear plants are closely controlled and involve negligible levels of exposure for nearby communities.*
- *Also, in 2001, the Florida Bureau of Environmental Epidemiology (FDOH 2001) reviewed claims that there are striking increases in cancer rates in southeastern Florida counties caused by increased radiation exposures from nuclear power plants. However, using the same data to reconstruct the calculations, on which the claims were based, Florida officials were not able to identify unusually high rates of cancers in these counties compared with the rest of the state of Florida and the nation.*
- *In 2000, the Illinois Public Health Department (IDPH 2000) compared childhood cancer statistics around seven nuclear power plants in Illinois and did not find any significant childhood cancer excess among children living near nuclear plants and did not observe any dose response patterns.*

As the NRC states in SECY-15-0104 (NRC 2015), studies conducted by Canada, France, Germany, Great Britain, Spain, and Switzerland since 2008 have generally found no association between nuclear facility operations and increased cancer risks to the public that are attributable to the releases or radiation exposure. The NRC has revised Section 3.9.1.4 of this LR GEIS to reference this information. Regarding comments about the proposed National Academy of Science's cancer study (National Research Council 2012, 2014), the NRC declined to continue the study because it was unlikely to be able to answer the basic question about risk. The sample size around the intended nuclear power plants would have been too small to statistically estimate the risk of cancer; therefore, the study would have been of limited use (NRC 2015). Nevertheless, the NRC conservatively assumes that any amount of radiation may pose some risk of causing cancer or having some hereditary effect and that the risk is higher for higher radiation exposures. This is called a linear, no-threshold dose-response model and is used to describe the relationship between radiation dose and the occurrence of cancer. This model assumes that any increase in dose above background levels, no matter how small, results in an incremental increase in risk above existing risk levels. The NRC has accepted this model for formulating radiation protection standards and planning radiation protection programs. The NRC's regulatory limits for radiological protection are set to protect workers and the public from harmful effects of radiation on humans. Radiation dose limits in 10 CFR Part 20 ensure adequate protection of workers and members of the public.

Comment: (58) Radiation exposures to the public. - 1. Consequences of possible radiological release events vary with the site's proximity to population concentrations and with the prevailing wind currents. (**7-14** [Stoddard, Philip])

Response: *The NRC agrees in part and disagrees in part with this comment. The NRC agrees that radiological exposures to the public during off-normal conditions and the associated consequences are important to public health and safety. The NRC disagrees to the extent that these comments refer to the use of site-specific information to request that an issue be treated as a Category 2 issue rather than a Category 1 issue.*

Postulated accidents and associated consequences are addressed in Section 4.9.1.2 and Appendix E of this LR GEIS, and the probability-weighted consequences of severe accidents would be SMALL. The analysis in Appendix E references plant-specific studies that incorporate

population and meteorological data. With respect to normal operations, the NRC does not expect population and meteorology to play a significant role in human health consequences due to existing plant structures, regulations, and procedures that limit dose during normal operations. In addition to the findings found in the LR GEIS, the environmental impacts are considered in plant-specific supplements to the LR GEIS.

The NRC has stated its methods and criteria for environmental issue identification, categorization, and definitions in Section 1.5 of this LR GEIS as well as in the footnotes to Table B–1 in Appendix B to Subpart A of 10 CFR Part 51, as revised pursuant to this final rule. The NRC's update of the LR GEIS included a review of changes to applicable laws and regulations, new data in its possession, collective experience, and lessons learned and knowledge gained from conducting environmental reviews for initial LR and SLR since development of the 2013 LR GEIS. A generic, Category 1 grouping is appropriate for the radiological human health issues, because the environmental impacts were found to be the same or similar at all plant sites based on previous license renewal environmental reviews. This finding is further supported by the NRC's analysis presented in Section 4.9.1.1 of the LR GEIS, which found that impacts of radiological impacts on human health during the license renewal term (initial LR or SLR) would be SMALL.

However, designation of an issue as a Category 1 issue does not mean that potential impacts are not considered. During preparation of plant-specific supplements to the LR GEIS, the NRC staff considers changes in nuclear power plant operating parameters and new and potentially significant information provided by the applicant or identified through public comments, or resulting from the NRC's due diligence in reviewing relevant information. Data are reviewed in part for information that could change the conclusion in the LR GEIS with regard to an issue. Thus, even though an issue is a Category 1 issue, mechanisms are in place to conduct a full plant-specific review if new and significant information warrants such a review. No changes were made in the LR GEIS, final rule, or guidance as a result of this comment.

Comment: The 2013 GEIS and 1996 GEIS acknowledged some difference in environmental impacts from the initial license to the LR, but the Draft GEIS fails to include similar discussions.[23] For example, in discussing radiation exposures to the public, the 2013 GEIS states that "[a]lthough dose rates (mrem/yr) are not expected to change during license renewal, *the cumulative dose (total mrem) would increase as a result of 20 more years of operations*. If the reactor operates for 60 years, it is estimated that the increase in fatal cancer risk to the [maximally exposed individual] would range from 6 x 10-7 to 4.6 x 10-4 (*a 50 percent increase over the baseline of 40 years of operation*)."[24] But the Draft GEIS just says "[a]lthough dose rates (mrem/yr) are not expected to change during initial LRs or SLRs, the cumulative dose (total mrem) would increase as a result of 20 to 40 more years of operations."[25] The Draft GEIS fails to include what the increase in fatal cancer risk would be because of a cumulative dose of 20 versus 40 additional years. Instead, the Draft GEIS arbitrarily dismisses concerns about this cumulative dose because "it is unlikely that the same person would be exposed to these doses during the initial LR or SLR term."[26] The NRC has no basis for this claim as more than half of the American population lives within 50 miles of a nuclear power plant. Further, several radioisotopes are mutagenic and teratogenic. This means that the cumulative dose will also have a cumulative impact on generations of people who were exposed before they were born.

[23] See also 1996 GEIS at 7-13 ("This section summarizes the quantities and types of radioactive waste and emissions generated in decommissioning after 40 and 60 years of operation, respectively.") and at 7-19 ("Extending reactor operating life from 40 to 60 years is expected to

increase the concentration of long-half-life radionuclides in the facility by up to 50 percent.").
[24] 2013 GEIS at 4-145 (emphasis added).
[25] Draft GEIS at 4-138.
[26] Draft GEIS at 4-138. (**32-3-2** [Reiser, Caroline])

Response: *The NRC disagrees with this comment. Radiological emissions from reactors have not substantially changed since publication of the 1996 LR GEIS, and no adverse trends have been identified by the NRC. The emission of radioactive materials is well-regulated and well-characterized. For the Category 1 radiological human health issues, "Radiation exposures to plant workers" and "Radiation exposures to the public," even if individuals were exposed to plant operations for a period greater than 60 years, the NRC concludes that impacts would still be SMALL based on the following.*

The NRC requires licensees to monitor radioactive effluents (routine and inadvertent) discharged into the environment; thus, each nuclear power plant is required to have a Radiological Environmental Monitoring Program (REMP). The REMP quantifies the environmental impacts associated with radioactive effluent releases from the plant. The REMP monitors the environment over time, starting before the plant operates to establish background radiation levels and continuing throughout its operating lifetime to monitor radioactivity in the local environment. The REMP provides a mechanism for determining the levels of radioactivity in the environment to ensure that any accumulation of radionuclides released into the environment will not become significant as a result of plant operations. The REMP also measures radioactivity from other nuclear facilities that may be in the area (i.e., other nuclear power plants, hospitals using radioactive material, research facilities, or any other facility licensed to use radioactive material). Thus, the REMP monitors the cumulative impacts from all sources of radioactivity in the vicinity of the power plant. To obtain information about radioactivity around the plant, samples of environmental media (e.g., surface water; groundwater; drinking water; air; milk; locally grown crops; locally produced food products; river, ocean, or lake sediment; and fish and other aquatic biota) are collected from areas surrounding the plant to measure the amount of radioactivity, if any, in the samples. The media samples reflect the radiation exposure pathways to the public from radioactive effluents released by the nuclear power plant and from background radiation (i.e., cosmic sources and naturally occurring radioactive material, including radon and global fallout). The information obtained through the REMP verifies that measurable concentrations of radioactive materials and levels of radiation in the environment are not higher than expected when compared against data on the amount of radioactive effluent discharged. The findings from the REMP are summarized in the Annual Radiological Environmental Operating Reports and the Annual Radioactive Effluent Release Reports issued for each operating nuclear power plant. As part of each plant-specific license renewal environmental review, the NRC staff reviews REMP reports to look for adverse data or evidence of a buildup of radioactivity in the environment.

Annual REMP and effluent reports from all nuclear power plants in the United States can be found at https://www.nrc.gov/reactors/operating/ops-experience/tritium/plant-info.html (NRC 2023f). A selection of effluent reports composes the basis of Tables 3.9-21 to 3.9-24 in this LR GEIS. These tables demonstrate that annual emissions remain very low and will not adversely affect human health. The values reported are consistent with those found in the previous revisions of this LR GEIS.

In addition, the NRC's regulatory limits for radiological protection are set to protect workers and the public from the harmful health effects of radiation on humans. The limits are based on the recommendations of standards-setting organizations. Radiation standards reflect extensive

scientific study by national and international organizations (i.e., International Commission of Radiological Protection [ICRP], National Council on Radiation Protection and Measurements, United Nations Scientific Committee on the Effects of Atomic Radiation, Health Physics Society, and the National Academy of Sciences) and are conservative to ensure that the public and workers at nuclear facilities are protected. The international community and Federal agencies (including the NRC) follow ICRP's current guidelines that the overall annual dose to members of the public from all sources should not exceed 1 mSv (100 mrem), in order to be protective of all individuals and the environment. These guidelines also hold that the exposure from a single source should be limited to a fraction of this overall dose. The purpose of the public dose limit is to limit the lifetime risk from radiation to a member of the general public. The conversion factor used to equate dose into risk is based on data from various populations of various ages exposed to very high doses of radiation, such as the atomic bomb survivors. Therefore, even though the studies use the term reference man, the variation in the sensitivity to radiation given age and gender is built into the standards, which are based on lifetime exposure. A lifetime exposure includes all stages of life, from birth to old age. For ease of implementation, the radiation standards, which are developed to minimize the lifetime risk, limit the annual exposure that an individual may receive.

Radiation protection experts conservatively assume that any amount of radiation may pose some risk of causing cancer or a severe hereditary effect and that the risk is higher for higher radiation exposures. Therefore, a linear, no-threshold dose response relationship is used to describe the relationship between radiation dose and adverse impacts, such as incidents of cancer. The linear, no-threshold model assumes any increase in dose, no matter how small, results in an incremental increase in health risk. The NRC uses this model for estimating health risks from radiation exposure, recognizing that the model probably overestimates risks from low doses (below about 0.1 Sv [10 rem]). Based on this model, the NRC conservatively establishes radiation dose limits, in 10 CFR Part 20, to ensure adequate protection of workers and members of the public. The NRC's regulatory limits incorporate conservative assumptions and are considered protective of adults and children. More information about these topics may be found at https://www.nrc.gov/about-nrc/radiation.html (NRC 2021e). No changes were made in the LR GEIS, final rule, or guidance as a result of this comment.

Comment: (iii) Air Quality
(5) Air Quality Impacts - 1. Is site-specific (2) where prevailing winds bring air over a sensitive natural area or a watershed. These conditions are the case at Turkey Point, where East winds take air, including radiation released during refueling, over Everglades National Park and the wellfield areas that serve the Florida Keys. At other times, winds from the South bring air north over Miami. Local elevation of strontium radioisotopes in children's deciduous teeth suggests that radiation release does occur at this site. (**7-2** [Stoddard, Philip])

Comment: The air risks is one of the reasons why I wanted to ask if there is any monitors that are out in the community around the plant. And is that a system that's been setup to identify releases of radiation so that there is an alarm system that would ensure that it's safe.
(**9-7-5** [Gosslee, Susybelle])

Response: *The NRC agrees in part and disagrees in part with these comments. The NRC agrees that radiological monitoring is important. Regulations at 40 CFR Part 190 constitute the EPA's rules for dose limits for the public, while 10 CFR Part 20 describes the NRC's rules for radiation protection and dose limits for the public. As described in Section 3.9.1.3.2 of the LR GEIS, background radiation measurements are obtained prior to operations of the nuclear reactor at all reactor sites. The REMP is conducted at each site to provide data on measurable*

levels of radiation and radioactive materials in accordance with 10 CFR Parts 20 and 50. The radiological environmental monitoring reports are publicly available in the NRC's Agencywide Documents Access and Management System, as well as by navigating to the reactor webpage for each site on the NRC's website. To obtain information about radioactivity around the plant, samples of environmental media (e.g., surface water, groundwater, drinking water, air, milk, locally grown crops, locally produced food products, river, ocean, or lake sediment, and fish and other aquatic biota) are collected from areas surrounding the plant for analysis to measure the amount of radioactivity, if any, in the samples. The media samples reflect the radiation exposure pathways and directional component (i.e., inhalation, ingestion, and physical location near the plant) to the public from radioactive effluents released by the nuclear power plant and from background radiation (i.e., cosmic sources, naturally occurring radioactive material, including radon and global fallout).

To the extent that these comments refer to the use of site-specific information to request that an issue be treated as a Category 2 issue rather than a Category 1 issue, the staff disagrees. The NRC has stated its methods and criteria for environmental issue identification, categorization, and definitions in Section 1.5 of this LR GEIS as well as in the footnotes to Table B–1 in Appendix B to Subpart A of 10 CFR Part 51, as revised pursuant to this final rule. The NRC's update of the LR GEIS included a review of changes to applicable laws and regulations, new data in its possession, collective experience, and lessons learned and knowledge gained from conducting environmental reviews for initial LR and SLR since the development of the 2013 LR GEIS. A generic, Category 1 grouping is appropriate for the radiological human health issues, because the environmental impacts were found to be the same or similar at all plant sites based on previous license renewal environmental reviews. This finding is further supported by the NRC's analysis presented Section 4.9.1.1 of the LR GEIS, which found that radiological impacts on human health during the license renewal term (initial LR or SLR) would be SMALL.

However, a designation of an issue as Category 1 issue does not mean that potential impacts are not considered. During preparation of plant-specific supplements to the LR GEIS, the NRC staff considers changes in nuclear power plant operating parameters and new and potentially significant information provided by the applicant or identified through public comments, or resulting from the NRC's due diligence in reviewing relevant information. Data are reviewed, in part, for information that could change the conclusion in the LR GEIS regarding an issue. Thus, even though an issue is a Category 1 issue, mechanisms are in place to conduct a full plant-specific review if new and significant information warrants such a review. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.

A.2.11 Human Health: Nonradiological

Comment: 1. Section/Page 3.9.2.2 3-127, Comment/Recommendation: The proposed addition in lines 25-27 to consider discharges to waters of the United States infers reference to the Clean Water Act, which has potential to expand the scope of this issue, if changes to the definition of waters of the US ever occur in the future. Recommend limiting the scope to waters receiving discharges that are accessible to the public for recreational use. (**19-2-6** [Uhle, Jennifer])

Response: *The NRC agrees in part and disagrees in part with the comment. The NRC agrees with the comment to the extent that the reference to the Clean Water Act should be removed. Members of the public should be protected from microbiological hazards resulting from plant discharges into waterbodies and not just to plant discharges into "waters of the United States." However, the NRC does not agree that the scope of the Category 2 issue, "Microbiological hazards to the public," should be limited to waters receiving discharges that are accessible to*

the public for "recreational use." The NRC has modified the text in Section 3.9.2.2 of this LR GEIS; Sections 3.9 and 4.9 of Regulatory Guide 4.2, Supplement 1, Revision 2 (NRC 2024a); and Sections 3.9 and 4.9 in NUREG-1555, Supplement 1, Revision 2 (NRC 2024b) to indicate that members of the public could be exposed to microorganisms in thermal effluents at nuclear plants that use cooling ponds, lakes, canals, or that discharge to publicly accessible surface waters. The NRC has also updated the text in Chapter 2 (i.e., Table 2.1-1) and Section 4.9.1.1.3 of this LR GEIS, and in Section 51.53(c)(3)(ii)(G) and Table B-1 of the final rule for consistency.

A.2.12 Environmental Justice

Comment: b. Environmental Justice
Nuclear power plants significantly impact environmental justice communities,[78] and under NEPA the NRC must take a hard look at these impacts. But categorizing most environmental issues as generic allows the NRC to wall off from review significant environmental impacts.

[78] See. e.g. Onondaga Nation, Haudenosaunee Environmental Task Force, and American Indian Law Alliance, Red Paper, Nuclear Reactors are not "Green" (Jan. 30, 2020).

As with climate change, the NRC seems to agree that environmental justice impacts can reach across multiple other environmental impacts. The Draft GEIS acknowledges that "[c]ontinued reactor operations during the license renewal term and refurbishment activities at a nuclear power plant could affect land, air, water, and ecological resources, which could result in human health or environmental effects,"[79] and therefore, for example, "the NRC examines radiological risk from consumption of fish, wildlife, and local produce; exposure to radioactive material in water, soils, and vegetation; and the inhalation of airborne radioactive material during nuclear power plant operation."[80]

[79] Draft GEIS at 4-150.
[80]Draft GEIS at 4-150.

But, also as with climate change, the NRC does not put this into practice. The Draft GEIS, other than in the specific environmental justice sections 3.10 and 4.10, only gives passing reference to environmental justice four times:

- Waste Management and Pollution Prevention. "As indicated in the Commission's policy statement on environmental justice, if the NRC receives an application for a proposed away-from-reactor ISFSI, a site-specific NEPA analysis would be conducted, and this analysis would include consideration of environmental justice impacts."[81]
- Environmental Consequences of Fuel Cycles, Environmental Impacts. "The environmental impacts of various individual operating uranium fuel cycle facilities are addressed in separate site-specific environmental reviews and NEPA documents prepared by the NRC. These documents include analyses that address human health and environmental impacts on minority populations, low-income populations, and Indian Tribes."[82]

- Environmental Consequences of Fuel Cycles, Transportation Impacts. "[S]egments of the population, including minority populations, low-income populations, and Indian Tribes, would likely experience some transportation- related environmental effects. The DOE did not identify any high and adverse human health or environmental impacts on members of the public from the transport of spent nuclear fuel, and determined that subsections of the population, including minority populations, low-income populations, and Indian Tribes, would not experience disproportionate effects."[83]
- Termination of Reactor Operations and Decommissioning.[84]

[81] Draft GEIS at 4-158.
[82] Draft GEIS at 4-178.
[83] Draft GEIS at 4-180.
[84]Draft GEIS at 4-193.

The Draft GEIS makes no commitment that the NRC will analyze environmental justice impacts related to all issues, whether Category 1 or 2, in site-specific reviews. Thus far, the site-specific reviews copy-and-paste the same language:

Potential impacts on minority and low-income populations (including migrant workers or Native Americans) would mostly consist of socioeconomic and radiological effects; however, radiation doses from continued operations during the license renewal term are expected to continue at current levels, and they would remain within regulatory limits. Section [] discusses the environmental impacts from postulated accidents that might occur during the license renewal 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 plants are designed and operated to successfully withstand such accidents, and the probability-weighted consequences of severe accidents are small.

Therefore, based on this information and the analysis of human health and environmental impacts presented in this chapter, there would be no disproportionately high and adverse human health and environmental effects on minority and low-income populations from the continued operation of Surry Units 1 and 2 during the renewal term.[85]

[85] See e.g. North Anna SEIS at 3-147; Surrey SEIS at 4-114; Waterford SEIS at 4-81 (emphasis added).

Site-specific reviews are able to wall off from review or to dismiss environmental justice impacts because the GEIS determines that impacts from Category 1 issues will be small. This is contrary to NEPA guidance that explains, "[a] disproportionately high and adverse impact to minority populations and low-income populations can occur at any level of NEPA review."[86] Moreover, there are "[a]dditional factors related to an impact's intensity (discussed in 40 CFR §1508.27(b)) that could lead to a finding of significance to minority populations and low-income populations in the affected environment, despite having no significant impact to the general population."[87]

[86] Federal Interagency Working Group on Environmental Justice & NEPA Committee, Promising Practices for EJ Methodologies in NEPA Reviews (Mar. 2016).
[87] Id. (emphasis added).

The NRC must take a hard look at all environmental justice impacts at a site-specific level, regardless of whether the related impact is Category 1 or 2. (**32-6-1** [Reiser, Caroline])

Response: *The NRC agrees in part and disagrees in part with the comments. The NRC agrees with the comment to the extent that environmental justice impacts must be analyzed for each resource area. The NRC disagrees with the assertions that environmental justice impacts are not considered for Category 1 issues and that the LR GEIS does not specify that environmental justice impacts will be analyzed in plant-specific reviews. As stated in Section 4.10.1.1 of the LR GEIS, the NRC's nuclear plant-specific analysis takes a hard look at all resource area impacts on environmental justice populations to determine whether human health and environmental effects from continued nuclear power plant operation during the license term would be disproportionately high and adverse. Such effects may include biological, cultural, economic, or social impacts and other related environmental issues, including new and significant information related to all Category 1 issues. In the environmental justice review, the NRC (1) identifies the location of minority and low-income populations that may be affected by the continued operation of the nuclear power plant during the license renewal term, (2) determines whether there would be any potential human health or environmental effects on these populations or on special pathway receptors (groups or individuals with unique consumption practices and interactions with the environment), and (3) determines whether any of the effects may be disproportionately high and adverse. No changes were made in the LR GEIS, final rule, or guidance as a result of this comment.*

A.2.13 Postulated Accidents and Severe Accident Mitigation Alternatives (SAMA)

A.2.13.1 Comments Regarding LR GEIS Appendix E.1, Introduction

Comment: 2., E-2, 9, Assertion that "[t]he NRC's understanding of severe accident risk has evolved since issuance of the 1996 and 2013 LR GEISs due in part to improvements in plant safety, improved plant operational performance, and lessons learned and knowledge gained."

This sentence is both nonsensical and misleading. Understanding does not come from improvements in plant safety or improved plant operational performance.
And as discussed in Comment 3, the NRC has not supported claims to a trend of increased safety. (**24-3-17** [Curran, Diane])

Comment: 3., E-2, 32, Assertion that the 1996 GEIS' description of nuclear plant accidents "remains conservative and the impacts of those described accidents is SMALL."

Based on all of the comments offered on this Draft GEIS, I find this assertion unsupported. (**24-3-18** [Curran, Diane])

Response: *The NRC disagrees with the comment that understanding does not come from improvements in plant safety or improved plant operational performance and further disagrees with the comment that the NRC has not supported its claim of a trend in increased plant safety. Section E.1 is the introduction to Appendix E of this LR GEIS. The NRC's understanding of severe accident risk has evolved since issuance of the 1996 and 2013 LR GEISs due in part to severe accident mitigation initiatives and regulatory programs to improve safety (see LR GEIS Section E.2), lessons learned from nuclear plant accidents (such as the Fukushima accident summarized in Section E.2.1), completed plant-specific postulated accident analyses (see Section E.3), and severe accident mitigation alternative (SAMA) analyses (see Section E.4). Further studies have been undertaken by the NRC such as the state-of-the-art reactor*

consequence analysis (SOARCA) and Level 3 research study to support the NRC's understanding of ways to improve knowledge gained and plant safety. In Appendix E, the NRC assesses more recent information (i.e., SECY papers, NUREGs, probabilistic risk assessments [PRAs], Regulatory Analyses, and other evaluations undertaken in part by the NRC to support some of these safety initiatives) regarding these topics and updates the analysis presented in Chapter 4.9 and Appendix E of the 2013 LR GEIS regarding severe accidents. This revision considers how these developments would affect the Chapter 5 conclusions in the 1996 LR GEIS and provides comparative data where appropriate. The NRC did not intend for revised Appendix E to constitute a comprehensive research report about plant safety or core damage frequency (CDF), although generalizations are made regarding the result of the staff's analysis and review. Rather, the NRC provided a discussion of overall favorable safety trends and knowledge gained to provide greater context for the discussion in Appendix E. The NRC revised Appendix E to clarify the staff's understanding of plant safety and severe accidents.

The NRC disagrees with comments suggesting that the conclusions in Appendix E regarding the impacts of an actual severe accident are not supported. The NRC has clarified in Appendix E in this LR GEIS that the environmental impact from severe accidents discussed is probability-weighted consequences. Simply put, a nuclear plant severe accident is a low-probability, high-consequence event. In Section 5.5.2.5 of the 1996 LR GEIS, the NRC concluded that the generic analysis "applies to all plants and that the probability-weighted consequences of atmospheric releases, fallout onto open bodies of water, releases to groundwater, and societal and economic impacts of severe accidents are of small significance for all plants." Probability-weighted consequences in this revised LR GEIS refer to environmental probability-weighted consequences outside the plant to the public and environment as a result of a severe accident. The NRC's approach for considering new information regarding the probability-weighted consequences finding in the 1996 LR GEIS that the impacts of severe accidents would be SMALL and basis for concluding that the impact finding remains valid are stated in Appendix E.

A.2.13.2 Comments Regarding LR GEIS Appendix E.2, Nuclear Power Plant Accidents

Comment: 4., E-3, 2-3, Assertion that "almost all key trends and developments, with one exception, are favorable (i.e., show improved plant safety or performance) or flat (i.e., show no discernable change in plant safety or performance)."

The cited reference for this assertion --"Perspective on Safety Improvements for Commercial Nuclear Power Plants." 34th Annual Regulatory Information Conference (March 8-10). Washington, D.C. - no ADAMS ML number is given. Nor could it be found in a Google search. Therefore, it is not possible to determine the basis for the assertion. In any event, the document appears to be a power point presentation, not a technical study. A power point presentation would lack the data and analysis necessary to demonstrate how the NRC reached such a significant conclusion. For these reasons, the claim cannot be credited.
(**24-3-19** [Curran, Diane])

Comment: 5., E-3, 3, Safety trends are "favorable" or "flat"

At the same time it fails to document the assertion that safety trends are favorable or flat, the GEIS also fails to address evidence to the contrary. For example:
-("Analysis of Loss-of-Offsite-Power Events 2021 Update," INL/RPT-2268809, August 2022, Figure 16," Statistically significant increasing trend for LOOP recovery times (all event types) from 1997-2021." Page 22). The report shows a significant increasing trend on how long LOOPs

last indicating that LOOP duration has increased fivefold from 1 hour to 5 hours.
-In 2021 the NIST test reactor melted fuel after violating a safety limit (ML22066B312). The event was caused by human errors. While the NIST reactor is a test reactor it was not conducting a test at the time of the event, but rather it was conducting a normal plant startup post-refueling. Therefore, the NIST event is relevant to risks of operating power reactors.
-In 2020, for the first time in the history of the US nuclear industry, a reactor was prematurely closed by a weather-related event that involved extensive damage to the plant (ML21139A091). The Duane Arnold reactor was retired when it was hit by beyond design basis external event (a Derecho) where wind speeds exceeded 100 mph. Ten hours after the event began, the emergency service water system cooling one of the two emergency diesel generators (EDGs) cooling the reactor became seriously degraded when debris clogged the safety related suction strainers and thus required bypassing. The clogging of the suctions strainers rendered the service water system and emergency diesel generator inoperable as defined by the plant's technical specification.

Not one of these significant events has been captured in the NRC's inadequate trend analysis. (**24-4-1** [Curran, Diane])

Comment: 7., E-3, 6, Assertion that NRC has "observed" a "reduction in plant performance issues."

The Draft GEIS provides no citation for this claim, and therefore it is not possible to determine whether the alleged reduction resulted from an actual decrease in performance issues or a reduced rate of inspection and enforcement by NRC. (**24-4-3** [Curran, Diane])

Comment: 8., E-3, 6, Assertion that "risks from external event hazards need further consideration."

This assertion begs the question: If further consideration is required, why is it safe to extend the licenses by 20 years before the analysis is complete? (**24-4-4** [Curran, Diane])

Comment: 9., E-3, 8-14, Assertion that Individual Plant Examination (IPE) and Individual Plan Examination of External Events (IPEEE) programs are "examples of items contributing to improved safety since publication of the 1996 LR GEIS"

The IPEs and IPEEEs were completed and submitted to the NRC in the early 1990s. Most if not all of the improvements from the insights gained were implemented when the risk 1996 GEIS was promulgated. Thus, there have been no improvement in the base line risk since that GEIS was approved. The NRC should not be claiming additional risk improvement the 1996 GEIS. (**24-4-5** [Curran, Diane])

Comment: 10., E-3, 15-17, Assertion that "identification of specific aging mechanisms (e.g., cables; irradiation-assisted stress corrosion cracking) and development of programs to monitor and control these mechanisms" are "examples of items contributing to improved safety since publication of the 1996 LR GEIS."

First, this is a partial list of aging mechanisms peculiar to SLR terms. It appears in SECY-14-0016. The complete list is "reactor pressure vessel embrittlement, irradiation-assisted stress corrosion cracking of reactor internals, concrete structures and containment degradation,

and electrical cable qualification and condition assessment." As noted in SECY-14-0016, there is uncertainty about how these components will perform and interact in a SLR term.

Second, the GEIS fails to note that these "aging mechanism" issues remain unresolved. See SRM-SECY-14-0016. Instead of directing their resolution through regulatory requirements, in SRM-SECY-14-0016 the NRC Commissioners directed the Staff and licensees to attempt to resolve them ad hoc and report back. No agency-wide requirements for monitoring and control of these mechanisms were established by SECY-14-0016. And no resolution is reported in the License Renewal GEIS. Therefore, the assertion that "programs to monitor and control" the specific aging mechanisms contribute to improved safety throughout the fleet of nuclear reactors is unsupported. It is also inconsistent with the NRC's original approach to unresolved safety issues, which was to resolve them before promulgating the Part 54 license renewal rule. 56 Fed. Reg. 64,943, 64,947-48 (Dec. 13, 1991). (**24-4-6** [Curran, Diane])

Comment: 11., E-3, 23-26, Assertion that "implementation of the NRC Orders, which have subsequently mostly been codified into NRC regulations, and information requests " following the Fukushima Dai-ichi nuclear power plant accident" provides "examples of items contributing to improved safety since publication of the 1996 LR GEIS."

This assertion is incorrect and grossly misleading. "Mostly," the NRC Orders have *not* been "codified into regulations." While the NRC Staff proposed to codify the Orders in 2015, a majority of the Commissioners rejected that proposal in 2019. The MDBDE rule therefore has no enforceable requirements for post-Fukushima mitigation measures. And the Orders, while enforceable at the time, do not have continuing enforceability. As Commissioner Baran noted, "[n]uclear power plants will be no safer with this rule than they are today." 84 Fed. Reg. 39,684, 39,72021 (Aug. 9, 2019). (**24-4-7** [Curran, Diane])

Comment: 12., E-3, 27-33, Assertion that "implementation of plant improvements and severe accident mitigation guidelines identified as a result of the NRC ICMs Orders and post-Fukushima Orders for mitigation of beyond-design-basis events" provides "examples of items contributing to improved safety since publication of the 1996 LR GEIS."

This is the same empty assertion as discussed above. There is no legal or reliable assurance that plant-specific, unenforceable, voluntary measures will be required or enforced at the time that operating licenses are renewed. Thus, the NRC does not have a reasonable basis for the broad generalization that these measures constitute an additional contribution to safety since 1996. (**24-4-8** [Curran, Diane])

Comment: 13., E-3, 34-35, Assertion that "developments in the area of severe accident management guidelines (SAMGs)" are "examples of items contributing to improved safety since publication of the 1996 LR GEIS."

The industry has written guidance for licensees on how to develop these SAMGs. However, the NRC has not developed its own SAMG guidance, let alone imposed it on licensees. Development of SAMGs is voluntary and therefore the NRC cannot enforce these measures. The quality of the developed guidelines thus varies significantly among individual reactors and licensees. Therefore, it is not possible to generalize that development of SAMGs has contributed to improved safety since 1996. (**24-4-9** [Curran, Diane])

Comment: 14., E-4, 3-6, Assertion that "[t]hus, the performance and safety record of nuclear power plants operating in the United States continues to improve. This is also confirmed by

analysis that, in many cases, indicates improved plant performance and design features have resulted in reductions in initiating event frequency, CDF, and containment failure frequency.[9]"

In footnote 9, the GEIS cites three reference documents for the asserted confirmation of reductions in initiating event frequency, CDF, and containment failure frequency. None of the references substantiates the claim.
-The first document - the NRC's 2007-2008 Information Digest (Figure 20 and Appendix G) --supplies no initiating event frequencies, CDF values or containment failure frequencies. Thus, it does not substantiate the NRC's claim.
-The second document --https://nrcoe.inl.gov/IndustryPerf/ (a 2020 update to industry-average performance for components and initiating events at U.S. commercial reactors) --supplies no CDF or containment failure frequencies. Thus, it does not substantiate the NRC's claim.
-The third reference - "information contained in plant-specific supplemental EISs (SEISs) to the 1996 LR GEIS for initial LR and SLR" --is not an independent source of data at all, but compilations of data. Thus, it does not substantiate the NRC's claim.
Therefore, the NRC claim that "performance ... continues to improve" is unsubstantiated. (**24-4-10** [Curran, Diane])

Response: *The NRC agrees in part and disagrees in part with these comments referring to Section E.2 of Appendix E in this LR GEIS. There were several comments or questions related to specific details of agency actions. The purpose of Section E.2 in Appendix E in this LR GEIS is to summarize and provide examples of NRC agency actions that are independent of the NRC's license renewal environmental review process that is the subject of this LR GEIS and associated rulemaking. Such agency actions and programs that are outside the scope of this LR GEIS and rulemaking include, for example, safety enhancements identified in mandated programs and agency initiatives such as the severe accident program, Individual Plant Examination (IPE), Individual Plant Examination of External Events (IPEEE), and Containment Performance Improvement programs, and lessons learned from accidents such as Fukushima that provide reasonable assurance of adequate protection of public health and safety. Agency actions are summarized in Section E.2 of Appendix E to provide additional context and perspective for the NRC's conclusions. The most up-to-date information about the NRC's reports and findings regarding safety enhancements are available on the NRC's official website. For example, plant-specific safety enhancements after Fukushima are available at https://www.nrc.gov/reactors/operating/ops-experience/fukushima.html. Section E.2 was modified to clarify this purpose.*

The NRC disagrees with the comments regarding aging management. As described in Section 1.7 of this LR GEIS, the NRC's license renewal environmental review process, which is the focus of this LR GEIS and rulemaking, is confined to analyzing the effects (impacts) on the environment of continued operation of nuclear power plants through the period of extended operation (either initial LR or SLR). Nuclear power plant operational safety issues related to the management of aging systems, structures, and components are outside the scope of the NRC's environmental reviews conducted under 10 CFR Part 51 as well as this LR GEIS and rulemaking. The NRC conducts both an environmental review and a safety review of each license renewal application. The results of the NRC's environmental review are documented in a plant-specific SEIS to the LR GEIS in accordance with the NRC's regulations set forth in 10 CFR Part 51. The staff's safety review is conducted in accordance with 10 CFR Part 54, and the results of the staff's evaluation are documented in a safety evaluation report (SER). To be granted renewed licenses, applicants must demonstrate that aging effects will be adequately managed such that the intended functions of the systems, structures, and components within the scope of license renewal will be maintained consistent with the current licensing basis for

the period of extended operation. In accordance with 10 CFR Part 54, the staff will conduct a review of the licensee's aging management programs and document the results in the SER. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.

The NRC agrees in part and disagrees in part with comments directly related to issues of aging regarding Section E.2 of the LR GEIS. For clarity, the NRC deleted the key point regarding identification of specific aging mechanisms (e.g., cables, irradiation-assisted stress corrosion cracking) and development of programs to monitor and control these mechanisms. Following Staff Requirements Memorandum (SRM)-SECY-14-0016 (NRC 2014a), emerging issues related to aging were addressed in the 2017 Generic Aging Lessons Learned Report (NRC 2017b). As summarized in the 2017 report:

> *The staff requirements memorandum (SRM) on SECY-14-0016, "Ongoing Staff Activities to Assess Regulatory Considerations for Power Reactor Subsequent License Renewal," (ADAMS Accession No. ML14241A578) directed the staff to continue to update the license renewal guidance, as needed, to provide additional clarity on the implementation of the license renewal regulatory framework. The SRM also directed the staff to keep the Commission informed on the progress in resolving the following technical issues related to SLR: (i) reactor pressure vessel neutron embrittlement at high fluence, (ii) irradiation-assisted SCC of reactor internals and primary system components, (iii) concrete and containment degradation, and (iv) electrical cable qualification and condition assessment. In addition, the SRM directed that the staff should keep the Commission informed regarding the staff's readiness for accepting an application and any further need for regulatory process changes, rulemaking, or research.*

Since aging management programs are related to the Part 54 license renewal rule and the purpose of Part 54 is to maintain the licensing basis for nuclear plants, the example related to aging management was deleted from Section E.2 of this LR GEIS. However, draft NUREG-2191, "Generic Aging Lessons Learned for Subsequent License Renewal Report," (NRC 2023g), has been issued for public comment. The report discusses generic aging management reviews of systems, structures, and components (SSCs) that may be within the scope of SLR applications and identifies aging management programs (AMPs) that are determined to be acceptable for managing the effects of aging on SSCs within the scope of license renewal, as required by Part 54.

The NRC agrees in part and disagrees in part with comments related to specific details of operating experience and lessons learned. Operating experience and lessons learned have contributed to NRC initiatives to provide reasonable assurance of adequate protection of public health and safety and to promote the common defense and security outside the context of license renewal. Previously, the Commission noted that all licensees had undergone, or were in the process of undergoing, detailed plant-specific severe accident analyses through processes separate from license renewal such as lessons learned from the Three Mile Island accident (operating experience). These processes include the Containment Performance Improvement, IPE, and IPEEE programs (61 FR 28467, 28481; June 30, 1996). Other examples are provided in Section E.2. The NRC has updated Section E.2 to clarify that the section is referring to safety enhancements initiated outside the scope of this LR GEIS and rulemaking. The NRC has also revised Section E.2 to clarify the description regarding examples of mitigation to improve safety since publication of the 1996 LR GEIS.

The NRC also agrees in part with comments regarding the update of orders, rules, and SECYs and has updated Appendix E of this LR GEIS accordingly. The NRC disagrees with the comment disputing the claim in the LR GEIS that the NRC orders issued following the Fukushima Dai-ichi accident have mostly been codified into NRC regulations. The majority of orders have been incorporated into the regulations. Nevertheless, the intent of this statement was to note that the requirements for two of the most significant orders, specifically Orders EA-12-049 (NRC 2012a) and EA-12-051 (NRC 2012b), have been incorporated into the NRC regulations. Section E.2 of Appendix E of the LR GEIS was updated to provide this clarification.

Regarding specific comments made regarding NRC orders and flexible coping strategies (FLEX), see the NRC's responses in Section A.2.13.3. The NRC has added a conclusion section to clarify that examples of mitigation to improve safety cited in Section E.2 since publication of the 1996 LR GEIS demonstrate that operating experience and lessons learned from accidents have further contributed to NRC initiatives to provide reasonable assurance of adequate protection of public health and safety and to promote the common defense and security.

The NRC agrees in part and disagrees in part with several comments or questions related to safety trends. Appendix E assesses more recent information regarding probability-weighted consequences to the public and environment and updates the analysis presented in Chapter 4.9 and Appendix E of the 2013 LR GEIS regarding severe accidents. Section E.2 in Appendix E of this LR GEIS only provides a summary of relevant agency initiatives since the 1996 LR GEIS was published; it is not intended to be a comprehensive catalog of risk and operating experience information. The NRC has updated Section E.2 of Appendix E to clarify this purpose. Section E.2 was also modified to clarify that the result of the assessment was that almost all key trends and developments for the 51 safety measures evaluated, with one exception (loss of offsite power recovery time), are favorable (i.e., show improved plant safety or performance) or flat (i.e., show no discernible change in plant safety or performance).

The NRC agrees that the 2022 Idaho National Laboratory report (INL/RPT-22-68809; INL 2022) shows that there has been an increasing trend in the duration of loss of offsite power (LOOP) events between 1997 and 2021. This conclusion is consistent with the presentation, Perspective on Safety Improvements for Commercial Nuclear Power Plants" (NRC 2022j). As stated above, the draft LR GEIS noted that there was one exception to the assessment of trends in key safety indicators that they are favorable (i.e., show improved plant safety or performance) or flat (i.e., show no discernible change in plant safety or performance). The one exception or negative trend is LOOP recovery time. Section E.2 in Appendix E of this LR GEIS was revised to specify this exception or negative trend.

The NRC agrees that an Agencywide Documents Access and Management System (ADAMS) number needs to be provided. The reference section of Appendix E was updated to provide an ADAMS accession number for NRC 2022j: "Perspective on Safety Improvements for Commercial Nuclear Power Plants." The NRC disagrees that the information presented in Section E.2 of the LR GEIS from this reference (NRC 2022j) is not relevant information to include in the LR GEIS because it was presented at the 34th Annual Regulatory Information Conference after being publicly released in accordance with NRC processes. While not of the same pedigree as a peer-reviewed comprehensive report, this information source provides insight into NRC regulatory activities for the benefit of diverse groups of stakeholders, which is the purpose of the NRC annual regulatory information conferences. Also, this information was not the basis for any of the conclusions in the LR GEIS, rather it was used only as a source of

supporting information to the overall observation that there has been an improvement in plant performance and public safety since issuance of the 1996 LR GEIS.

Regarding the comment on the statement in Section E.2 of Appendix E that "risks from external event hazards need further consideration," the statement is referring to a conclusion cited in reference NRC 2022j, Regulatory Information Conference presentation on "Perspective on Safety Improvements for Commercial Nuclear Power Plants." The NRC modified Section E.2 in this LR GEIS for clarity and completeness.

The NRC agrees with the comments that state that the NRC has not developed detailed plant-specific severe accident management guideline (SAMG) guidance; however, the development and implementation of severe accident management strategies and guidelines, required by 10 CFR 50.155(b)(1), instructs plant operators and designated support staff on additional strategies for managing accident sequences that progress beyond the capacity of the mitigating strategies contained in plant emergency operating procedures.

The NRC disagrees with the comment related to use of references after 1996. References providing examples of items contributing to improved safety since publication of the 1996 LR GEIS included the IPE (NRC 1997a) and IPEEE (NRC 2002a). Moreover, as provided in the 1996 final rule (61 FR 28467) statements of consideration, "The draft GEIS established the bounds and significance of potential environmental impacts at 118 light-water nuclear power reactors that, as of 1991, were licensed to operate or were expected to be licensed in the future." As a result, plant improvements made since about 1990 were not considered in the 1996 LR GEIS.

The NRC agrees that the cited references do not provide any insight into containment failure frequency and that NRC's 2007-2008 Information Digest does not provide insight into initiating event frequency and CDF. The NRC disagrees that the other two cited references, https://nrcoe.inl.gov/IndustryPerf/ and plant-specific SEISs to the 1996 LR GEIS, do not substantiate reductions in many initiating event frequencies and CDFs generally. However, the scope of Section E.2 in Appendix E of this LR GEIS is improvements in plant safety, not risk, which is the topic of Section E.3. Therefore, the NRC has deleted the cited references and clarified the text in Section E.2 to reflect this reality.

A.2.13.3 Comments Regarding LR GEIS Appendix E.2.1, Fukushima Accident - Lessons Learned – NRC Orders, FLEX, and Regulations

Comment: The Draft GEIS Makes Unsupported Claims to Improved Safety.
The Draft GEIS repeatedly takes credit for alleged post-Fukushima orders requiring improvements to safety. *See id*. at E-82, E-83. But credit is not warranted, because those orders have, to a significant extent, been replaced by regulations that render key aspects of the mitigation measures unenforceable and subject only to the unilateral decisions of licensees as to whether to maintain them. While post-Fukushima orders required all licensees to install "FLEX" equipment to respond to beyond-design-basis accidents, those regulations have now been supplanted with regulations that leave it to licensees to decide whether to provide training or instruction that would ensure that they could be utilized. And in promulgating the regulations, the Commission deleted a requirement that they be protected against the beyond-design basis flooding hazards that are now understood to threaten a large portion of the U.S. reactor fleet.

The evisceration of the post-Fukushima requirements for FLEX equipment drew a strong rebuke from dissenting Commissioners Steven Burns (then the NRC Chairman) and Commissioner Jeff Baran. Each accused their fellow Commissioners of "weaken[ing] (Burns) or "gut[ting] this key post-Fukushima safety rule" (Baran).

In addition, as noted by Commissioner Burns, the Commission undermined any future reliance on post-Fukushima measures to reduce accident risks at operating nuclear plants:

[T[he majority's approach calls into question the degree to which the NRC will be able to give credit for the existence of the mitigation strategies in a number of risk-informed regulatory initiatives like adaptation of alternative treatment requirements for SSCs under 10 CFR 50.69, "Risk-informed categorization and treatment of structures, systems and components for nuclear power reactors," and risk-informed technical specifications. Licensees are also seeking credit for mitigation strategies in the Reactor Oversight Process and have expressed interest in pursuing credit for use of the strategies in the physical security program. **The assessment of the degree to which credit for the mitigation strategies is possible will be much more complex now that the mitigation strategies will not be required to address the reevaluated hazards**.

84 Fed. Reg. 39,684, 39,720 (Aug. 9, 2019) (emphasis added). Commissioner Burns' comment is equally applicable to the Draft GEIS. The NRC has no justification to make generalizations about improved safety resulting from post-Fukushima measures that are left to the voluntary discretion of each separate licensee. (**24-1-5** [Curran, Diane])

Comment: 33., E-31, 15, "NRC issued Order EA-12-049" This text refers multiple times to NRC Order EA-12-049 as the source of *diverse and flexible coping strategies (FLEX)" that licensees were directed to provide. However, this 2012 order was superseded in 2019 by NRC regulation 10 CFR 50.155, and thus is no longer effective after 2019. The text should reflect this regulation as this is where the current requirements reside. (**24-5-10** [Curran, Diane])

Comment: 34., E-31, 22-24, Assertion that "[t]he FLEX strategies and equipment, when coupled with plant procedures, **provide a safety benefit for all applicable events** ..." (emphasis added).
The Draft GEIS is misleading. "All applicable events" presumably include reasonably foreseeable beyond-design-basis floods and earthquakes, such as the increased seismic and flooding hazards identified in response to the NRC's post-Fukushima Request for Additional Information. But FLEX equipment is only required to be "reasonably protected from the effects of natural phenomena that are equivalent in magnitude to the phenomena assumed for developing the design basis of the facility." See 10 CFR 50.155(b)(2). (**24-5-11** [Curran, Diane])

Comment: 35., E-31, 22-24, Assertion that "[t]he FLEX strategies and equipment, when coupled with plant procedures, **provide a safety benefit for all applicable events** ..." (emphasis added).

The FLEX equipment does not supply benefits for all applicable events. It supplies no benefits for comparatively fast events, e.g., large LOCA, when there is inadequate time to deploy the equipment. (**24-5-12** [Curran, Diane])

Comment: 36., E-31, 22-24, Assertion that "[t]he FLEX strategies and equipment, when coupled with plant procedures, **provide a safety benefit** for all applicable events, both design-basis and beyond-design-basis events." (emphasis added).

FLEX strategies can provide a safety benefit, i.e., a reduction in CDF, for those events like the Fukushima accidents where it is obvious that the permanently installed equipment has failed and cannot be recovered. But more likely than these extreme events are events like the TMI accident, which was initiated by a common loss of feedwater complicated by multiple equipment and human errors. For example, consider a simple loss of offsite power while one EDG is unavailable due to maintenance, coupled with a failure of the redundant EDG. In this example, the plant staff would be required to decide whether to attempt restoration of one the EDGs or to deploy FLEX. This required additional decision making complicates the process leading to potentially higher risk levels - due to FLEX. (**24-5-13** [Curran, Diane])

Comment: 42., E-50, 45-60, Assertion that "the NRC issued Order EA-12-049, 'Issuance of Order to Modify Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events,' dated March 12, 2012 (NRC 2012d)."... "All operating power reactor licensees have complied with the portions of the Order that affect the shutdown risk processes."

As previously discussed, this order has been replaced by new regulation in 10 CFR 50.155. As the order is no longer controlling, the discussion here should be replaced with a discussion of 10 CFR 50.155, its provisions, and whether they must be complied with in the future (i.e., during the license renewal or subsequent license renewal term). (**24-5-19** [Curran, Diane])

Comment: 48., E-55, 16-19, Assertion that "the staff issued Order EA-12-051 (NRC 2012a), which requires that licensees install reliable means of remotely monitoring SFP levels to support effective prioritization of event mitigation and recovery actions in the event of a beyond-design-basis external event. In addition, the staff issued Order EA-12-049 (NRC 2012c), which requires that licensees develop, implement, and maintain guidance and strategies to maintain or restore core cooling, containment, and SFP cooling capabilities after a beyond-design-basis external event."

As discussed in previous comments, the orders referenced in this section have be superseded by regulation found in 10 CFR 50.155. The text should reflect this. (**24-6-6** [Curran, Diane])

Comment: 49., E-55, 30-32, Assertion that "[t]he FLEX strategies and equipment, when coupled with plant procedures, provide a safety benefit for all applicable events, not just the beyond-design-basis events."

FLEX supplies no safety benefit for design basis events because as defined by the NRC design basis events are terminate without core damage by the emergency core cooling system. Thus, there is no need for FLEX during design basis events. (**24-6-7** [Curran, Diane])

Comment: 50., E-55, 34-36, Assertion that "[a]s a result of the terrorist attacks of September 11, 2001, the NRC issued EA-02-026, "Order for Interim Safeguards and Security Compensatory Measures" (NRC 2002b), referred to as the ICMs Orders, dated February 25, 2002."

This order was supplanted by 10 CFR 50.54 (hh). This text should be corrected to reference the currently applicable requirements. (**24-6-8** [Curran, Diane])

Comment: 53., E-81, 32-34, Assertion that “[i]n addition, as cited above, plant improvements made in response to **NRC Orders** and industry initiatives have contributed to the improved safety of all plants during both full power operation and low power and shutdown operation." (emphasis added).

As discussed in comments above, the NRC is referencing orders which are no longer in effect because they have been replaced by new regulations. (**24-6-11** [Curran, Diane])

Comment: Draft NUREG-1437 Revision 2
E.3.7 Impact From Accidents at Spent Fuel Pools
As directed by the Commission in SRM-SECY-12-0025, dated March 9, 2012 (NRC 2012e), after the severe accident at the Fukushima Dai-ichi nuclear power plant, the NRC staff has undertaken regulatory actions that originated from the NTTF recommendations to enhance reactor and SFP safety.

On March 12, 2012, the staff issued Order EA-12-051 (NRC 2012a), which requires that licensees install reliable means of remotely monitoring SFP levels to support effective prioritization of event mitigation and recovery actions in the event of a beyond-design-basis external event.

In addition, the staff issued Order EA-12-049 (NRC 2012c), which requires that licensees develop, implement, and maintain guidance and strategies to maintain or restore core cooling, containment, and SFP cooling capabilities after a beyond-design-basis external event. Upon full implementation of these Orders, SFP safety was anticipated to be significantly increased.

The NRC issued Order EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design Basis External Events," (NRC 2012c) in March 2012 after the accident at the Fukushima Dai-ichi nuclear plant (NRC 2012f). This Order was effective immediately and directed the nuclear power plants to provide FLEX in response to beyond-design basis external events. The nuclear power plants' Final Integrated Plans provide strategies for maintaining or restoring core cooling, containment cooling, and SFP cooling capabilities for a beyond-design-basis external event. The FLEX strategies and equipment, when coupled with plant procedures, provide a safety benefit for all applicable events, not just the beyond-design-basis events.

Comments See reference comments. (**33-3-5** [Magnuson, Brian])

Comment: References
EA-12-051, Order Modifying Licenses With Regard to Reliable Spent Fuel Pool Instrumentation:

. . . the NRC's assessment of new insights from the events at Fukushima Dai-ichi leads the NRC staff to conclude that additional requirements must be imposed on Licensees and CP holders to increase the capability of nuclear power plants to mitigate beyond-design-basis external events. These additional requirements represent a substantial increase in the protection of public health and safety.

The spent fuel pool level instrumentation shall include the following design features: Installed instrument channel equipment within the spent fuel pool shall be mounted to retain its design configuration during and following the maximum seismic ground motion considered in the design of the spent fuel pool structure. (**33-3-6** [Magnuson, Brian])

Comment: EA-12-049, Issuance of Order to Modify Licenses with Regard to Requirements for Mitigation Strategies For Beyond-Design-Basis External Events:
Current regulatory requirements and existing plant capabilities allow the NRC to conclude that a sequence of events such as the Fukushima Dai-ichi accident is unlikely to occur ill the U.S, Therefore, continued operation and continued licensing activities do not pose an imminent threat to public health and safety.

However, NRC's assessment of new insights from the events at Fukushima Dai-ichi leads the staff to conclude that additional requirements must be imposed on Licensees or CP holders to increase the capability of nuclear power plants to mitigate beyond-design-basis external events. These additional requirements are needed to provide adequate protection to public health and safety, as set forth in Section III of this Order.

The events at Fukushima, however, demonstrate that beyond-design-basis external events may adversely affect: (1) more than one unit at a site with two or more units, and (2) multiple safety functions at each of several units located on the same site.

The events at Fukushima further highlight the possibility that extreme natural phenomena could challenge the prevention, mitigation, and emergency preparedness defense-in-depth layers.

Stakeholder input influenced the staff to pursue a more performance-based approach to improve the safety of operating power reactors than envisioned in NTTF Recommendation 4.2, SECY-11-0124, and SECY-11-0137.

To address the uncertainties associated with beyond-design-basis external events, the NRC is requiring additional defense-in-depth measures at licensed nuclear power reactors so that the NRC can continue to have reasonable assurance of adequate protection of public health and safety in mitigating the consequences of a beyond-design-basis external event.

The Commission has determined that ensuring adequate protection of public health and safety requires that power reactor Licensees and CP holders develop, implement and maintain guidance and strategies to restore or maintain core cooling, containment, and SFP cooling capabilities in the event of a beyond-design-basis external event. These new requirements provide a greater mitigation capability consistent with the overall defense-in-depth philosophy, and, therefore, greater assurance that the challenges posed by beyond-design-basis external events to power reactors do not pose an undue risk to public health and safety.
(33-3-7 [Magnuson, Brian])

Comment: NEI 12-06 (Revision 5) Diverse and Flexible Coping Strategies (FLEX) Implementation Guide

This revision of the guide also provides an acceptable method to implement the requirements of Order EA-12-049 while also addressing mitigating strategy approaches for addressing reevaluated flooding and seismic hazard information. The revisions to the guide also align it with the Mitigating Beyond-Design-Basis Events rulemaking.

Cooling and makeup water inventories contained in systems or structures with designs that are robust for the applicable hazard(s)[3] are available.

Fire or other pumps may be available provided they are robust for the applicable hazard(s).

[3] Equipment only needs to be robust for the hazards for which it is relied on for mitigation.

Installed electrical distribution system, including inverters and battery chargers, remain available provided they are protected consistent with current station design.

Minimum makeup rate must be capable of exceeding boil-off rate for the boundary conditions described in Section 3.2.1.6.

3.2.1.6 SFP Conditions: The initial SFP conditions are:

1.All boundaries of the SFP are intact, including the liner, gates, transfer canals, etc.
2.Although sloshing may occur during a seismic event, the initial loss of SFP inventory does not preclude access to the refueling deck around the pool.
3.SFP cooling system is intact, including attached piping.
4.SFP heat load assumes the maximum design basis heat load for the site.
(**33-3-8** [Magnuson, Brian])

Comment: SECY-11-0124:
The staff concluded that additional review is needed to identify specific regulatory actions related to NTTF Recommendation 7 regarding enhanced spent fuel pool makeup capacity and instrumentation for spent fuel pools. For example, the resolution strategy for Recommendation 2.1 may influence the seismic qualification of potential instrumentation for spent fuel pools. (**33-3-9** [Magnuson, Brian])

Comment: § 50.155 Mitigation of Beyond-Design-Basis Events:
(b)Strategies and guidelines. Each applicant or licensee shall develop, implement, and maintain:

(1)Mitigation strategies for beyond-design basis external events—Strategies and guidelines to mitigate beyond-design-basis external events from natural phenomena that are developed assuming a loss of all ac power concurrent with either a loss of normal access to the ultimate heat sink or, for passive reactor designs, a loss of normal access to the normal heat sink. These strategies and guidelines must be capable of being implemented site-wide and must include the following:

(i)Maintaining or restoring core cooling, containment, and spent fuel pool cooling capabilities; and

(2)Extensive damage mitigation guidelines—Strategies and guidelines to maintain or restore core cooling, containment, and spent fuel pool cooling capabilities under the circumstances associated with loss of large areas of the plant impacted by the event, due to explosions or fire, to include strategies and guidelines in the following areas:
(i)Firefighting;
(ii)Operations to mitigate fuel damage; and
(iii) Actions to minimize radiological release.

(c)Equipment. (1) The equipment relied on for the mitigation strategies and guidelines required by paragraph (b)(1) of this section must have sufficient capacity and capability to perform the functions required by paragraph (b)(1) of this section.

(2)The equipment relied on for the mitigation strategies and guidelines required by paragraph (b)(1) of this section must be reasonably protected from the effects of natural phenomena that are equivalent in magnitude to the phenomena assumed for developing the design basis of the facility.

(h) Withdrawal of orders and removal of license conditions. (1) On September 9, 2022, Order EA-12-049, "Order Modifying Licenses With Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," and Order EA-12-051, "Order Modifying Licenses With Regard to Reliable Spent Fuel Pool Instrumentation," are withdrawn for each licensee or construction permit holder that was issued those Orders.
[84 FR 39718, Aug. 9, 2019] (**33-3-10** [Magnuson, Brian])

Comment: NTTF Recommendations - Enhancing Reactor Safety in the 21st Century (SECY-11-0093)

Current NRC regulations and associated regulatory guidance provide a robust regulatory approach for evaluation of site hazards associated with natural phenomena. However, this framework has evolved over time as new information regarding site hazards and their potential consequences has become available. As a result, the licensing bases, design, and level of protection from natural phenomena differ among the existing operating reactors in the United States, depending on when the plant was constructed and when the plant was licensed for operation.

Over the years, the NRC has initiated several efforts to evaluate risks and potential safety issues resulting from these differences. However, the NRC reviews did not attempt to validate or verify the licensees' IPEEE results or the acceptability of proposed improvements. Further, the IPEEE analyses did not document the potential safety impacts of proposed improvements, and plants were not required to report completion of proposed improvements to the NRC.

The SEP, IPEEE program, USI A-46, and other regulatory initiatives, including licensing actions to address vulnerabilities, have resulted in some plant-specific safety enhancements to address the risk of external events resulting from natural phenomena. However, the staff has not undertaken a comprehensive reestablishment of the design basis for existing plants that would reflect the current state of knowledge or current licensing criteria. As a result, significant differences may exist between plants in the way they protect against design-basis natural phenomena and the safety margin provided.

With regard to seismic hazards, as discussed above, available seismic data and models show increased seismic hazard estimates for some operating nuclear power plant sites. The state of knowledge of seismic hazards within the United States has evolved to the point that it would be appropriate for licensees to reevaluate the designs of existing nuclear power reactors to ensure that SSCs important to safety will withstand a seismic event without loss of capability to perform their intended safety function. As seismic knowledge continues to increase, new seismic hazard data and models will be produced. Thus, the need to evaluate the implications of updated seismic hazards on operating reactors will recur and need to be reevaluated at appropriate intervals.

Protection from natural phenomena is critical for safe operation of nuclear power plants due to potential common-cause failures and significant contribution to core damage frequency from external events. Failure to adequately protect SSCs important to safety from appropriate design-basis natural phenomena with appropriate safety margins has the potential for common-cause failures and significant consequences as demonstrated at Fukushima.
(**33-3-11** [Magnuson, Brian])

Comment: The Task Force recommends that the Commission direct the following actions to ensure adequate protection from natural phenomena, consistent with the current state of knowledge and analytical methods. These should be undertaken to prevent fuel damage and to ensure containment and spent fuel pool integrity:

2.1 Order licensees to reevaluate the seismic and flooding hazards at their sites against current NRC requirements and guidance, and if necessary, update the design basis and SSCs important to safety to protect against the updated hazards.

2.2 Initiate rulemaking to require licensees to confirm seismic hazards and flooding hazards every 10 years and address any new and significant information. If necessary, update the design basis for SSCs important to safety to protect against the updated hazards.

2.3 Order licensees to perform seismic and flood protection walkdowns to identify and address plant-specific vulnerabilities and verify the adequacy of monitoring and maintenance for protection features such as watertight barriers and seals in the interim period until longer term actions are completed to update the design basis for external events.

The strategies, called EDMGs, implemented to meet the requirements of the 2002 Interim Compensatory Measures Order, subsequent facility-specific license conditions, and ultimately 10 CFR 50.54(hh)(2), did not address external natural hazards (e.g., seismic, flooding tornadoes, hurricanes) or initiating events other than extensive damage to the facilities caused by large fires or explosions. The equipment is not expected to be protected from design-basis or beyond-design-basis external events, such as floods, earthquakes, or high winds.

4.2.4 Spent Fuel Pool Safety

SSCs for spent fuel storage and handling have safety classifications that reflect their importance to safety. SSCs essential to retaining the inventory of spent fuel pool water covering the spent fuel and to maintaining a substantial margin to criticality are typically classified as safety related. Such safety-related SSCs include the spent fuel pool structure and penetrations, the spent fuel storage racks, the neutron-absorbing panels in the racks, and the spent fuel itself. Some fuel handling equipment is also safety related. Because the consequences of many fuel handling events and loss of spent fuel forced cooling events have been evaluated and found to be small, these events are not classified as design-basis events. Consequently, other spent fuel storage and handling equipment and spent fuel pool water inventory makeup and cooling systems may not be classified as safety related. At U.S. reactors, some of the spent fuel pool cooling and makeup systems are powered by safety-grade ac electrical power and some are powered by nonsafety-grade ac electrical power.

Recommendation 7: The Task Force recommends enhancing spent fuel pool makeup capability and instrumentation for the spent fuel pool. The Task Force recommends that the Commission direct the staff to do the following:

7.1 Order licensees to provide sufficient safety-related instrumentation, able to withstand design-basis natural phenomena, to monitor key spent fuel pool parameters (i.e., water level, temperature, and area radiation levels) from the control room.
7.2 Order licensees to provide safety-related ac electrical power for the spent fuel pool makeup system.
7.3 Order licensees to revise their technical specifications to address requirements to have one train of onsite emergency electrical power operable for spent fuel pool makeup and spent fuel pool instrumentation when there is irradiated fuel in the spent fuel pool, regardless of the operational mode of the reactor.
7.4 Order licensees to have an installed seismically qualified means to spray water into the spent fuel pools, including an easily accessible connection to supply the water (e.g., using a portable pump or pumper truck) at grade outside the building.
7.5 Initiate rulemaking or licensing activities or both to require the actions related to the spent fuel pool described in detailed recommendations 7.1-7.4. (**33-3-12** [Magnuson, Brian])

Comment: 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:

Along with an assessment of reactor integrity, the NTIF recommended an evaluation of the spent fuel pool (SFP) integrity. The addressee's evaluation should consider all seismically induced failures that can lead to draining of the SFP. The evaluation should consider SFP walls, liner, penetrations (cooling water supplies or returns, drains), transfer gates and seals, seals and bellows between the SFP, transfer canal, and reactor cavity, sloshing effects (including loss of SFP inventory, wave-induced failures of gates, and subsequent flooding), siphon effects caused by cooling water pipe breaks, and other relevant effects that could lead to a significant loss of inventory of the SFP.

On December 23, 2011, the Consolidated Appropriations Act, Public Law 112-074, was Signed into law. Section 402 of the law also requires a reevaluation of licensees' design basis for external hazards, and expands the scope to include other external events, as described below:

The Nuclear Regulatory Commission shall require reactor licensees to re-evaluate the seismic, tsunami, flooding, and other external hazards at their sites against current applicable Commission requirements and guidance for such licensees as expeditiously as possible, and thereafter when appropriate, as determined by the Commission, and require each licensee to respond to the Commission that the design basis for each reactor meets the requirements of its license, current applicable Commission requirements and guidance for such license. Based upon the evaluations conducted pursuant to this section and other information it deems relevant, the Commission shall require licensees to update the design basis for each reactor, if necessary.

Reevaluation of the design basis with respect to other external events will be requested later as a separate action from this letter. However, licensees are encouraged to consider this when performing the Recommendation 2.3 walkdowns for flooding.

Footnote 1: For the purpose of this document, plant-specific vulnerabilities are defined as those features important to safety that when subject to an increased demand due to the newly calculated hazard evaluation have not been shown to be capable of performing their intended safety functions. (**33-3-13** [Magnuson, Brian])

Comment: EPRI Technical Report 1025286, Seismic Walkdown Guidance for Resolution of Fukushima Near-Term Task Force Recommendation 2.3: Seismic, dated June 2012.

The 50.54(f) Letter requires the seismic walkdown activity to "...verify the adequacy of licensee monitoring and maintenance procedures." This will not be done directly by the Seismic Walkdowns and Area Walk-Bys, but it will be indirectly verified based on the findings from these activities, e.g., if degraded conditions are found, the issue, along with the underlying cause, will be evaluated under the plant's CAP.
Screen #1 --Seismic Category I, limits the items to those that have a seismic licensing basis.
Screen #2 --Equipment or Systems, considers only those items associated with the spent fuel pool that are appropriate for an equipment walkdown process.
Screen #3 --Sample Considerations, represents a process intended to result in SWEL 2 that sufficiently represents a broad population of SFP Seismic Category I equipment and systems to meet the objectives of the NRC 50.54(f) Letter.
Screen #4 --Rapid Drain-Down, identifies items that could allow the spent fuel pool (SFP) to drain rapidly. Based on typical designs of spent fuel pools at nuclear power plants, this scope of items would be typically limited to hydraulic lines connected to the SFP and the equipment connected to those lines. The adequacy of the SFP structure is typically assessed by analysis as a Seismic Category I structure. Therefore, the SFP structure is assumed to be seismically adequate for the purposes of this program.

The SSCs that should be identified are not Limited to Seismic Category I items, but may be limited to those that could allow rapid drain-down of the SFP. Rapid drain-down is defined as lowering the water level to the top of the fuel assemblies within 72 hours after the earthquake. (**33-3-14** [Magnuson, Brian])

Comment: Reference Comments
The NRC withdrew Order EA-12-051 in 2022. It seems inappropriate to reference or credit withdrawn orders. Reference 10 CFR 50.155, Mitigation of Beyond-Design-Basis Events.

Notwithstanding, EA-12-051 was ordered "to increase the capability of nuclear power plants to mitigate beyond-design-basis external events"; however, its design requirement of the SFP level instruments is limited to design-basis*the seismic design "considered in the design of the spent fuel pool structure."

This is "new and significant information." It extends beyond the Draft NUREG-1437 Revision 2 package.

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The NRC withdrew Order EA-12-049 in 2022. It seems inappropriate to reference or credit withdrawn orders. Reference 10 CFR 50.155, Mitigation of Beyond-Design-Basis Events.

Notwithstanding, the "safety benefits" of EA-12-049, credited by Draft NUREG-1437 Revision 2, do not apply to severe SFP accidents caused by beyond-design-basis seismic events. As described in NEI 12-06, the (EA-12-049) FLEX strategies assume (1) "all boundaries of the SFP are intact, including the liner, gates, transfer canals," and (2) "although sloshing may occur during a seismic event, the initial loss of SFP inventory does not preclude access to the refueling deck around the pool."

The SFP FLEX strategies assume that all SFP boundaries will remain intact during beyond - design-basis seismic events, regardless of the existing Seismic Category of each SFP boundary. This assumption originates from EPRI Technical Report 1025286.

EPRI Technical Report 1025286, Seismic Walkdown Guidance for Resolution of Fukushima Near-Term Task Force Recommendation 2.3: Seismic states: The adequacy of the SFP structure is typically assessed by analysis as a Seismic Category I structure. Therefore, the SFP structure is assumed to be seismically adequate for the purposes of this program.

This EPRI assumption is fundamentally wrong and deceptive. It undermines the intent of the Order and negates any "reasonable assurance of adequate protection of public health and safety in mitigating the consequences of a beyond-design-basis external event." (**33-3-15** [Magnuson, Brian])

Comment: Some spent fuel pools, particularly those at old nuclear plants that may request subsequent license renewal, are not Seismic Category I structures. If the SFP structure(s) is not Seismic Category I, neither are the respective SFP gates (components).

SFP gates are a weak link in any seismic analysis. Just because a SPF structure is Seismic Category I, does not mean that its gates are Seismic Category I components.

NRC RG 1.29 (Rev. 5), 'Seismic Design Classification for Nuclear Power Plants' states: The SSCs of a nuclear power plant that are designated as seismic Category I must be designed to withstand the effects of the SSE [Safe Shutdown Earthquake] and remain functional. The pertinent quality assurance requirements of Appendix B to 10 CFR Part 50 shall apply to all activities affecting the safety-related functions of seismic Category I SSCs. The following SSCs of a nuclear power plant, including their foundations and supports, should be designated as seismic Category I:

d. systems[1] or portions thereof (including but not limited to systems such as residual heat removal and auxiliary feedwater) that are needed to (1) shutdown the reactor and maintain it in a safe shutdown condition, (2) remove residual heat (including heat stored within the spent fuel pool), (3) control the release of radioactive material, or (4) mitigate the consequences of an accident; (**33-3-16** [Magnuson, Brian])

Comment: Several key examples of systems included in items 1.c and 1.d are provided below for reference, but do not represent the complete scope of these items. Determining the complete scope of these items is the applicant's or licensee's responsibility.

--The spent fuel storage pool structure, including the fuel racks.

Footnote 1: The system boundary includes those portions of the system required to accomplish the specified safety function and connected piping up to and including the second isolation valve or outboard containment isolation valve, such that the effects of an earthquake on non-seismic Category I portions of systems may be isolated from seismic Category I portions. This footnote applies wherever the phrase "systems or portions thereof" appears in this guide.

It is important to recognize that Non-Seismic Category I SFP structures were not/are not "designed to withstand the effects of the SSE [Safe Shutdown Earthquake] and remain functional." Otherwise stated, Non-Seismic Category I SFP structures (and components) were not designed to remain functional during a design-basis (SSE) earthquake.

It is unreasonable and fundamentally wrong to assume that Non-Seismic Category I SFP structures (and components)—that are not designed to remain functional during a design-basis earthquake— would remain functional during a beyond-design-basis (worse) earthquake.

It is impractical, if not impossible, to physically reinforce Non-Seismic Category I SFP structures (and components), such that they would could satisfy remain functional during a design-basis earthquake. The same is true for Seismic Category I SFP structures (and components)—such that they would remain functional during a beyond-design-basis earthquake.
Ultimately, there are no feasible engineering solutions that would protect people and the environment from beyond-design-basis seismic SFP accidents. This is why the nuclear industry concocted the seismically 'robust' contravention.

Additional insights may be gained by reviewing RG 1.29 (all revisions).
(**33-3-17** [Magnuson, Brian])

Comment: EPRI Technical Report 1025286 also states:
The 50.54(f) Letter requires the seismic walkdown activity to "...verify the adequacy of licensee monitoring and maintenance procedures." This will not be done directly by the Seismic Walkdowns and Area Walk-Bys, but it will be indirectly verified based on the findings from these activities, e.g., if degraded conditions are found, the issue, along with the underlying cause, will be evaluated under the plant's CAP.

The NRC approved EPRI Technical Report 1025286, even though it does clearly did not satisfy the intent of NTTF Recommendation 2.3.
The NRC's approval of EPRI Technical Report 1025286 appears to circumvent Fukushima NTTF recommendations and Public Law 112-074. (**33-3-18** [Magnuson, Brian])

Comment: 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 (March 12, 2012) states:

The NRC requests that each addressee confirm that they will use the industry developed, NRC-endorsed, seismic walkdown procedures 1 or provide a description of plant-specific walkdown procedures that include the following characteristics:
a. Determination of the seismic walkdown scope and any combined effects
b. Consideration of NUREG-1742, EPRI Report NP-6041, GIP, and common issues and findings discussed in the responses to TI 2515/183
c. Pre-walkdown actions (e.g., data collection, review of drawings and procedures, identification of the plant licensing basis, identification of current seismic protection levels)
d. Identification of SSCs requiring seismic protection and used in the protection of the reactor and spent fuel pool, including the ultimate heat sink (UHS)

Along with an assessment of reactor integrity, the NTIF recommended an evaluation of the spent fuel pool (SFP) integrity. The addressee's evaluation should consider all seismically induced failures that can lead to draining of the SFP. The evaluation should consider SFP walls, liner, penetrations (cooling water supplies or returns, drains), transfer gates and seals, seals and bellows between the SFP, transfer canal, and reactor cavity, sloshing effects (including loss of SFP inventory, wave-induced failures of gates, and subsequent flooding), siphon effects caused by cooling water pipe breaks, and other relevant effects that could lead to a significant loss of inventory of the SFP.

On December 23, 2011, the Consolidated Appropriations Act, Public Law 112-074, was Signed into law. Section 402 of the law also requires a reevaluation of licensees' design basis for external hazards, and expands the scope to include other external events, as described below:

The Nuclear Regulatory Commission shall require reactor licensees to re-evaluate the seismic, tsunami, flooding, and other external hazards at their sites against current applicable Commission requirements and guidance for such licensees as expeditiously as possible, and thereafter when appropriate, as determined by the Commission, and require each licensee to respond to the Commission that the design basis for each reactor meets the requirements of its license, current applicable Commission requirements and guidance for such license. Based upon the evaluations conducted pursuant to this section and other information it deems relevant, the Commission shall require licensees to update the design basis for each reactor, if necessary.

Reevaluation of the design basis with respect to other external events will be requested later as a separate action from this letter. However, licensees are encouraged to consider this when performing the Recommendation 2.3 walkdowns for flooding.

The NRC's approval of EPRI Technical Report 1025286 does not appear to satisfy the intent of NTTF Recommendation 2.3. Because of this NRC approval, the corresponding March 12, 2012 50.54(f) letter was, in part, rendered ineffective.

Based on Public Law 112-074, the NRC's approval of EPRI Technical Report 1025286 appears to be an unlawful concession.
This concession is "new and significant information." It extends beyond the Draft NUREG-1437 Revision 2 package.

Contrary to the Draft NUREG-1437 Revision 2 package, SFP accidents cannot be generically evaluated.

NEI 06-12, "B.5.b Phase 2 & 3" states: Equipment associated with these strategies is not to be treated as safety-related equipment. As such, it is not subject to any of new special treatment requirements under 10 CFR (e.g., QA, seismic, EQ, etc.).
As such, it is imprudent to assume that B.5.b equipment and strategies would successfully mitigate severe SFP accidents induced by beyond-design-basis seismic events.

SFP SSCs that are not classified as safety-related are not likely classified as Seismic Category I.

Should not NTTF Recommendation 7.1 state: . . . able to withstand beyond-design-basis natural phenomena?

Contrary to Public Law 112-074, it appears transfer gates and seals, and bellows between the SFP, transfer canal, and reactor cavity were screened out of the 50.54(f) required analyses at many, if not all, nuclear power plants.

Reference EPRI Technical Report 1025286 and see comments above.
(**33-3-19** [Magnuson, Brian])

Comment: As stated in my May 1, 2023 comments, I found the referenced studies of Draft NUREG-1437, Revision 2, Section E.3.7 do not support its assumptions and conclusions. As required by Public Law 112-074, the NRC required (2) each nuclear plant to evaluate plant components, including SFP gates, to ensure they would not fail in the event of a beyond-design-basis earthquake. However, after issuing the March 12, 2012 §50.54(f) letter, the NRC circumvented PL 1120074 by endorsing EPRI Report 1025286, which allowed nuclear power plants to simply assume that SFP gates will not fail in a beyond-design-basis seismic event.

This assumption (concession) appears unlawful and conflicts with the actual performance of SFP gates under non-seismic conditions (NUREG-1275) and direct observations from the seismic accident at Fukushima published by the National Academy of Sciences (1):

". . . the damage observed in the Unit 3 gates (Figure 2.9) demonstrates a pathway by which a severe accident could compromise spent fuel pool storage safety: drainage of water from a spent fuel pool through a damaged gate breach into an empty volume such as a dry reactor well or fuel transfer canal. A gate breach could drain a spent fuel pool to just above the level of the racks in a matter of hours, and the resulting high radiation fields on the refueling deck could hinder operator response actions."

"Assessment of spent fuel pool performance, including gate leakage, is not a new topic for the USNRC. A review of historical data in 1997 (USNRC, 1997c) documented numerous instances of significant accidental drainage of pools in pressurized water reactor and BWR plants due to various failures including gate seals. . . .the report goes on to identify the most prevalent reason for loss of pool inventory was leaking fuel pool gates. Given the potential for gate leakage under normal operations it is not surprising that it is also an issue under severe accident conditions."

Given this information, it appears the NRC is ignoring their own research and that conducted by the National Academy of Sciences.

The NRC has not taken a "hard look" and the environmental impacts of SFP accidents. (**43-1** [Magnuson, Brian])

Response: *The NRC agrees in part and disagrees in part with the comments regarding lessons learned from the Fukushima accident. The NRC established measures to respond to the Fukushima accident in orders, rulemakings, guidance documents, and other regulatory instruments apart from the LR GEIS. As a result, specific challenges to how the NRC implemented those measures are not within the scope of this LR GEIS and associated rulemaking. The NRC agrees that use of the phrase "…provide a safety benefit for all applicable events…" can be misinterpreted to be broader than intended. Section E.4 of Appendix E of the LR GEIS has been revised to refine this phrase to clarify that FLEX can provide a safety benefit or additional mitigation capability for events other than those than for which FLEX was intended. Also, the purpose of Section E.2.1 was only to provide an example of NRC actions that are taken outside of the NRC's license renewal process (safety) to mitigate the consequences of a severe accident.*

The NRC disagrees with the comment that the LR GEIS cannot take credit for post-Fukushima orders requiring improvements to safety as an example of items that have contributed to improved plant safety since publication of the 1996 LR GEIS. This is just one of several examples listed in Section E.2 of Appendix E of this revised LR GEIS of NRC activities that have contributed to improved safety since publication of the 1996 LR GEIS. Section E.2 is not a comprehensive list nor are the listed activities quantified in Appendix E in terms of their relative

significance to improved safety. The extent to which mitigation strategies that have been implemented subsequent to the post-Fukushima NRC orders and the Mitigation of Design-Basis Accidents Final Rule can be credited in plant-specific PRAs is an ongoing topic of discussion between the NRC and industry.

The NRC disagrees with the other comments. Section E.2 of Appendix E of the LR GEIS explains that NRC Orders EA-12-049 (NRC 2012a) and EA-12-051 (NRC 2012b) have been incorporated into 10 CFR 50.155 and have been rescinded. Statements made in other sections of Appendix E of the LR GEIS that plant improvements (e.g., FLEX) were implemented in response to these orders are factual. However, Appendix E of the LR GEIS was updated to clarify that these orders were incorporated into the Mitigation of Beyond-Design Basis Events rulemaking (84 FR 39684). In addition, the FLEX strategies implemented in response to the post-Fukushima NRC orders, and subsequently required under 10 CFR 50.155, provide a mitigation capability consistent with the overall NRC defense-in-depth philosophy. These strategies are focused on maintaining or restoring key plant safety functions and are not tied to any specific damage state or mechanistic assessment of external events. Hence, implementation of FLEX strategies potentially provides a safety benefit, or additional mitigation capability, for not just beyond-design-basis events but also for certain design-basis events in which the designated mitigation systems fail, such as loss of coolant accidents (LOCAs) due to a loss of offsite power.

The NRC disagrees that the Fukushima accident lessons learned (which includes seismic adequacy of spent fuel pools) have not been adequately addressed. The NRC has taken significant action to enhance the safety of nuclear power plants in the United States based on the lessons learned from the Fukushima accident. Because these lessons learned are applicable to all nuclear power plants in the United States, the NRC established a process, separate from the NRC's license renewal process, to identify and implement the lessons it has learned. The endorsement of regulatory guidance for performing the required post-Fukushima accident assessments (e.g., NEI 12-06; NEI 2016) was performed in accordance with established NRC processes and procedures. Where applicable, Section E.3 of Appendix E of the LR GEIS has accounted for these lessons learned (e.g., updated seismic risk estimates discussed in Section E.3.2). A summary of the NRC post-Fukushima lessons-learned implementation for operating power reactors is provided in Section E.2.1 of Appendix E of this LR GEIS. See the following NRC website for the plant-specific actions and safety enhancements taken in response to the lessons learned from this accident: http://www.nrc.gov/reactors/operating/ops-experience/fukushima.html.

A.2.13.4 Comments Regarding LR GEIS Appendix E.3, Accident Risk and Impact Assessment

Comment: Distorted and misleading application of CDF values
In addition to providing incomplete information in the tables of CDF values, the NRC analyzes the information in a distorted and misleading manner.

For instance, the Draft GEIS makes incorrect and unsupportable use of "mean values" for CDF. The distortions are two-fold. First, the tables incorrectly present "Mean value" and "Median value" for CDF for 44 plants as if they were representative of the entire U.S. fleet of 53 plants. This is both unnecessary and misleading. Second, the NRC mis-uses the mean values to reach unsupported conclusions about accident risk. The Draft EIS uses the mean values on a minority of the entire fleet in Tables E.3-2 and E.3-3 to assert that CDF values have declined over time. (Appendix E, Page E-15). But mean CDF values do not yield meaningful information. Averages

provide no insights on the acceptability of the individual plant CDFs. To the contrary, they can mask individual plants that have comparatively high risk values.

In addition, the Draft GEIS repeatedly makes the distorted and unsupported assertion that the 1996 LR GEIS overstates the average plant SAMA risk by an average factor of 120 or 12,000%. (Appendix E, Pages E-89, E-91). The alleged conservatism is presented as follows:

The net result when all hazards are considered is that the All Hazards CDF, on average, is comparable to that assumed for just internal events in the 1996 LR GEIS. However, the reduction in All Hazards PDR, or probability-weighted dose consequence, ranges from a factor of 3 to over 1,000 and is, on average, about a factor of 120 (or 12,000%) less than the corresponding predicted 95 percent UCB values.

(Id., p. E-89). The Draft GEIS also represents that for Diablo Canyon, the risk is overstated by a factor of 3 (Id. See also Draft GEIS Table E.3-1, p. E-9).

The Draft GEIS' assertion that risk is reduced by 12,000% begs the question: where does the value come from? The Draft GEIS does not say. It might be derived from the data in Table E.3-1 "Comparison of 1996 LR GEIS Predicted Risks to License Renewal Estimated Risks," (Draft GEIS Pages E-6 to E-9). This table compares for each currently operating plant *1996 LR GEIS Non-normalized Predicted Total Dose (person-rem/RY) (95% UCB) to the "License Renewal SAMA Total PDR (person-rem/RY)." The far right value in this table appears to supply the ratio of these two values. Using Diablo Canyon 1 & 2 as an example (Draft GEIS Table E.3-1, Page E-9):
Column 5: 1996 LR GEIS Non-normalized Predicted Total Dose (person-rem/RY) (95% UCB): 346
Column 6: License Renewal SAMA Total PDR (person-rem/RY): 101
Column 7: Ratio of GEIS 95% UCB Population Dose to License Renewal Total PDR: 3.

Dividing Column 5 by Column 6 (346 / 101) and rounding to the nearest whole number does equal 3. Checking other plants this calculation appears to yield the ratios in Column 7. For all of the previous discussed tables the Draft GEIS supplied the mean and median CDF values. Table E.3-1 does not. As the Draft GEIS appears to base a major conclusion on this ratio, the source should be supplied and a justification made for why it can and should be used made. With respect to the Draft GEIS' assertion that the Diablo Canyon risk is overstated by a factor of 3, it is possible to find the source of that number. But this estimate is not supportable, because the Draft GEIS does not give a value for internal event CDF at Diablo Canyon, other than the hypothesized value in the 1996 LR GEIS. In addition, the 1996 LR GEIS does not quantitatively consider external event risks such as fire and seismic. When the better available internal event, fire and seismic CDFs are used, that ratio of total risk to internal events risk is 6.4 (= 9.0E-5 / 1.4E-5). (See the Table 1 below and corresponding discussion below for the details on this calculation.) This factor increase is equally applicable to the SAMA PDR where the Diablo Canyon SAMA PDR is given as 101 person-rem/RY (Table E.3-1) or a value of 646 person-rem/RY (101 X 6.4) which exceeds the 1996 LR GEIS value of 346 person-rem/RY. Thus, using more complete and up-to-date information, it appears that the 1996 LR GEIS *understated* the total risk rather than overstating it for Diablo Canyon.

And setting aside the question of whether the asserted conservatism of 12,000% is a valid number, the tremendous range between the asserted average value of 120 and the Diablo Canyon-specific value of 3 demonstrates it is fallacious to generalize about conservatisms in the environmental analysis for license renewal.

Digging deeper there is an additional issue. The dose risk evaluated in the 1996 LR GEIS is based on internal event risk only, as previously discussed and documented. Thus, the values in Table E.3-1 are also derived from internal event risks only. In Table 1 below, I have presented the total at-power Diablo Canyon Unit 1 CDF as derived from a range of documents including the Draft GEIS and other sources.

[See Table 1: Diablo Canyon Total CDF Evaluation within ML23123A411]

(a) Because the Draft GEIS does not supply any value for the Diablo Canyon internal events, another source was necessary. This internal event value was obtained from "PRA of Nuclear Power Plant Spent Fuel Handling and Storage Programs: Methodology and Application to the Diablo Canyon Plant," The B. John Garrick Institute of the Risk Sciences, UCLA Engineering, GIRS-2020-3/L, February 17, 2020. (https://docslib.org/doc/2072892/probabilistic-risk-assessment-of-nuclear-power-plant-spent-fuel-handlingand-storage-programs-methodology-and-application-to-the-diablo-canyon-power-plant), Table 4-3, "Total DCPP CDF/LERF for Plant Internal Events, Seismic Events, Internal Fires, and Internal Floods for At-Power Conditions (events/year)," Page 49. Where internal events risk is 4.98E-6 and internal flooding for Unit 1 is 8.99E-6 for a total of 1.4E-5.
(b) Draft GEIS, Table E.3-10, "Fire (Full Power) Core Damage Frequency Comparison"
(c) Draft GEIS, Table E.3-11, "Seismic (Full Power) Core Damage Frequency Comparison"
(**24-3-7** [Curran, Diane])

Comment: 1., E-1, 25, Assertion that "[e]stimated impacts were based on the analysis of severe accidents at 28 nuclear power plant sites..."

While basing the methodology on a partial subset of the total number of plants might have been necessary and sufficient in 1996 when the NRC prepared the first License Renewal GEIS, it is no longer true. Today, every nuclear power plant has at a minimum an internal events PRA consistent with the ASME/ANS internal events PRA standard. Every reactor in the country has submitted at least one risk-informed license amendment application to the NRC. In addition, the NRC has Standardized Plant Analysis Risk (SPAR) PRAs for every operating reactor. Thus, NRC has substantial risk information on every reactor. There is no need to use the results from a subset of the entire industry. And as discussed below, focusing on a limited subset is not an adequate method for assessing risk because each reactor or set of reactors has distinct characteristics that affect risk. (**24-3-16** [Curran, Diane])

Comment: 16., E-5, 34-39, Assertion that "[t]he 1996 LR GEIS used information from the 28 plant-specific EISs and a metric called the exposure index (EI) to (1) scale up the radiological impact of severe accidents on the population due to demographic changes from the time each original EIS was done until the year representing the mid-license renewal period, and (2) estimate the severe accident environmental impacts for the other plants (whose EISs did not include a quantitative assessment of severe accidents)."

While in 1996 it might have been appropriate to generalize conclusions about accident risks based on the limited data available for a subset of 28 nuclear plants, that approach is not necessary today when all plants have internal event PRAs and most have external event PRAs for some combination of fire, seismic, high winds, flood, etc. This is borne out at page E-10 of the GEIS, which states that most operating plants have submitted an initial license renewal application that "includes plant-specific updated CDFs for internal and, for most plants, external event hazards, plant-specific updated analyses of containment performance under severe accident conditions, and updated consequence analyses using plant-specific information about

radionuclide source terms, radionuclide releases, projected population distribution during the license renewal period, meteorological data, and emergency response."

The NRC's should base its environmental impact analysis on the best available information -- which includes the PRA information which is now available for each individual reactors. (**24-4-12** [Curran, Diane])

Comment: 17., E-5, 39-40 Assertion that "[t]he EI method uses the projected population distribution around each nuclear power plant site at the middle of its license renewal period and ..."

It would be more reflective of actual impacts to use the project population distribution at the peak distribution rather than the middle of the license renewal period. (**24-4-13** [Curran, Diane])

Comment: 18., E-6, 10, The probability-weighted consequences or risk is the product of the probability (i.e., CDF) and the consequences (e.g., total population dose) of a severe accident. This statement is factually incorrect. Core damage frequencies (CDF) are frequencies not probabilities - there is a substantial technical difference between probabilities and frequencies. (**24-4-14** [Curran, Diane])

Response: *The NRC agrees in part and disagrees in part with the comments regarding Section E.3 of Appendix E of the LR GEIS. Essentially all plants have completed a plant-specific SAMA analysis and determined that their plant-specific probability-weighted consequences are smaller than predicted in the 1996 GEIS (see population dose risk [PDR] comparison in Table E.3-1). Also considering new information, the 2013 LR GEIS and this revised LR GEIS confirmed the generic determination that the probability-weighted consequences of a severe accident continue to be SMALL.*

Considering the limited scope of Section E.3 and the context of this section, none of the comments resulted in changes regarding the NRC determination that the 1996 LR GEIS estimates of the environmental impact of severe accidents are SMALL. As explained in Sections E.3.1 to E.3.9 of the LR GEIS, while several of the factors may result in modest increases to severe accident risk, other new information regarding these factors suggests that the probability-weighted environmental consequences of severe accidents may be, on average, substantially lower than previously estimated.

The 1996 LR GEIS supported the rulemaking regarding the generic determination that the probability-weighted consequences to the public and environment, which accounts for both the likelihood and consequences of postulated severe accidents to the public and environment, are small. The purpose of Section E.3, Accident Risk and Impact Assessment, of Appendix E of this revised LR GEIS is to determine whether new information might challenge the 1996 LR GEIS determination during an SLR period. In the 2013 LR GEIS and this update of the LR GEIS, the staff reviewed new and updated information to estimate how the consideration of new risk insights might affect the 1996 LR GEIS determination regarding the environmental impacts or probability-weighted consequences of severe accidents.

As provided in the Summary/Conclusion in Table E.5-1 of Appendix E of this LR GEIS, the NRC determined that given the new and updated information, the reduction in estimated environmental impacts from the use of new internal event and source term information

outweighs any increases from the consideration of factors that may increase reactor risk, such as low power and reactor shutdown risk, external events, power uprates, and spent fuel pool (SFP) severe accident risk.

Severe accident risk, which is the estimated probability-weighted consequences or likelihood of the accident times its estimated consequences, typically considers in the consequence assessment portion only the consequences to the public from postulated releases. This is done to compare the estimated risks to the NRC safety goals for individual latent cancer fatality risk and early fatality risk. Comments throughout Section E.3 are acknowledged that new information could potentially and conditionally make the severe accident probability-weighted consequences go higher. As explained in Sections E.3.1 to E.3.9 of Appendix E of this LR GEIS, while several of the factors may result in modest increases to severe accident risk, other new information regarding these factors suggests that the risk of severe accidents may be, on average, substantially lower than previously estimated. In this LR GEIS, probability-weighted consequences of a severe accident are equal to the PDR, which is equal to CDF times population dose (PD). The mean All Hazards PDR is reduced by a factor of 120. The left and right sides of the equation are roughly proportional to the PDR and CDF factors, respectively. Even if the mean CDF increases by a factor of 10 (which is not expected), the margin compared to the 1996 mean PDR value is still a factor of 12 [120(PDR)/10*(CDF*PD)]. This considerable margin justifies the NRC conclusion that the PDR has decreased from the values used to make the probability-weighted consequences determination of small in the 1996 LR GEIS. As a result, this LR GEIS analysis further supports the generic findings from the 1996 LR GEIS and 2013 LR GEIS and rule determination that the probability-weighted consequences of severe accidents would be SMALL. The NRC clarified these positions in this revised LR GEIS.*

The NRC disagrees with the comments that state that the NRC should base its environmental impact analysis on limited best available Level 1 PRA information, regarding plant CDF, because it does not provide probability-weighted consequences to the environment. The Level 1 PRA is used to determine the frequency of reactor core damage (or CDF) only. A plant-specific environmental consequence analysis (with a Level 2 and 3 PRA) model provides much more information than just information regarding the frequency of reactor core damage.

There were comments that were misapplying the term probability-weighted consequences and Level 1 PRA consequences and CDF. Regarding the rule, the probability-weighted consequences of atmospheric releases, fallout onto open bodies of water, releases to groundwater, and societal and economic impacts are small for all plants. These probability-weighted environmental consequences from severe accidents are determined primarily using Level 3 PRA. To determine these environmental consequences, the Level 3 PRA uses comprehensive site-specific information including release frequencies and release fractions from the Level 2 PRA and CDFs from the Level 1 PRA. Severe accidents are beyond design-basis accidents that could result in substantial damage to the reactor core (evaluated using Level 1 PRA resulting in CDFs). The release of radioactive materials is expected to be contained but may occur after a core damage event if the containment structure is breached or if there are failures in other safety systems designed to prevent the escape of radioactive substances. These considerations of containment damage are provided in the Level 2 PRA. Alternatives to mitigate severe accidents must be considered for all plants that have not considered such alternatives. For the type of nuclear plant currently operating in the United States, a PRA can estimate three levels of risk.

- *A Level 1 PRA estimates the frequency of accidents that cause damage to the nuclear reactor core. This is commonly called CDF (core damage frequency).*

- *A Level 2 PRA, which starts with the Level 1 core damage accidents, estimates the frequency of accidents that release radioactivity from the nuclear power plant.*
- *A Level 3 PRA, which starts with the Level 2 radioactivity release accidents, estimates the consequences in terms of injury to the public and damage to the environment.*

See https://www.nrc.gov/about-nrc/regulatory/risk-informed/pra.html for more information.

Although the Level 1 PRA provides important input for the Level 2 and 3 PRA, the Level 2 and 3 PRA analysis uses many more inputs to determine much more comprehensive probability-weighted consequences (PDR) outside of the containment that is the purpose of this rule.

In this Appendix E, the NRC considered updated information of many hazards with CDFs such as internal events and external events holistically for all plants (some went up and others went down) to make a generic determination. In this LR GEIS (Table E.3-1), individual plant-specific evaluation results show the probability-weighted consequences or PDR is lower than predicted in the 1996 LR GEIS in their SAMA analysis that was reviewed by the NRC. Any new and significant information will be evaluated in plant-specific reviews to determine whether the conclusions are still valid.

CDF is a term used in PRA that indicates the likelihood of an accident that would cause severe damage to nuclear fuel in a nuclear reactor core. Plant-specific CDFs used in this revised LR GEIS are from the SAMA analysis, or risk informed license amendment request, or safety evaluations from publicly available sources. There were comments indicating that risk could increase if certain events or specific conditions occurred. Core damage accidents are considered extremely serious because severe damage to the fuel in the core prevents adequate heat removal or even safe shutdown. However, conditional calculations that attempt to estimate the probability of core damage given that an event or specific condition occurred are not within the scope of this LR GEIS analysis.

The NRC agrees with the comment that CDF is a frequency, not a probability. The probability-weighted consequences or PDR may be characterized as the product of the CDF and the consequences (population dose) of a severe accident. The 1996 LR GEIS used the term "probability-weighted consequences" when referring to frequency-weighted consequences. This updated LR GEIS continues with the 1996 LR GEIS terminology to maintain consistency with that LR GEIS. A footnote was added to Appendix E of the LR GEIS to explain that these two terms are used interchangeably.

The NRC disagrees with the comment challenging the use of 28 nuclear power plants to make a generic determination in the tables describing CDF values. The point of these tables is to compare the CDF information used for the 28 plants in the 1996 LR GEIS to the most current available information. The CDFs for just these 28 plants were used in the 1996 LR GEIS to develop the probability-weighted consequences (population dose risk, latent fatality risk, and prompt fatality risk) for all operating plants at that time, which are the metrics used to make the determination that the environmental impact of severe accidents was SMALL. To provide the CDFs for other plants provides no value for the purposes of this LR GEIS, because there is no basis for comparison to the 1996 LR GEIS.

The NRC disagrees with the comment challenging the use of best available information. As indicated in the comment, the 1996 LR GEIS used the best available information to support the conclusion in the 1996 LR Final Rule (61 FR 28467) that the probability-weighted consequences

were SMALL. As provided in Section 5.3.3.2.2 of the 1996 LR GEIS, the data in Table 5.5 of the 1996 LR GEIS summarizes the information for 28 nuclear plant sites that were used to develop the relationship between Exposure Index and consequences of severe accidents analysis for both pressurized water reactors (PWRs) and boiling water reactors (BWRs). Because of fundamental design differences between PWRs and BWRs, separate regression analyses were performed for each to better account for the BWR-PWR differences in plant failure modes and source terms. The very conservative estimation of future severe accident consequences and risk was based on the existing risk and consequence analyses found in the approved Final Environmental Statement for licensed plants at that time because they included severe accident analyses and constitute a representative set of plants and sites for the United States. Updated CDFs were used in the original plant-specific SAMAs (as explained in NEI 05-01 [NEI 2005]) to confirm that the probability-weighted consequences remain SMALL (see Table E.3-1 of Appendix E of the LR GEIS). Any updated CDFs are used to determine whether there is any new and significant information to change the determination of SMALL in SLR. Also, the plant-specific LR calculated values presented in Table E.3.1 of Appendix E of the LR GEIS demonstrated the magnitude of conservatism used in the 1996 LR GEIS predicted values. Furthermore, in Section 5.3.3.2.4 of the 1996 LR GEIS, the NRC concluded that the risk of early and latent fatalities from individual nuclear power plants is small because it represents only a small fraction of the risk to which the public is exposed from other sources. This provides additional conservatism between the 1996 predicted values and the health criteria used to support the SMALL finding in the 1996 LR GEIS and rule. The staff updated Appendix E to clarify the justification for why the probability-weighted consequences are SMALL.

The staff disagrees with the comment regarding use of Standardized Plant Analysis Risk (SPAR) models for environmental consequence analysis. SPAR models are used for Level 1 PRA to typically calculate a CDF. The CDF values are only one of many inputs used in the comprehensive Level 3 analysis. To the extent the comments suggest the NRC should have undertaken a more rigorous approach to analyzing severe accidents, the NRC disagrees. Appendix E specifically addresses plant-specific SAMA analyses, which rest on a detailed computer simulation. Regarding software, as of 2022, almost all the currently operating nuclear plants have submitted license renewal applications and been approved for initial LR. Per the Commission's regulations, applicants are required to include a plant-specific SAMA analysis in the environmental report if one has not been previously considered. A SAMA analysis is "a cost-benefit analysis that addresses whether the expense of implementing a mitigation measure not mandated by the NRC is outweighed by the expected reduction in environmental cost it would provide in a core damage event" (Massachusetts v. NRC, 708 F.3d 63, 68 (1st Cir. 2013)). Similar to the 1996 LR GEIS, the consequence analysis software that was typically used for the SAMA analysis was the MELCOR Accident Consequence Code System (MACCS) code (SNL 2021). MACCS was developed at and continues to be maintained by Sandia National Laboratories for the NRC. It is used to model estimates of the health risks and economic impacts of offsite radiological releases. Thus, most operating plants have submitted an initial LR application that includes a more recent plant-specific estimate of the total PDR due to severe accidents, which is an update of the non-normalized predicted total dose (person-rem/reactor-year) (95 percent upper confidence bound [UCB]) consequences provided in the 1996 GEIS. This consequence analysis includes plant-specific best available CDFs for internal and external event hazards, plant-specific updated analyses of containment performance under severe accident conditions, and updated consequence analyses using plant-specific information about radionuclide source terms, radionuclide releases, projected population distribution during the license renewal period, meteorological data, and emergency response. The estimated PDR developed for the SAMA analyses, at a minimum, included the

contribution from severe accidents due to internally initiated events, which also generally included events initiated by internal flooding.

The NRC disagrees with the comment regarding Diablo Canyon. The conservative total PDR value of 101 for Diablo Canyon includes both internal and external events in Table E.3-1, thus an additional external events multiplier is not needed. The source of the conservative Diablo Canyon PDR was from Pacific Gas and Electric (PG&E 2015) regarding a SAMA analysis that was not approved in an EIS but was correctly referenced in Table E.3-1. Because it is the best available information at present regarding the SAMA analysis, the Diablo Canyon PDR value will be retained in Table E.3-1. If the new updated plant-specific hazard PRAs show that the 1996 LR GEIS underpredicted a site-specific value, an evaluation will be performed to determine whether the probability-weighted consequences to the public and the environment are still small for Diablo Canyon. Because of the significant margin compared to the health criteria and the conservatism in the overall values in the 1996 LR GEIS, and the relatively low PDR value provided for Diablo Canyon in the 1996 LR GEIS, the probability-weighted consequences to the public and environment are still predicted to be small. The NRC revised Appendix E to note actions that will be taken if the 1996 LR GEIS underpredicts the PDR.

The NRC agrees with the comment that each reactor or set of reactors has distinct characteristics that affect risk. As shown in Table E.3-1 in Appendix E of this LR GEIS, plant-specific evaluations have demonstrated that the plant-specific probability-weighted consequences are smaller than estimated in the 1996 LR GEIS. The NRC also agrees that a plant-specific new and significant evaluation should be performed for SLR.

The NRC agrees that the bases for the "ratios" and "factors" in the discussion in Section E.3.1.1 of Appendix E of this LR GEIS with respect to Tables E.3-2, E.3-3, E.3-4, and E.3-5 are unclear. Specifically, Section E.3.1.1 explains that the factors of 4 and 6 are the ratios of the mean of the SAMA internal events CDF to the mean of the 1996 LR GEIS CDF for PWRs and BWRs, respectively, provided in Tables E.3-2 and E.3-3. Similarly, Section E.3.1.1 explains that the mean of the SAMA PDR estimates listed in Table E.3-4 and Table E.3-5 are lower than the corresponding mean 1996 LR GEIS expected value PDR by more than a factor of 30 for PWRs and just under a factor of 30 for BWRs. Section E.3.1.1 of Appendix E of the LR GEIS was revised to specifically show the calculation of these values using the results referenced in the appendix tables.

The NRC disagrees with the comment that Appendix E does not provide sufficient information to support the NRC's conclusion that some components of plant risk may have decreased by a factor of 120. Table E.3-1 of Appendix E of this revised LR GEIS demonstrates the 1996 LR GEIS assumption that, "The use of the 95 percent upper prediction confidence bounds provides even greater assurance that the [1996] GEIS does not underestimate potential future environmental impacts." Specifically, the predicted 95 percent UCB population dose values from the 1996 LR GEIS population are higher by factors ranging from 3 to over 1,000 and are on average a factor of 120 higher than the corresponding total PDR values from the license renewal SAMA analyses. Thus, the consequences of a severe accident were demonstrated for all plants having a SAMA analysis to be lower than predicted in the 1996 LR GEIS. The license renewal SAMA analyses did not include estimates of the early fatality risk or latent fatality risk. However, the 1996 LR GEIS 95 percent UCB predicted values for early fatalities and latent fatalities are derived from the estimated radiological doses to the population. Therefore, the NRC concludes that the 1996 LR GEIS predicted 95 percent UCB results for early fatalities and latent fatalities are also very conservative based on the updated information from the license renewal SAMA analyses regarding PDR. The plant-specific LR calculated values presented in

Table E.3.1 of Appendix E of this LR GEIS demonstrate the magnitude of conservatism used in the 1996 LR GEIS predicted values, both from the standpoint of reduced consequences using more recent plant-specific information and the conservatism built into the 1996 LR GEIS methodology, and demonstrate the general conclusion that the probability-weighted consequences due to severe accidents to the public and environment are smaller than predicted in the 1996 LR GEIS. Appendix E of the LR GEIS was clarified to further support the NRC's conclusion.

A.2.13.5 Comments Regarding LR GEIS Appendix E.3.1, Impact of New Information About Accidents Initiated by Internal Events

Comment: 2. Claims of improved and improving plant safety that are undocumented or contradicted elsewhere in the License Renewal GEIS and in other NRC sources (**24-3-2** [Curran, Diane])

Comment: 6., E-3, 5, Assertion that the NRC has "observed" a "large reduction in average core damage frequency (CDF) for internal events"

The Draft GEIS provides no citation for this claim. Therefore, reviewers have no means to assess by what means the NRC "observed" CDF frequency, when the observations were made, or on what basis the NRC determined that the reduction in CDF frequency was "large." Accordingly, the claim cannot be credited. (**24-4-2** [Curran, Diane])

Response: *The NRC agrees in part and disagrees in part with the comments. The NRC agrees with the comment because the bases for the "ratios" and "factors" in the discussion in Section E.3.1.1 of Appendix E of this LR GEIS with respect to Tables E.3-2, E.3-3, E.3-4, and E.3-5 are unclear. Specifically, Section E.3.1.1 of Appendix E of this LR GEIS explains that the factors of 4 and 6 are the ratios of the mean of the SAMA internal events CDF to the mean of the 1996 LR GEIS CDF for PWRs and BWRs, respectively, provided in Tables E.3-2 and E.3-3. Similarly, Section E.3.1.1 explains that the means of the SAMA PDR estimates listed in Table E.3-4 and Table E.3-5 are lower than the corresponding mean of the 1996 LR GEIS expected value PDRs by more than a factor of 30 for PWRs and just under a factor of 30 for BWRs. Section E.3.1.1 of Appendix E of this LR GEIS was revised to specifically show the calculation of these values using the results shown in the tables.*

Regarding the comment that the NRC has "observed" a "large reduction in average CDF for internal events," the reference for this statement is "Perspective on Safety Improvements for Commercial Nuclear Power Plants" (NRC 2022j). The NRC has revised the text in Section E.2 of Appendix E of this LR GEIS to reflect this. Further, information about Internal Event trends can be found in Section E.3.1. In response to these comments, the NRC revised Appendix E of the LR GEIS to clarify the purpose and intent of each section as it relates to probability-weighted consequences.

A.2.13.6 Comments Regarding LR GEIS Appendix E.3.2, Impact of Accidents Initiated by External Events

Comment: Patchwork of incomplete and outdated information

Tables E.3-2 and E.3-3, for instance, purport to present an "Internal Event (Full Power) Core Damage Frequency Comparison" for pressurized water reactors (PWRs) and boiling water reactors (BWRs). (*Id.*, pp. E-16 - E-17). These tables supplement the 1996 information with

internal event CDFs from the IPEs and the SAMAs. But the tables present internal CDF results for only a limited set of nuclear plants --the same group of 28 nuclear plants (44 reactors) that were evaluated in the 1996 LR GEIS. The NRC did not supplement those tables with internal event CDF results for the balance of the operating fleet, *i.e.*, the additional 53 plants that are operating in the U.S. today. Without this information, it is impossible to see how CDF varies by plant.

In Tables E.3-6 and E.3-7, the Draft GEIS supplements the internal events CDFs of the original 28 PRWs and BWRs with "all hazards" CDF information from the 1996 LR GEIS and severe accident mitigation alternatives (SAMA) analyses from plant-specific license renewal applications. As with Tables E.3-2 and E.3-3, no values are presented for the balance of the operating fleet.

In Table E.3-10, the Draft GEIS supplies full power fire CDFs for a large portion of the operating fleet. This table documents full power fire CDFs for both PWR and BWRs from the SAMAs and from subsequent license amendment requests. This table is the most comprehensive comparison supplying data on 39 plants representing 68 reactors.

In Table E.3-11, the Draft GEIS supplies full-power seismic CDFs for PWRs and BWRs, comparing current full power seismic CDFs with SAMA seismic CDFs. Like Tables E.3-2, E.3-3, E.3-6, and E.3-7, however, this table provides information for only a limited subset of operating U.S. reactors --17 plants and 33 reactors.

Table E.3-12 supplies another comparison of all hazard PWR and BWR CDF in addition to Tables 3.6 and 3.7. This table contains 1996 LR GEIS as well as SAMA and LAR CDF data. But Table E.3-12 represents only 18 plants and 26 reactors, a subset of the 28 plants and 44 reactors analyzed in the 1996 LR GEIS.

In sum, not one of these 7 tables (Tables E.3-2, E.3-3, E.3-6, E.3-7, E.3-10, E.3-11, and E.3-12) supplied CDF values for the entire fleet of operating U.S. reactors. And the information cannot be found anywhere else in the Draft GEIS. (**24-3-5** [Curran, Diane])

Comment: Lack of information regarding external events

While acknowledging that "risks from severe accidents initiated by external events (such as an earthquake) could have potentially high consequences," (Appendix E, Page E-4, lines 29-30) the Draft GEIS fails to provide readily-available up-to-date information on external events. Instead, it repeats the conclusion of the 1996 LR GEIS that "external events are adequately addressed through a consideration of a severe accident initiated by an internal event (such as a loss of cooling water)." (Appendix E, Page E4, lines 28-34). There is no justification for continuing to follow this outdated approach of hypothesizing external event CDFs by applying a multiplier to internal event CDFs. The NRC should have updated its methods for the first GEIS revision in 2013. It is now long past time to do so. The Draft GEIS provides no justification for failing to use up-to-date information on external events, and indeed none exists.

Table E.3-1 of the Draft GEIS demonstrates that the NRC is aware of and has access to much more comprehensive data than is provided for public review in the Draft GEIS. As shown by this table, the NRC has gathered fatality data for the entire fleet from a combination of the 1996 LR GEIS and the subsequent SAMA submittals, all of which is based on CDF values for internal events. The Draft GEIS also discusses the availability of licensee external events models

including fire (Page E-26) and seismic (Page E-29). This is all the more reason that the NRC lacks any excuse for failing to provide the information clearly and comprehensively in the Draft GEIS. (**24-3-6** [Curran, Diane])

Comment: 19., E-10, 13-19, Assertion that "[m]ost SAMA analyses, however, accounted for externally initiated events by developing an external events multiplier in accordance with the methodology in NEI 05-01 (NEI 2005), which has been endorsed by the NRC (2013d). The external events multiplier is the ratio of the total plant CDF (both internally initiated and externally initiated) to the CDF for internally initiated events. This multiplier is multiplied by the estimated population dose risk (PDR) for internally initiated events to develop the estimate of the total plant PDR that is included in Table E.3-1."

While crude estimates of external events impacts based on internal events impacts may have been appropriate in 2005 it is unnecessary today with the modern risk tools available. The NRC in its efforts to be a modern risk-informed regulator should use currently available methods not this archaic one. (**24-4-15** [Curran, Diane])

Comment: 21., E-21, 6-9, Assertion that "[t]ypically, the external events that contribute the most to plant risk are seismic and fire events. In some cases, **high winds, floods, tornadoes, and other external hazards may also contribute to plant risk;** however, **these contributions are generally, but not always, much lower** than those from seismic and fire events. (emphasis added)"

If high winds, floods, tornadoes and other external events are "not always" much lower, then the NRC should not assume as a general matter that they are lower. This is a strong indicator that the significance of external events as contributors to accident risks are site-specific and not subject to generalization. (**24-4-17** [Curran, Diane])

Comment: 40., E-34, 5-7, Assertion that "it is reasonable to conclude that the impact of accidents caused by external events on surface water and groundwater contamination would also be much less than the impacts contained in the 1996 LR GEIS."

This is an extraordinarily inaccurate and unsupported statement, given the significant contamination of groundwater and seawater caused by the Fukushima Daichii accidents. These new insights should be taken into consideration. (**24-5-17** [Curran, Diane])

Response: *The NRC agrees in part and disagrees in part with the comments. Several comments misapplied probability- or frequency-weighted consequences to the core (CDF) with probability-weighted consequences to the environment (PDR). Regarding the rule, the probability-weighted consequences of atmospheric releases, fallout onto open bodies of water, releases to groundwater, and societal and economic impacts are small for all plants. These probability-weighted environmental consequences from severe accidents are determined primarily using Level 3 PRA. To determine these environmental consequences, the Level 3 PRA uses comprehensive site-specific information including release frequencies and release fractions from the Level 2 PRA and CDFs from the Level 1 PRA. Severe accidents are beyond design-basis accidents that could result in substantial damage to the reactor core (evaluated using Level 1 PRA resulting in CDFs). The release of radioactive materials is expected to be contained but may occur after a core damage event if the containment structure is breached or if there are failures in other safety systems designed to prevent the escape of radioactive substances. These considerations of containment damage are provided in the Level 2 PRA. However, alternatives to mitigating severe accidents must be considered for all plants that have*

not considered such alternatives. For the type of nuclear plant currently operating in the United States, a PRA can estimate three levels of risk.

- *A Level 1 PRA (https://www.nrc.gov/about-nrc/regulatory/risk-informed/pra.html#Level1) estimates the frequency of accidents that cause damage to the nuclear reactor core. This is commonly called CDF.*
- *A Level 2 PRA (https://www.nrc.gov/about-nrc/regulatory/risk-informed/pra.html#Level2), which starts with the Level 1 core damage accidents, estimates the frequency of accidents that release radioactivity from the nuclear power plant.*
- *A Level 3 PRA (https://www.nrc.gov/about-nrc/regulatory/risk-informed/pra.html#Level3), which starts with the Level 2 radioactivity release accidents, estimates the consequences in terms of injury to the public and damage to the environment.*

See https://www.nrc.gov/about-nrc/regulatory/risk-informed/pra.html for more information.

Although the Level 1 PRA provides important input for the Level 2 and 3 PRA, the Level 2 and 3 PRA analysis uses many more inputs to determine more comprehensive probability-weighted consequences (PDR) outside of the containment. In this Appendix E, the NRC considered updated information about many hazards with CDFs, such as internal events and external events, holistically for all plants (some went up and others went down) to make a generic determination regarding the rule. In this LR GEIS (Table E.3-1), individual plant-specific evaluation results show the probability-weighed consequences or PDR is lower than predicted in the 1996 LR GEIS in their SAMA analysis that was reviewed by the NRC. Any new and significant information will be evaluated in plant-specific reviews to determine whether the conclusions are still valid for license renewal.

The CDF is a term used in PRA that indicates the likelihood of an accident that would cause severe damage to nuclear fuel in a nuclear reactor core. Plant-specific CDFs used in the revised LR GEIS are from the SAMA analysis, risk-informed license amendment requests, or safety evaluations from publicly available sources. There were comments indicating that risk could increase if certain events or specific conditions occurred. Core damage accidents are considered extremely serious because severe damage to the fuel in the core prevents adequate heat removal or even safe shutdown. However, conditional calculations that attempt to estimate the probability of core damage given that an event or specific condition occurred are not within the scope of this analysis. In response to these comments, the NRC made changes in Appendix E of this LR GEIS to clarify the purpose and intent of each section as it relates to probability-weighted consequences.

The NRC staff disagrees that the external event multiplier is used in Table E.3-1 to develop a crude estimate of external event impacts. Table E.3-1 reflects plant-specific SAMA analyses, in which the external events multiplier is multiplied by the estimated PDR for internally initiated events to develop the license renewal SAMA total plant PDR. As provided in footnote b to Table E.3-1, data were obtained from the applicable plant-specific supplement to NUREG-1437, unless otherwise noted. Where applicable, the SAMA PDR was adjusted using the external events multiplier. The external events multiplier was developed on a plant-specific basis using the best available information and guidance at the time of the plant-specific SAMA analysis. Nonetheless, the NRC considered newer information from plant-specific reviews that included updated estimates of external risk in Section E.3.2 of Appendix E. The NRC concluded that none of the updated information about external events would have a sufficiently large impact to change the overall conclusion that the probability-weighted consequences of severe accidents are SMALL for all plants.

The NRC agrees that generalities are made in this revised LR GEIS to make a determination for all plants. The NRC also agrees that the risk contribution of hazards are site-specific. The analysis in Appendix E accounts for site-specific variations in data and, where appropriate, uses conservative assumptions to demonstrate that the conclusion in the 1996 LR GEIS that the probability-weighted consequences of severe accidents are SMALL remains valid and if anything may significantly overstate the impacts of severe accidents. The NRC has revised Section E.3 to provide additional detail and further clarify that the approach taken supports the generic conclusion that the probability-weighted consequences remain SMALL for all reactors listed in Table E.3-1.

The NRC agrees that there was contamination of groundwater and seawater caused by the Fukushima Dai-ichi accidents. Section E.3.1.2 of this LR GEIS provides multiple references and the relative conservative value used for the groundwater impact in the 1996 LR GEIS. See 1996 LR GEIS Section 5.2.1.3, Exposure Pathways, for discussion regarding the groundwater pathway. Moreover, the analysis in Appendix E is focused on the probability-weighted consequences of the impacts of severe accidents rather than the consequences alone. The NRC staff notes that surface water and groundwater releases estimated from the Fukushima Dai-ichi accidents are significantly smaller than many of the atmospheric releases considered in Appendix E. For example, the SOARCA uncertainty analyses discussed in Appendix E considered a wide range of potential atmospheric releases, some quite large. The NRC has revised Section E.3 to provide additional detail and further clarify that the approach taken supports the generic conclusion that the probability-weighted consequences remain SMALL for all reactors.

The NRC disagrees with the specific comment regarding a patchwork of incomplete and outdated information in the tables. The point of these tables is to compare the CDF information used for the 28 plants in the 1996 LR GEIS to the most current available information. The CDFs for just these 28 plants were used in the 1996 LR GEIS to develop the probability-weighted consequences (population dose risk, latent fatality risk, and prompt fatality risk) for all operating plants at that time, which are the metrics used to make the determination that the environmental impact of severe accidents was small. To provide the CDFs for other plants provides no value for the purposes of this LR GEIS, because there is no basis for comparison to the 1996 LR GEIS. No changes were made in the LR GEIS, final rule, or guidance as a result of this comment.

A.2.13.7 Comments Regarding LR GEIS Appendix E.3.2, Impact of Accidents Initiated by External Events - Fire Events

Comment: 29., E-26, 20, Assertion that "[e]ach of the FPRAs [fire probabilistic risk assessments] reported in this table has been independently peer reviewed in accordance with NRC guidance (see, for example, NRC 2020a)."

NRC Regulatory Guide 1.200, Rev. 3 (Reference NRC 2020a) does not supply guidance on how to perform peer reviews. (**24-5-6** [Curran, Diane])

Comment: 30., E-26, 29-33, Assertion that "given the significant margin between the cumulative PDR results from the license renewal SAMA analyses and the cumulative 95th percentile UCB PDR results from the 1996 LR GEIS, the updated FCDFs [fire core damage frequencies] do not challenge the 95th percentile estimates used in the 1996 LR GEIS (even if a factor of 2.5 increase in FCDF were uniformly applied to all of the nuclear power units)."

This assertion is based on a comparison between Table E.3-8 (which compares the 1996 LR GEIS estimated PDR (non-normalized 95% UCB) to the SAMA All Hazards PDR) with Table E.3-10 (which compares FCDFs from the 1996 LR GEIS to FPRA FCDFs, which are derived from LARs. But comparison of averages (found at the end of Table E.310) distorts the details. A cursory review of the Table E.3-10 Fire CDF Comparison SAMA to LAR results reveals multiple examples where the SAMA fire CDF calculates the LAR CDF significantly:

-Beaver Valley 1 & 2 (PWRs) by ~12X
-Catawba 1 & 2 (PWRs) by ~20X
-Monticello (BWR) by ~7X
-Nine Mile Point 2 (BWR) by ~8X
-Oconee 3 (PWR) by ~14X
-Palo Verde 1, 2 & 3 (PWRs) by ~18x
-Susquehanna 1 & 2 (BWRs) by ~25X

These large multipliers challenge the NRC's previous conclusions on Page E-24 that: "The data in these tables [Tables E.3-8 and E.3-9 PWR and BWR PDR comparisons] show that the estimated PDR in the SAMA analyses, accounting for the risk from all hazards, is significantly less than the 95 percent UCB estimates in the 1996 LR GEIS. Specifically, as shown in Table E.3-8 and Table E.3-9, the SAMA analyses are more than a factor of **10 less** than the corresponding 95 percent UCB estimates for all but one PWR plant ... For BWRs, ... the All Hazards PDR from the SAMA analyses is more than a factor of **20 less** than the corresponding 95 percent UCB estimates ..."

Beaver Valley, Catawba, Oconee and Palo Verde all exceed the asserted factor of 10 conservatism in PWRs. While the Susquehanna units exceed the asserted factor of 20 conservatism in BWRs. With the fire risk underestimated on these individual plants by such large factors it is not clear that the PDR estimates in the 1996 LR GEIS PDR are conservative. (**24-5-7** [Curran, Diane])

Comment: 31., E-28 and E-29, 36-38 and 1-2, Assertion that "because of the plant modifications that have been made to reduce fire risk and to cope with the loss of large areas of the plant due to large fires and explosions, the NRC staff concludes that the new information from the FPRAs is not significant for the purposes of the LR GEIS."

As stated in the preceding text, the post September 11, 2001 modifications and the NFPA 805 modifications were all incorporated into the FPRA LAR results, given that the LARs were probably almost exclusively submitted via the NFPA 805 process. By implying that the actual fire risks may be lower than the LAR reported values, the Draft GEIS appears to be double-crediting the qualitative conclusions. (**24-5-8** [Curran, Diane])

Comment: 32., E-30, 8-9, Assertion that "[e]ach of the SPRAs [seismic] reported in this table have been independently **peer reviewed in accordance with NRC guidance** (see, for example, NRC 2020a)." (emphasis added)

NRC 2020a RG 1.200 Rev. 3 does not supply peer review guidance. (**24-5-9** [Curran, Diane])

Response: *The NRC acknowledges the comment regarding increases in fire CDF values. As noted in the comment, Section E.3.2 of Appendix E of this LR GEIS acknowledges that there has been, on average, a significant increase in CDFs for fire events since completion of the SAMA analyses. The comment also notes that, for some nuclear power plants, the increase has*

been substantial. However, the 1996 LR GEIS based the determination that the impact of severe accidents is SMALL on estimates for probability-weighted consequences (PDR, latent fatality risk, and prompt fatality risk), not CDFs. The point of the tables providing estimates of fire CDF is to show the extent to which fire CDF information used in the SAMA analyses has changed relative to the most current available information, which provides insight into how probability-weighted consequences to the core may have changed since the SAMA analyses were conducted. This updated fire CDF information is then used in Table E.3-12 to show the change in the license amendment request (LAR) All Hazards CDF, which, on average, is unchanged from the 1996 LR GEIS Estimated CDF and about 35 percent higher than the SAMA All Hazards CDFs for the plants used in the 1996 LR GEIS for which updated CDF information is available. This difference is not significant because the environmental impacts (i.e., PDR) from events initiated by all hazards based on the results of SAMA analyses, as shown in Table E.3-1 of Appendix E of this LR GEIS, are on average more than two orders of magnitude less than those estimated in the 1996 LR GEIS.

The NRC agrees with the comment questioning the conclusion that the new information from the fire PRAs (FPRAs) is not significant for the purposes of the LR GEIS. The NRC modified the conclusion in Section E.3.2.1 of Appendix E of this LR GEIS to read as follows:

> *When considered in isolation, based on the large margin between the PDR estimates from the SAMA analyses compared to the estimates in the 1996 LR GEIS reported in Table E.3-1, the updated FCDFs [fire CDFs] reported in Table E.3-10 do not challenge the 95th percentile UCB for population dose estimates used in the 1996 LR GEIS. For this reason, and because of the fire mitigation and plant modifications that have been made to reduce fire risk and to cope with the loss of large areas of the plant due to large fires and explosions that may not be modeled in PRAs, the NRC staff concludes that the new information from the FPRAs is not significant for the purposes of the LR GEIS.*

The plant-specific LR calculated values presented in Table E.3.1 of Appendix E of this LR GEIS demonstrated the magnitude of conservatism used in the 1996 LR GEIS predicted values. Furthermore, in Section 5.3.3.2.4 of the 1996 LR GEIS, the NRC concluded that the risk of early and latent fatalities from individual nuclear power plants is small because it represents only a small fraction of the risk to which the public is exposed from other sources. This provides additional conservatism between the 1996 predicted values and the health criteria used to support the finding of small in the 1996 LR GEIS. The staff updated Appendix E to clarify the justification for why the probability-weighted consequences of severe accidents are SMALL.

The NRC agrees with the comment that the statement "[e]ach of the FPRAs [fire probabilistic risk assessments] reported in this table has been independently peer reviewed in accordance with NRC guidance" needs to be corrected. The NRC modified this statement in Section E.3.2.1 of Appendix E of this LR GEIS to say: "Each of the FPRAs for which FCDFs are reported in this table were determined to be technically acceptable by the NRC for specific risk-informed LARs in accordance with Regulatory Guide 1.200, Rev. 3 (NRC 2020a)" [NRC 2020d in this appendix].

The NRC disagrees with the comment specific to peer reviews. RG 1.200, Rev. 3 (NRC 2020d), states: "One acceptable approach for performing a peer review of a PRA is to perform an established, NRC-endorsed peer review process by qualified personnel that documents the results and identifies both strengths and weaknesses of the base PRA." RG 1.200, Rev. 3 (NRC 2020d), further identifies the NRC-endorsed national consensus PRA standards and

industry guidance for how to perform a PRA peer review process. No changes were made in the LR GEIS, final rule, or guidance as a result of this comment.

A.2.13.8 Comments Regarding LR GEIS Appendix E.3.2, Impact of Accidents Initiated by External Events - Level 1 Comparison (CDF)

Comment: 20., E-15, 12-15 Assertion that the data in Table E.3-2 and Table E.3-3 of the Draft GEIS "show that CDFs have been **steadily declining** since the original estimates in the EISs. Specifically, as can be seen in Table E.3-2 and Table E.3-3, for many plants, the IPE CDFs are smaller than those from the original EISs..." (emphasis added)

This assertion is false. Tables E.3-2 and E.3-3 do not show that values are steadily declining from the 1996 LR GEIS to the IPE. In fact, ten reactors (Beaver Valley 2, Callaway 1, Catawba 1 & 2, Harris, Palo Verde 1, 2 & 3, Seabrook and Clinton) all show increases. In addition, the Susquehanna 1 & 2 IPE CDF values are reported as 5.6E-7 per year. These values are known to be gross under-estimates of the actual risk by the NRC and the industry. They should not be sited without this recognition. Thus, the CDFs are not steadily declining, but rather some CDFs are up and others are down. (**24-4-16** [Curran, Diane])

Comment: 22., E-21, 38-39, Assertion that the data in Tables E.3-6 and E.3-7 (which compare CDF data from the 1996 License Renewal GEIS and SAMA All Hazards CDF data from individual SAMA analyses submitted with license renewal applications) "show that after accounting for the CDF contribution from all hazards, the **total plant CDFs are generally lower than the original estimates in the EISs...**" (emphasis added)

The data in Tables E.3-6 and E.3-7 do not support the assertion that total plant CDFs are "generally lower than the original estimates in the EISs" in two respects. First, the tables represent only a subset of operating nuclear plants. See comment above. The NRC should provide complete data for all reactors. Second, the data do not show a downward trend. Fully 30% of the PWRs (7 of 20 plants) and 10% of the BWRs (1 of 10 plants) have higher CDF values in the SAMA analysis than the GEIS. This clearly indicates that EIS methodology underestimated CDFs in some cases.

The conclusion that the CDFs from all hazards is lower than the original EIS estimates is also directly contradicted by the statement on Page E-34 at 15:

"[I]t is concluded that the **CDFs from severe accidents initiated by all hazards** (i.e., internal and external events), as quantified in **recent risk-informed LARs** and the other sources cited above, are, in some cases, **higher** than the internal events CDFs that formed the basis for the 1996 LR GEIS and, on average, are about **35 percent higher** than the All Hazards CDFs used in the license renewal SAMA analyses (emphasis added)."

The GEIS is deficient because it does not present a consistent analysis of the contribution of CDF to accident risk. (**24-4-18** [Curran, Diane])

Comment: 23., E-22, 8-12, Assertion that "[a]ccordingly, the likelihood of an accident that leads to core damage, including accounting for the contribution from external events, is generally less for both PWRs and BWRs than the likelihood used as the basis for the 1996 LR GEIS, and **all are appreciably less than the highest estimated CDF from the 1996 LR GEIS**." (emphasis added)

This is a tortured look at the data. The NRC is implying that the EIS analysis is always conservative, i.e., overestimating the actual values, when in fact the results increased in 8 of plants when better analysis was used (results from Table E.3-12, where 8 plants LAR All Hazards CDFs are higher than the SAMA All Hazards CDFs). (**24-4-19** [Curran, Diane])

Comment: 25., E-22, 14-24, Table E.3-6, PWR **All Hazards** (Full Power) CDF Comparison (emphasis added)

There is an error in Table E.3-6. The Estimated CDF values presented in Table E.3-6 for the 1996 LR GEIS are identical to the corresponding values in Table E.3-2, which represents only PWR internal event CDF (see page E-16). Given that Table E.3-6 is entitled "All Hazards," it presumably presents CDF values for both internal and external events. But the All Hazards values in Table E.3-6 cannot be identical to the values in Table E.3-2 unless the external event values are all zero. Clearly, this is not the case. The table must be corrected.
(**24-5-2** [Curran, Diane])

Comment: 26., E-23, 1-11, Table E.3-7, BWR **All Hazards** (Full Power) CDF Comparison (emphasis added)

Similar to the immediately preceding comment, the calculated CDF values presented in Table E.3-7 for the 1996 LR GEIS are identical to the corresponding values in Table E.3-3, which represents only PWR internal event CDF (see page E17). Given that Table E.3-7 is entitled "All Hazards," it presumably presents CDF values for both internal and external events. But the All Hazards values in Table E.3-7 cannot be identical to the values in Table E.3-3 unless the external event values are all zero. Clearly, this is not the case. The table must be corrected.
(**24-5-3** [Curran, Diane])

Comment: 37., E-32, 30-31, Assertion that "the mean of the LAR All Hazards CDFs is essentially the same as the mean of the EIS CDFs."

This assertion distorts the information supplied in the corresponding table (E.312). While the calculations of the CDF statistical mean for both the 1996 LR GEIS and the LAR All Hazard are the same, the individual plant CDF results are not the same. A full 50% (13 of the 25) of the plants' LARs exceed their corresponding 1996 LR GEIS CDF estimates. The most extreme difference is for the Susquehanna 2 unit where the LAR CDF (6.6E-5 per year) is a full 2.8 times higher than the LR GEIS CDF (2.4E-5). The difference in CDF values for the Columbia plant is nearly as great, with a LAR of 6.0E-5 vs. 1996 LR GEIS CDF of 2.4E-5 --an increase of 2.5 times. The NRC distorts these significant increases in the estimates by hiding behind the statistical means. The NRC also fails to account for the fact that the 1996 LR GEIS CDF values are based on UCB. The UCB captures a very conservative, i.e., high, estimate of CDF. It is therefore significant that 15 out of the 26 reactors in Table E.3-12 exceed this very conservative estimate of CDF from the 1996 LR GEIS. The NRC may not wish to take this factor into account, because it also demonstrates that the 1996 LR GEIS was insufficiently conservative to bound the actual plant risks. But in order to provide a reasonable and thorough impact analysis, this significant new information about CDF must be addressed. (**24-5-14** [Curran, Diane])

Comment: 38., E-32, 31-34, Assertion that "the mean of the LAR All Hazards CDFs is about 35 percent greater than the mean of the SAMA All Hazards CDFs. These are relatively small differences that do not affect the conclusions of the 1996 LR GEIS."

According to Table E.3-12, the mean value for CDF in the 1996 LR GEIS is 6.1E-5, the mean value for SAMA All Hazards CDF is 4.4E-5, and the mean value for LAR All Hazards CDF is 6.1E-5. An increase of 35% from the SAMA All Hazards CDF cannot reasonably be considered small, given that this presumably will lead to a comparable increase in fatalities and land contamination. (**24-5-15** [Curran, Diane])

Response: *The NRC staff agrees that internal event CDFs in some cases have increased since the IPE (NRC 1997a). However, to clarify, the internal event-initiated CDFs from the original (plant-specific) EISs are compared to the CDFs reported in the plant-specific IPEs and in the license renewal SAMA analyses for the PWRs and BWRs considered by the 1996 LR GEIS. Before making this comparison, it is notable that the CDFs from the original EISs are for severe accidents initiated by internal events, while the CDFs from the IPEs and SAMA analyses, in many cases, also include severe accidents initiated by internal flooding events. Table E.3-2 and Table E.3-3 in Appendix E of this LR GEIS show these comparisons. The data in these tables show that CDFs have been steadily declining since the original estimates in the EISs. Specifically, as can be seen in Table E.3-2 and Table E.3-3, for many plants, the IPE CDFs are smaller than those from the original EISs, particularly for BWRs.*

The mean value of the IPE CDFs listed in Table E.3-2 and Table E.3-3 are lower than the corresponding mean of the 1996 LR GEIS CDFs by 30 percent for PWRs and by about a factor of 3.5 for BWRs. Furthermore, the SAMA internal event CDFs are smaller than those from the original EISs for all plants except one and smaller than those from the IPE for most of the plants. Specifically, the mean value of the SAMA CDFs listed in Table E.3-2 and Table E.3-3 are a factor of almost 4 lower than the corresponding mean of the 1996 LR GEIS CDFs for PWRs (i.e., from Table E.3-2, 8.4×10^{-5}/yr for the 1996 LR GEIS mean CDF divided by 2.2×10^{-5}/yr for the SAMA mean CDF) and more than a factor of 6 lower for BWRs (i.e., from Table E.3-3, 5.4×10^{-5}/yr for the 1996 LR GEIS mean CDF divided by 8.7×10^{-6}/yr for the SAMA mean CDF). Information from recent risk-informed LARs submitted to the NRC show that these CDFs are, on average, further reduced from what were reported in the license renewal SAMA analyses. Accordingly, the likelihood of an accident that leads to core damage, based on just internally initiated events, is significantly less for both PWRs and BWRs than those used as the basis for the 1996 LR GEIS. The NRC has revised Section E.3 to provide additional detail and further clarify that the approach taken supports the generic conclusion that the probability-weighted consequences remain SMALL for all reactors listed in Table E.3-1.

The NRC disagrees with the comment that the estimated CDF values presented in Table E.3-6 for the 1996 LR GEIS are identical to the corresponding values in Table E.3-2, which represents only PWR internal event CDF values. There is no contradiction in the LR GEIS. As explained in Appendix E of this LR GEIS, the 1996 LR GEIS developed an estimate of the internal events CDFs and assumed that the contribution from external events was within the uncertainty of these estimates. Hence, the CDF values for the 1996 LR GEIS provided in Tables E.3-6 and E.3-2 of this revised LR GEIS for PWRs, and in Tables E.3-6 and E.3-2 of this LR GEIS for BWRs, are the same because it is not possible to separate the contribution from internal events and external events.

The NRC disagrees with the comment regarding percentage differences in the CDF. For the purposes of this LR GEIS, a 35 percent difference between the average SAMA All Hazards CDF and the average 1996 LR GEIS CDFs is immaterial to the conclusions especially considering the orders of magnitude reduction in PDR provided in Table E.3-1.

The NRC disagrees with the statement that the revised LR GEIS is deficient because it does not present a consistent analysis of the contribution of CDF to accident risk. The comparison of CDFs in Tables E.3-6 and E.3-7 shows that, on average, the SAMA All Hazards CDFs are lower than the 1996 LR GEIS CDFs and, for all of the plants, the SAMA All Hazards CDFs are less than the highest 1996 LR GEIS CDF of 3.5×10^{-4}/yr for Indian Point 2. The comparison of CDFs in Table E.3-12 shows that, on average, the LAR All Hazards CDFs are higher than the SAMA All Hazards CDFs and are essentially the same as the 1996 LR GEIS CDFs, and, for all of the plants, the SAMA All Hazards CDFs and the LAR All Hazards CDFs are less than the highest LR GEIS CDF of 3.5×10^{-4}/yr for Indian Point 2. Furthermore, the point of these tables is to compare the CDF information used for the 28 plants in the 1996 LR GEIS to the most current available information. The CDFs for just these 28 plants were used in the 1996 LR GEIS to develop the probability-weighted consequences (PDR, latent fatality risk, and prompt fatality risk) for all operating plants at that time, which are the metrics used to make the determination that the environmental impact of severe accidents was SMALL. To provide the CDFs for other plants provides limited value since the intent was for direct comparison to the 1996 LR GEIS and there was so much margin compared to the health objectives used to make the small impact determination.

The NRC disagrees with the comment that the staff determination was based on CDF. The 1996 LR GEIS based the determination that the impact of severe accidents is SMALL on estimates for probability-weighted consequences to the environment, not CDFs. Furthermore, the LR GEIS is not a plant-specific assessment but rather draws its conclusions based on available plant-specific information and other relevant information. Specifically, the probability-weighted consequences estimated in the 1996 LR GEIS remain bounding after consideration of new and applicable plant-specific information and other relevant information. Table E.3-1 of Appendix E of this LR GEIS shows that the SAMA Total PDR is smaller than the LR GEIS 95 percent UCB population dose for all nuclear power plants evaluated and, in most cases, is substantially less than the LR GEIS 95 percent UCB population dose. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.

A.2.13.9 Comments Regarding LR GEIS Appendix E.3.2, Impact of Accidents Initiated by External Events - Level 1 Comparison (PDR)

Comment: 24., E-23, 18-25, Assertion that "[f]or most of the SAMA analyses . . . the PDR estimates reported in the plant-specific SEISs to the LR GEIS were estimated based on the contribution from internal events and internal flooding events only. In these cases, the impact of external events was addressed in the license renewal SAMA analyses by multiplying the plant-specific environmental impacts, which include the estimated PDR in addition to other impacts, by an external events multiplier. The external events multiplier is the ratio of the All Hazards CDF to the internal events CDF, including flooding CDF."

Using the external events multiplier appears non-conservative. With internal events (with the exception of weather and grid related losses of off-site power) there will be limited damage to the surrounding infrastructure, e.g., roads, bridges, power lines, etc. With external events, as illustrated by the Fukushima Daichii accident, damage to the infrastructure can inhibit evacuations. This difference could increase the population dose. (**24-5-1** [Curran, Diane])

Comment: 27., E-24, 2-4, Assertion that the data in Tables E.3-8 and E.3-9 "show that the estimated PDR in the SAMA analyses, accounting for the risk from all hazards, is significantly less than the 95 percent UCB [upper confidence bound] estimates in the 1996 LR GEIS."

It is not surprising that comparing the UCB (presumably the 95th percentile) in one data distribution to presumably the mean values in another distribution are significantly less. This type of difference is what is expected as 95th are higher than means in any given distribution by definition. (**24-5-4** [Curran, Diane])

Comment: 28., E-24, 2, Assertion that the data in Tables E.3-8 and E.3-9 "show that the estimated PDR in the SAMA analyses, accounting for the risk from all hazards, is **significantly less** than the 95 percent UCB estimates in the 1996 LR GEIS (emphasis added)."

The PDR in the 1996 LR GEIS from external events is not calculated directly, instead it is crudely accounted for by using the UCB. The PDR in the SAMA from external events is not calculated directly, instead it is crudely accounted for by using an "external events multiplier" based on the ratio of the external event to internal event CDFs. It is presumptuous to argue that comparing one crude estimate to another crude estimate by two completely different methods shows that PDR "is significantly less." This observation is presumably a major analysis conclusion because if the SAMA PDR where higher than the 1996 LR GEIS PDR, the PDRs today would have to be reevaluated by some other method. A better basis for showing the public health, safety and environmental impacts are acceptable than comparing two crude estimates is needed. Especially, in light that the reevaluated CDFs for many plants from various events continue to increase. (**24-5-5** [Curran, Diane])

Comment: 39., E-32, 34-36, Assertion that "on average, the SAMA All Hazards PDR is over a factor of 20 less than the mean of the 95th percentile UCB for population dose estimates reported in the 1996 LR GEIS."

Again, the Draft GEIS masks individual plant risks by using average values. In addition, as discussed in the previous comment, it is clear SAMA CDFs are underestimating accident risk as shown by the increase in the mean LAR CDF compared to the SAMA CDFs. And as also previously discussed, Table E.3-12 shows that for at least five reactors (Clinton, Columbia, Susquehanna 2 and Vogtle 1 & 2) the LAR CDF values are double the values of the supposedly very conservative UCB CDF values in the 1996 LR GEIS. The Draft GEIS' discussion of PDR unreasonably ignores all of these risk increase insights are ignored. (**24-5-16** [Curran, Diane])

Response: *The NRC acknowledges the comments regarding external event multipliers. The comment that the external event multiplier is a source of non-conservatism was acknowledged in footnote 13 in Appendix E of the draft LR GEIS (now, footnote 15 in Appendix E of this final LR GEIS) with specific regard to seismic events; however, footnote 15 explains why this non-conservatism is unlikely to affect the overall conclusions in Appendix E.*

The NRC disagrees with comments that the LR GEIS approach is not a conservative estimate. The conservative 95 percent UCB values were used in the 1996 LR GEIS and are estimates that are not expected to be exceeded. As provided on page 5-33 of the 1996 LR GEIS, if the future risks for all plants are then estimated using the appropriate (BWR or PWR) regression and the middle year of relicense exposure index (EI), the resulting UCB values are estimated future risks that are not expected to be exceeded. Table E.3-1 in Appendix E of this LR GEIS confirmed this expectation for the PDR or probability-weighted consequences for the plants listed. The 1996 LR GEIS intentionally developed a "conservative" estimate of the environmental impact of severe accidents, specifically probability-weighted consequences, based on available plant-specific information. Based on this "conservative" assessment, the 1996 LR GEIS concluded the environmental impact of severe accidents is SMALL due to the large margin compared to the cancer and fatality criteria. Mean values were used in this generic

analysis for direct comparison to the 1996 LR GEIS. This revised LR GEIS (see Table E.3-1 in Appendix E) shows that, based on plant-specific information from completed SAMA analyses and other studies, the conclusion is that the environmental impact of severe accidents continues to be SMALL because the 1996 LR GEIS non-normalized predicted total dose is significantly higher than the license renewal SAMA total population dose risk. Therefore, Appendix E relies on a comparison of similar values obtained from previously completed NEPA analyses to support its conclusions. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.

A.2.13.10 Comments Regarding LR GEIS Appendix E.3.2, Impact of Accidents Initiated by External Events – Diablo Canyon Seismic

Comment: In addition, SLOMFP proffers additional evidence demonstrating that generic treatment is unjustified for any conclusions regarding accident risks at the Diablo Canyon nuclear plant. As demonstrated in Dr. Bird's attached declaration, the Draft GEIS fails to satisfy NEPA because its conclusion that the environmental impacts of externally initiated accidents are small is unsupported. In particular, the NRC fails to support the assertion that "new information" from external event probabilistic risk assessments (PRAs) is "not significant" for purposes of revising an earlier conclusion that the environmental impacts of reactor accidents initiated by external events are small. The NRC relies on PG&E models of seismic sources, ground motion equations, and site amplification that are not "up-to-date" as claimed by NRC, but outdated and inadequate.

PG&E's failure to utilize these modern methods has led to incomplete and biased results, both in terms of underestimated tectonic strain rates and overestimated minimum distances of active faults from DCPP. As a result, PG&E underestimates the seismicity of the region surrounding DCPP by a factor of approximately two. And it also fails to recognize the significant potential for thrust faults dipping under the reactors. These factors could significantly increase both earthquake rates and strength of shaking above the NRC's estimates.

As Dr. Bird concludes, the Draft EIS is inadequate to evaluate seismic risks at Diablo because its conclusions perpetuate rather than correct the significant errors and gaps in PG&E's analysis. Therefore, the relatively low accident rates assumed in the Draft GEIS do not provide an adequate basis for evaluating the significance of earthquake-related environmental impacts at Diablo Canyon. (**27-3** [Curran, Diane])

Response: *The NRC disagrees with the comment. This comment raises issues regarding the operational safety of the Diablo Canyon plant and other matters appropriately considered as part of plant-specific license renewal actions. Nuclear power plant operational safety issues are outside the scope of the NRC's environmental reviews conducted under 10 CFR Part 51 as well as this LR GEIS and associated rulemaking. Nonetheless, the NRC provides continuous oversight for the safe operation of nuclear power plants through its ongoing reactor oversight process to verify that the nuclear plants are being operated and maintained in accordance with NRC regulations. If the NRC discovers an unsafe condition, or that a licensee is not complying with its licensing basis, the NRC has the authority to take whatever action is necessary to protect public health and safety.*

As noted in Appendix E and in response to other comments in this appendix, the NRC found a significant overall decrease in the risk posed by severe accidents since the Commission first concluded the probability-weighted consequences of severe accidents would be SMALL in the 1996 LR GEIS. Moreover, the 1996 LR GEIS itself found a significant overall margin compared

to the health criteria and reflected conservatisms in the overall values; additionally, the 1996 LR GEIS found a relatively low PDR value for Diablo Canyon. Given these considerations, the NRC concludes that it is unlikely that the relatively modest increase in risk from external events identified in the comments would challenge that conclusion. The comment does not provide any new information that would challenge the findings in this revised LR GEIS.

The licensee (PG&E) submitted a license renewal application for Diablo Canyon in November 2023. The NRC will conduct an environmental review leading to the preparation of a plant-specific supplement (i.e., SEIS) to the LR GEIS. For initial LR, PG&E needed to include a plant-specific SAMA analysis in the environmental report that addresses alternatives for mitigating severe accidents. This analysis will be subject to independent review by the NRC staff, which will include the consideration of new information regarding external events, including seismicity. No changes were made in the LR GEIS, final rule, or guidance as a result of this comment.

Comment: 6. To summarize my opinion of the Draft GEIS, I believe its conclusion that environmental impacts of externally initiated accidents are small is unsupported. The PG&E-sponsored analysis relied on by the NRC for its conclusion significantly underestimates the earthquake rate and proximity of potential earthquakes that could affect the Diablo Canyon nuclear reactors, because it is based on incomplete information, and did not consider all relevant methods for estimating hazard available at the time. (**27-5** [Curran, Diane])

Response: *The NRC disagrees with this comment. The most currently available best estimate of nuclear power plant seismic CDFs (SCDFs) is reported in Table E.3-11 of this LR GEIS. The third column of the table reports an SCDF of 2.8×10^{-5} per year for each of the two units of the Diablo Canyon plant. As stated in this LR GEIS, the seismic PRA (SPRA) from which this result was produced was submitted to the NRC in response to Near-Term Task Force (NTTF) Recommendation 2.1. Specifically, the Diablo Canyon SPRA was submitted to the NRC in 2018 (PG&E 2018). The NRC evaluation of the Diablo Canyon SPRA submittal concluded in 2019 (NRC 2019b) that the SPRA (which was independently peer reviewed in accordance with NRC guidance) is of sufficient technical adequacy that "no further response or regulatory actions associated with NTTF Recommendation 2.1" are required. Furthermore, in response to an earlier submittal to the NRC providing the reevaluated seismic hazard for the Diablo Canyon site, also in response to NTTF Recommendation 2.1, the NRC concluded that the reevaluated seismic hazard is suitable for use in other seismic assessments submitted in response to NTTF Recommendation 2.1 (NRC 2016).*

Additionally, the conclusion in this LR GEIS that the risk (probability-weighted consequences) of severe accidents is SMALL is not based on the estimated externally initiated severe accident risks for a single plant but rather on the estimated total (both internally and externally initiated) severe accident risks for all currently operating nuclear power plants. As reported in Section E.5 of this LR GEIS, the All Hazards PDR, or probability-weighted dose consequence, ranges from a factor of 3 to over 1,000 and is, on average, about a factor of 120 less than the corresponding predicted 95 percent UCB values from the 1996 LR GEIS, and this factor is expected to be higher based on evaluated uncertainties. However, new and significant information pertinent to the evaluation of the impacts of severe accidents, including seismic risk information, is considered during preparation of plant-specific supplements to the LR GEIS. Thus, even though an issue is a Category 1 issue, mechanisms are in place to conduct a full plant-specific review if new and significant information warrants such a review. No changes were made in this LR GEIS, final rule, or guidance as a result of this comment.

Comment: 7. In particular, in my professional opinion, PG&E underestimates the seismicity of the region surrounding DCPP by a factor of approximately two. And it also fails to recognize the significant potential for thrust faults dipping under the reactors. These factors could significantly increase both earthquake rates and strength of shaking above the NRC's estimates.

8. At page E-34 of the Draft GEIS, the NRC reports that "new information" from external event probabilistic risk assessments (PRAs) is "not significant" for purposes of revising an earlier conclusion that the environmental impacts of reactor accidents initiated by external events are small. As discussed below, this conclusion may not reasonably be applied to the Diablo Canyon reactors, because the supporting analyses are out of date and incomplete.

9. One of the foundational documents for the NRC's conclusion that seismic impacts are insignificant is the seismic hazard reevaluation performed by PG&E in response to post-Fukushima orders by the NRC. This seismic hazard reevaluation can be found in the PSHA referenced above in par. 5 and note 1. The PSHA provides estimates for fault traces, fault dips, and fault slip-rates that affect the risk of an earthquake at Diablo Canyon, plus application of ground-motion prediction equations to forecast the intensities of acceleration (and spectral accelerations) as a function of recurrence time. Then in the SPRA, these estimates of shaking are combined with estimates of plant fragility to estimate recurrence times between plant failures due to earthquakes.

10. At page E-29 of the Draft GEIS, the NRC states:

"In the first phase of this screening approach, a seismic hazard reevaluation was performed for each nuclear power plant site, which included development of new plant-specific seismic hazard curves using up-to-date models representing seismic sources, ground motion equations, and site amplification."

11. I emphasized the phrase "up-to-date" in quoting the Draft GEIS because that assertion is not only incorrect now, but it was incorrect in 2015, when PG&E performed the PSHA. The only sense in which the PSHA is "up-to-date" is the fact that it updated the parameter values for specific fault sources that had been considered in previous PSHAs. It did not take account of, or make use of, then-published and available scientific developments in measurement and computation of the parameters for those and other fault sources, including:

a. measurement of crustal motion by permanent and campaign Global Positioning System (GPS) receivers (e.g., Shen et al., 2003; Kreemer et al., 2003, 2014; Kreemer, 2016) or

b. computation of long-term crustal strain rates and fault slip rates by computer modeling (including kinematic finite-element models) of crustal motion measurement data, in combination with geologic and stress data (e.g., Bird, 2009; Field et al., 2013, 2014; Parsons et al., 2013).

12. The PSHA also ignored recent initiatives in seismic hazard estimation which do not assume that a complete inventory of active faults is available, but instead compute the expected seismicity across the map area from crustal strain rates and fault slip rates (if and where available) using a calibration of global shallow seismicity categorized by plate-tectonics (Bird & Kagan, 2004; Bird & Liu, 2007; Bird et al., 2010; Bird et al., 2015). Two motivations for the development of such models were that:

(a) a number of recent large earthquakes in the California region (Landers 1972 m7.3, Hector Mine 1999 m7.1, El Mayor-Cucupah 2010 m7.2, Ridgecrest 2019 m6.5 + m5.4 + m7.1) had occurred in places where no seismogenic fault, or only short and disconnected faults, had been recognized; and

(b) the discovery that the global distribution of shallow earthquakes was such that they spread in bands of half-width 257 km around plate boundary faults of the Continental Transform Fault (CTF) type (Bird & Kagan, 2004).

13. PG&E's failure to utilize these modern methods led to incomplete and biased results, both in terms of underestimated tectonic strain rates and overestimated minimum distances of active faults from DCPP. The distance between the plant and the active earthquake rupture is important because it is one factor affecting the peak acceleration (and spectral acceleration) at the plant; this is recognized in the ground-motion prediction equations that are routinely used in the PSHA process.

14. The Irish Hills and the San Luis Range are a dextral-transpressional orogen that has formed since ~3.5 million years or mega annus (Ma) (Page et al., 1998), or possibly since 7.8~6 Ma (Atwater & Stock, 1998; Bird & Ingersoll, 2022) when the motion of the Pacific plate changed its direction to become more compressional relative to North America. This means that the region can be expected to be cut by a number of both strike-slip and thrust (compressional) faults.

15. Evidence of this ongoing compression includes:
a. The Pismo syncline is the primary structural feature in the Irish Hills (Pacific Gas & Electric, 2014). Here beds have been rotated ~45° since ~5 Ma, which is the depositional age of the youngest strata in the core of the fold (ibid). This folding implies crustal strains of ~0.8, and mean strain-rates of ~0.8/5 Ma = 5×10^{-15} per second (/s). This is ~10× faster than rates of "off-fault" or "off-modeled-fault" (or "continuum") deformation that are typical in the long-term neotectonics of the western US (5×10^{-16} /s, Bird, 2009). This high rate of strain implies a high rate of faulting and of earthquakes, even if the specific fault traces and fault planes have not yet been identified.

b. The 2003 San Simeon m6.6 and 1983 Coalinga magnitude (m) 6.2 earthquakes had thrust mechanisms (Global Centroid Moment Tensor Catalog, Ekström et al., 2012). This is evidence of highly compressive horizontal stresses in the Coast Ranges region, suggesting a likelihood of thrust-faulting in other locations as well.

c. SSW-NNE directions of most-compressive stress shown by data in the World Stress Map (Mueller et al., 1997; Heidbach et al., 2008, 2016), and by interpolation of stress directions using the method of Bird & Li (1996), are almost perpendicular to the traces of the regional fault grain (Shoreline, San Luis Bay, and Los Osos faults). This strongly suggests that these faults are currently either purely, or dominantly thrust faults.

d. Models of neotectonic deformation, informed and guided by GPS velocity data, include such long-term compression. Specifically, Shen & Bird (2022) computed a suite of kinematic finite-element (F-E) models of neotectonics across the western US based on geodetic, geologic, & stress data with program NeoKinema. Their preferred model, which is being incorporated into the 2023 update of the USGS National Seismic Hazard Model, shows convergence of crustal blocks on both sides of the Irish Hills/San Luis Range at velocities of ~1 mm/a, for a total of ~2 mm/a of local convergence. (**27-6** [Curran, Diane])

Comment: 16. The 2015 PSHA for DCPP is seriously deficient because it considers only the strike-slip component of ongoing deformation, and ignores this thrusting/compressional component.

17. Given the evidence cited above (par. 12) for active horizontal compression, thrust faults and resulting thrust-faulting earthquakes must be expected. The lack of consideration of thrust faulting in the 2015 PSHA is unacceptable given that:

a. the basement of the Irish Hills is Franciscan Complex, which is an accretionary melange with incorporated thrust nappes (Wakabayashi, 1999) that formed in a dextral-transpressional subduction environment in Jurassic-Neogene times (Cloos, 1982). This thick pile of materials originally scraped off the tops of subducting oceanic plates is full of low-angle thrust faults which are available for reactivation; and

b. bedding-plane slip is the dominant mode of compression in layered sedimentary rocks such as the Paleogene and Neogene units that overlie the Franciscan Complex in the Irish Hills (Pacific Gas & Electric, 2014) but bedding-plane slip produces no visible or mappable offsets of rock lithologies; and

c. the 2015 m7.8 Nepal earthquake showed that low-angle thrust faults can produce devastating shaking without leaving any mappable surface rupture.

18. PG&E's systematic omission from the PSHA of earthquakes resulting from horizontal compression is material and serious because:

a. Kinematic F-E models of regional neotectonics (Shen & Bird, 2022) prepared for use in the US Geological Survey's National Seismic Hazard Model, and seismicity models based on their kinematics plus global calibrations (Bird & Kagan, 2004; Bird et al., 2009; Bird & Kreemer, 2015), suggest that seismicity due to distributed compression may be roughly equal (and additive) to that caused by strike-slip on named, mapped faults. Specifically, in my publications I have advocated a seismicity model known as Seismic Hazard Inferred From Tectonics (SHIFT), with two basic principles:

i. the long-term seismic moment rate of any tectonic fault, or any large volume of permanently deforming lithosphere, is approximately that computed using the coupled seismogenic thickness (i.e., dimensionless seismic coupling coefficient × seismogenic thickness) of the most comparable class of plate boundary; and

ii. the long-term rate of earthquakes generated along any tectonic fault, or within any large volume of permanently deforming lithosphere, is approximately that computed from its SHIFT moment rate (of method i above) using the frequency–magnitude distribution of the most comparable class of plate boundary.

19. This method, encoded in my program Long_Term_Seismicity_v12, provides maps and statistics on model seismicity above any desired minimum earthquake magnitude. For the preferred model of Shen & Bird (2022), we compute that "off-fault" seismicity should be 44% of total m7+ seismicity in the western US, compared to 56% "on-fault" seismicity. That is, a regional PSHA prepared for the western US by traditional methods that rely on a list of named active faults would miss about half of the actual earthquake rate.

20. Following the method described above, DCPP must be reevaluated for its vulnerability to thrust faults. Locally, DCPP lies on a transition from a domain to the SW where seismicity is dominated by the strike-slip component on modeled faults, to a domain on the NE (Irish Hills

and San Luis Range) where seismicity is dominated by compression in the continuum. This means that cryptic bedding-plane and Franciscan thrust faults, and/or a NE-dipping strand of the Shoreline fault, could exist directly under DCPP at shallow depths.

21. The simplest structural explanation for the folding that produced the Pismo syncline in the Irish Hills is that both flanking faults (Shoreline fault on the SW; Los Osos fault on the NE) are active thrust faults which have relatively uplifted their respective flanks of the Irish Hills. In this connection, we note the assertion in the 2015 PSHA that the Shoreline fault has a vertical dip (and therefore is strike-slip), but also note the point raised by Prof. Jackson (Jackson, 2015):

"PG&E's seismic hazards analysis fails to account for reasonably foreseeable earthquakes located nearer to the DCPP than PG&E has assumed. For instance, the seismic stations used to locate earthquakes on the Shoreline Fault are all onshore, east of the fault, so that the fault's east-west location is highly uncertain."

In my professional opinion, Dr. Jackson raised an important consideration which remains valid. Furthermore, the Shoreline fault could have partitioned slip, on two active planes.

22. The 2015 PSHA for DCPP was incomplete with regard to potential seismic sources, and its estimates of expected shaking (as a function of recurrence time) therefore are biased low to a potentially significant degree. This was due to the systematic omission or underestimation of horizontally-compressional (thrust-faulting) deformation in the region. All subsequent analyses relying on the PSHA simply perpetuate the errors and omissions in the PSHA, and therefore are correspondingly inadequate to assess earthquake risk. Therefore, the relatively low accident rates obtained from that SPRA and assumed in the Draft GEIS do not provide an adequate basis for evaluating the significance of earthquake-related environmental impacts at DCPP.

23. As discussed above in par. 7, in my professional opinion, PG&E underestimates the seismicity of the region surrounding DCPP by a factor of approximately two. And it also fails to recognize the significant potential for thrust faults dipping under the reactors. These factors could significantly increase both earthquake rates and strength of shaking above the NRC's estimates. (**27-7** [Curran, Diane])

Response: *The NRC acknowledges these comments. These comments express a multitude of concerns about the probabilistic seismic hazard assessment (PSHA) that was performed for the Diablo Canyon plant and was submitted to the NRC in response to NTTF Recommendation 2.1 (PG&E 2018), which was used in the Diablo Canyon SPRA (NRC 2022a) that was the basis for the SCDF cited in Table E.3-11 of this LR GEIS. The specifics of how the NRC implemented the Commission's post-Fukushima orders are not within the scope of this LR GEIS and rulemaking.*

Nonetheless, the NRC is cognizant of the significant ongoing research to improve understanding of the seismic record, fault geometry, and seismicity rates in San Luis Obispo County, California, and throughout the United States. The conclusion in this LR GEIS that the risk (probability-weighted consequences) of severe accidents is SMALL is not based on the estimated externally initiated severe accident risks for a single plant but rather on the estimated total (both internally and externally initiated) severe accident risks for all currently operating nuclear power plants. As noted in Appendix E and in response to other comments in this appendix, the NRC found a significant overall decrease in the risk posed by severe accidents since the Commission first concluded the probability-weighted consequences of severe accidents would be SMALL in the 1996 LR GEIS. Moreover, the 1996 LR GEIS itself found a

significant overall margin compared to the health criteria and reflected conservatisms in the overall values; additionally, the 1996 LR GEIS found a relatively low PDR value for Diablo Canyon. Given these considerations, the NRC concludes that it is unlikely that the relatively modest increase in risk from external events identified in the comments would challenge that conclusion. Any new and significant information pertinent to the evaluation of the impacts of severe accidents, including seismic risk information, is considered during preparation of plant-specific supplements to the LR GEIS.

Furthermore, the NRC requires all licensees to take into account changes in seismic hazards in order to maintain safe operating conditions at all nuclear power plants. The NRC's ongoing safety oversight, which includes seismic safety, is separate from the license renewal process. Nonetheless, the NRC expects that its ongoing oversight activities will be sufficient to ensure that seismic hazards do not pose an undue risk during any license renewal term. No changes were made in this LR GEIS, final rule, or guidance as a result of these comments.

A.2.13.11 Comments Regarding LR GEIS Appendix E.3.4, Impact of Power Uprates

Comment: 41., E-45, 12-13, Assertion that "[t]o this end, Table E.3-16 presents the change in LERF [large early release frequency] calculated by licensees who have been granted an EPU [extended power uprate]."
Here the Draft GEIS discusses the change in LERF as percentages from the pre-extended power uprates. However, the analysis is deficient because the NRC does not provide a context or baseline. For example, the reader is left to wonder whether the increase is from a very high LERF value) e.g., 1E-4 per year) or a low LERF value (e.g., 1E-7 per year). In addition, no source is given for any of the EPUs in the table, as needed to verify the information presented. The Draft GEIS should supply references and context. (**24-5-18** [Curran, Diane])

Response: *The NRC agrees in part and disagrees in part with the comments. The NRC agrees that references for each of the plants should be provided. The reference for power uprate values provided in Table E.3-16 of this LR GEIS is NRC 2022a, as listed in Section E.6 of Appendix E.*

The NRC disagrees with the comment that the analysis is deficient because the NRC does not provide a context or baseline. Table E.3-16 provides the percent increase of the power uprate and the percent increase in internal event large early release frequency (LERF) that is needed for supporting the conclusion in Section E.3.4 of this LR GEIS. As provided in Section E.3.4, for small power uprates (i.e., measurement uncertainty recapture power uprates [MURs] and stretch power uprates), the risk increases are expected to be exceedingly small, so LARs for these power uprates do not generally include an assessment of the change in risk. For extended power uprates (EPUs), however, notwithstanding any plant modifications that could reduce risk, some increase in risk is expected. Depending on the type of plant-specific modifications necessary to implement the larger power uprates, these power uprates have the potential to significantly increase plant risks, so an assessment of the impact on CDF and LERF is included with EPU LARs (NRC 2022a). Sections E.3.4 and E.3.5 address power uprates and higher fuel burnup and indicate the increase could potentially affect the previously calculated population dose risk by up to 75 percent. Taken in combination with the other information presented in Appendix E, the increases would be bounded by the 95 percent UCB values in the 1996 LR GEIS, which are repeated in Table E.3-1 of this LR GEIS, and would be very small increases in environmental impact relative to the large decreases in PDR (orders of magnitude) since the publication of the 1996 LR GEIS. Regulatory Guide 1.174 (NRC 2018b) allows the use of LERF as a surrogate for the individual early fatality risk when considering the quantitative health objectives (QHOs). Thus, the impact of a power uprate on early fatalities can be gauged

by considering the impact of the uprate on the LERF metric. To this end, Table E.3-16 in Appendix E presents the change in LERF calculated by licensees who have been granted an EPU. As shown, the change in LERF ranges from decreases of 8 percent to increases of up to 32 percent (with a mean of 5.7 percent). Relative to the substantial decreases in probability-weighted consequences since issuance of the 1996 LR GEIS discussed previously with respect to new information about internal and external events and about source terms, this increase due to EPUs is judged to be small. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.

A.2.13.12 Comments Regarding LR GEIS Appendix E.3.6, Impact from Accidents at Low Power and Shutdown Conditions

Comment: 2. Accidents during shutdown
The Draft GEIS does not address low power and shutdown (LPSD) accidents in Section 4. However, it does attempt to consider it in Appendix E, Section E.3.6. Section E.3.6 acknowledges that the 1996 GEIS does not address LPSD accidents (Page E-49, lines 28-29). It goes on to recognize that "operating experience has shown that events affecting fuel cooling do occur during shutdown operations." (Page E-50, lines 8-9) It cites the two most detailed LPSD published reports to date: NUREG/CR-6143 on Grand Gulf and NUREG/CR-6144 on Surry. In Section E.3.6.3 it "[c]oncluded that the environmental impacts from accidents at low power and under shutdown conditions are generally comparable to those from accidents at full 8 power," (Page E-54, lines 7-9).

But then the Draft GEIS goes on to say, "Although the impacts under low power and shutdown conditions could be somewhat greater than for full power conditions (for certain metrics), the 1996 LR GEIS **estimates of the environmental impact of severe accidents bound the potential impacts from accidents at low power and shutdown conditions with significant margin**." (Page E-54, lines 12-15) (emphasis added). This conclusion is inconsistent with the data that it presents for Surry Unit 1, the "Latent Fatality Risk for LPSD Accidents (mean values) is 2E-2 per year" and the "Full Power Accident Internal Events (mean value) is ~5E-3 per year." (Table E.3-18). That is, the latent fatality risk is higher for LPSD than for full power operations. Clearly, the subject has not been adequately considered.

As a final observation, the LPSD analysis presented here does not explore contributions from external events during LPSD operations. And as illustrated elsewhere in the Draft GEIS, external event risks can significantly exceed contribution from internal events. Therefore, the Draft GEIS must more thoroughly address the contributions from LPSD internal and external events. Mitman Report at 13-14. (**24-1-19** [Curran, Diane])

Comment: Accident risks during shutdown

The Draft GEIS does not address low power and shutdown (LPSD) accidents in Section 4. However, it does attempt to consider it in Appendix E, Section E.3.6. Section E.3.6 acknowledges that the 1996 GEIS does not address LPSD accidents (Page E-49, lines 28-29). It goes on to recognize that "operating experience has shown that events affecting fuel cooling do occur during shutdown operations." (Page E50, lines 8-9) It cites the two most detailed LPSD published reports to date: NUREG/CR-6143 on Grand Gulf and NUREG/CR-6144 on Surry. In Section E.3.6.3 it "[c]oncluded that the environmental impacts from accidents at low power and under shutdown conditions are generally comparable to those from accidents at full 8 power," (Page E-54, lines 7-9).

But then the Draft Environmental Report goes on to say, "Although the impacts under low power and shutdown conditions could be somewhat greater than for full power conditions (for certain metrics), the 1996 LR GEIS **estimates of the environmental impact of severe accidents bound the potential impacts from accidents at low power and shutdown conditions with significant margin**." (Page E-54, lines 12-15) (emphasis added). This conclusion is inconsistent with the data that it presents for Surry Unit 1, the "Latent Fatality Risk for LPSD Accidents (mean values) is 2E-2 per year" and the "Full Power Accident Internal Events (mean value) is ~5E-3 per year." (Table E.3-18). That is, the latent fatality risk is higher for LPSD than for full power operations. Clearly, the subject has not been adequately considered.

As a final observation, the LPSD analysis presented here does not explore contributions from external events during LPSD operations. And as illustrated elsewhere in the Draft GEIS, external event risks can significantly exceed contribution from internal events. Therefore, the Draft GEIS must more thoroughly address the contributions from LPSD internal and external events. (**24-3-15** [Curran, Diane])

Comment: 43., E-51, 30-33, Listing of the following assessed conditions:
-plant operation at power levels between 0 and 5 percent;
-shutdown with containment open; and
-fuel handling inside the containment structure."
As shown by the NRC Level 3 project and other studies, significant impact to public safety and the environment also exist during shutdown with the containment closed. Contributions from containment close condition should also be discussed. (**24-6-1** [Curran, Diane])

Comment: 44., E-52, 12-15, Assertion that "[d]ue to the decay time associated with low power and shutdown conditions (i.e., decay of short-lived isotopes and lower decay heat) and, in most cases ... the offsite consequences would be less than for accidents under full power."(emphasis added).

During low power the reactor is still at power and thus short-lived isotopes are still present, i.e., not decayed out. Thus, the assertion in the Draft GEIS that offsite consequences would be lower is not true when considering accidents at low power operations. The analysis should be done again using correct information. (**24-6-2** [Curran, Diane])

Comment: 45., E-52, 12-15, Assertion that "[d]ue to the decay time associated with low power and shutdown conditions (i.e., **decay of short-lived isotopes** and lower decay heat) ... the **offsite consequences would be less than for accidents under full power**." (emphasis added).

The decay of short-lived isotopes will decrease the early fatality risk. However, short-lived isotopes are not the driver of latent cancer fatality risk. Therefore, their decay will have no impact on latent cancer fatality risk. (**24-6-3** [Curran, Diane])

Comment: 46., E-52, 12-15, Assertion that "[d]ue to the decay time associated with low power and shutdown conditions (i.e., decay of short-lived isotopes and lower decay heat) and, in most cases, **longer times available to take mitigative action**, the offsite consequences would be less than for accidents under full power." (emphasis added).
One high risk configuration during some PWR shutdowns is operation at mid-loop. Mid-loop is a configuration where reactor water level is lowered to the middle of the hotleg piping. This level is only several feet above the top of the reactor core. During mid-loop configurations the time to core boiling can be quite short, typically 12 to 15 minutes early in an outage. Likewise the time

to core uncovery from a PWR loss of inventory or drain down event can also be very short, i.e., less than an hour. With timing like this it is inaccurate to say that there is "longer time available to take mitigative actions." (**24-6-4** [Curran, Diane])

Comment: 47., E-52, 15-17, Assertion that "in certain plant operating states, the containment in those states may be open. Thus, a higher conditional probability for containment bypass might exist."
To perform a BWR refueling outage the drywell head must be removed. The drywell head is part of each BWRs Mark I and II primary containment. Thus, during a refueling outage the containment must be opened to perform the refueling. In a BWR Mark III containment the drywell --while not part of the containment shell --is an integral part of containment. Thus, in a Mark III the containment will not function as designed. Therefore, in all BWRs primary containment is non-functional during refueling outages and therefore, the conditional probability of containment is always 1.0. During these conditions no credit should be given containment. (**24-6-5** [Curran, Diane])

Comment: 54., E-84, 15-17, Assertion that "[w]ith respect to severe accidents during low power and shutdown conditions (which are not currently included in SAMA analyses), **the risks are generally comparable** to those for severe accidents during full power operation (emphasis added)."

This statement overlooks critical differences between the sources of accident risk at full power, low power, and shutdown. Mid-loop operation (a configuration during PWR outages where reactor water level is lowered to the middle of the hotleg piping) is unlike any configuration ever encountered during at power operation. A new simple SAMA that would mitigate the risk and would probably be cost beneficial would be simply to never perform a mid-loop operation. Likewise, BWR operations during low power and shutdown with containment non-functional outages has significant impact on safety. (**24-6-12** [Curran, Diane])

Response: *The NRC agrees in part and disagrees in part with the comments. Considering the limited scope of Section E.3.6 and the context of the section as described above, none of the comments resulted in changes regarding the NRC determination that the 1996 LR GEIS estimates of the environmental impact of severe accidents bound the potential impacts of accidents at low power and reactor shutdown. However, Section E.3.6 and related areas of this LR GEIS were clarified to make the context clear regarding the intent of this revised LR GEIS. As explained in Sections E.3.1 to E.3.9 of Appendix E of this LR GEIS, while several of the factors may result in modest increases to severe accident risk, other new information regarding these factors suggests that the probability-weighted environmental consequences of severe accidents may be, on average, substantially lower than previously estimated.*

The 1996 LR GEIS supported the rulemaking regarding the generic determination that the probability-weighted consequences to the public and environment, which accounts for both the likelihood and consequences of postulated severe accidents to the public and environment, are SMALL. The purpose of Section E.3.6 of Appendix E of this LR GEIS, Impact from Accidents at Low Power and Shutdown Conditions, is to determine whether new information might challenge the 1996 LR Final Rule (61 FR 28467) determination during an SLR period. Low power and shutdown (LPSD) PRAs were not included in the 1996 LR GEIS environmental consequence analysis, nor are LPSD PRAs required to be submitted and reviewed by the NRC. In the 2013 LR GEIS and this revised LR GEIS, the NRC reviews available information to make an estimate of how the LPSD risk might affect the 1996 LR GEIS and rule determination regarding the probability-weighted consequences.

As summarized in Table E.5-1 of Appendix E of this LR GEIS, the NRC determined:

> *The environmental impacts from accidents under low power and reactor shutdown conditions are generally comparable to those from accidents at full power when comparing the values in SNL 1995 and BNL 1995 to those in the NUREG-1437 supplements. Nonetheless, the 1996 LR GEIS estimates of the environmental impact of severe accidents bound the potential impacts from accidents at low power and reactor shutdown. Finally, safety during low power and shutdown operations has been improved since issuance of the 1996 LR GEIS as a result of (1) industry initiatives taken during the early 1990s, as discussed in SECY-97-168 (NRC 1997c) [NRC 1997b in this appendix]; (2) improved safety of low power and shutdown operation compliance with the Maintenance Rule including 10 CFR 50.65(a)(4) for the assessment and management of risk associated with maintenance activities, including during low power operations and plant shutdown configurations; and (3) compliance with NRC Order EA-12-049 (NRC 2012c) [NRC 2012a in this appendix] requiring licensees to be capable of implementing the mitigating strategies for beyond-design-basis external events in all modes of plant operation, including full power operations, low power operations, and plant shutdown configurations.*

The NRC acknowledges the comment that recommended a potentially cost-effective SAMA for keeping the plant out of mid-loop operation during shutdown such as "Mid-loop operation (a configuration during PWR outages where reactor water level is lowered to the middle of the hotleg piping) is unlike any configuration ever encountered during at-power operation." The Maintenance Rule (10 CFR 50.65(a)(4)) already requires the following of the applicant:

> *"(4) Before performing maintenance activities (including but not limited to surveillance, post-maintenance testing, and corrective and preventive maintenance), the licensee shall assess and manage the increase in risk that may result from the proposed maintenance activities. The scope of the assessment may be limited to structures, systems, and components that a risk-informed evaluation process has shown to be significant to public health and safety."*

The intent of this regulation is to manage increases in risk during shutdown. In addition, most facilities expected to reference this LR GEIS have already completed a SAMA analysis and therefore need not undertake a second one per NRC regulations. The totality of the studies and regulatory actions discussed in Section E.4 of Appendix E provides a strong basis for the Commission's decision to not require applicants to perform a SAMA analysis if the NRC has previously completed a SAMA or severe accident mitigation design alternative (SAMDA) analysis for that facility. Furthermore, the impacts of all new information in this update confirm the low likelihood of finding cost-effective significant plant improvements by conducting further SAMA analyses. Alternatives to mitigating severe accidents still 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.

Developments or new information regarding plant operation and accident analysis have occurred and could affect the assumptions made in these previous analyses. These changes include consideration of reactor accidents under LPSD conditions (Section E.3.6). This area is also evaluated in plant-specific SLR applications to determine their significance. This revised LR GEIS evaluates new information regarding severe accidents for this topic and considers

whether the information would, collectively, change the conclusions in the 1996 LR GEIS and 2013 LR GEIS that the probability-weighted consequences of severe accidents are SMALL. As explained in this LR GEIS, while several of these factors may result in modest increases to severe accident risk, other new information regarding these factors suggests that the risk of severe accidents may be, on average, substantially lower than previously estimated. As a result, the overall analysis further supports the findings from the 1996 LR GEIS and 2013 LR GEIS that the probability-weighted consequences of severe accidents are SMALL.

*The NRC, however, understands that new information could potentially and conditionally increase the estimated severe accident probability-weighted consequences. As explained in Sections E.3.1 to E.3.9 of Appendix E of this LR GEIS, while several of the factors may result in modest increases to severe accident risk, other new information regarding these factors suggests that the risk of severe accidents may be, on average, substantially lower than previously estimated. In the LR GEIS, probability-weighted consequences of a severe accident are equal to the population dose risk (PDR). PDR = core damage frequency (CDF)*population dose (PD). The mean All Hazards PDR is reduced by a factor of 120. The left and right sides of the equation are roughly proportional to the respective PD and CDF factors. This considerable margin justifies the NRC's conclusion that the PDR has decreased from the values used to make the probability-weighted consequences determination of small in the 1996 LR GEIS, despite potentially modest increases in PDR resulting from LPSD conditions. As a result, this LR GEIS analysis further supports the generic findings from the 1996 LR GEIS and 2013 LR GEIS that the probability-weighted consequences of severe accidents would be SMALL.*

As explained in Section E.3.6 of Appendix E of this LR GEIS, the composite of the LPSD accident risk assessments and NRC actions taken that directly reduce LPSD severe accident risk provides a strong basis for the NRC conclusion that the probability-weighted consequences from LPSD accidents is bounded by the probability-weighted consequences reported in the 1996 LR GEIS. No new information was provided in the comments that would change the NRC's conclusion that the probability-weighted consequences reported in the 1996 LR GEIS continue to bound the impact of severe accidents and that severe accidents are a Category 1 issue. However, the NRC made clarifying revisions to Appendix E in this LR GEIS to enhance the explanation of the basis for the rule.

The NRC agrees that Table E.3-18 of Appendix E of this LR GEIS shows that the latent fatality risk (per year) for LPSD operations is greater than that for full power operations, and that this is not consistent with the conclusion in Section E.3.6.3 of Appendix E of the LR GEIS "that the environmental impacts from accidents at low power and under shutdown conditions are generally comparable to those from accidents at full power..." Specifically, Table E.3-18 of Appendix E of the LR GEIS shows that the latent fatality risk is a factor of four higher for LPSD operations than that for full power operations for both the Grand Gulf Unit 1 ($4 \times 10^{-3}/1 \times 10^{-3}$) and Surry Unit 1 ($2 \times 10^{-2}/5 \times 10^{-3}$) nuclear power reactors. However, for Surry Unit 1, early fatality risk (/year) is a factor of 40 ($2 \times 10^{-6}/5 \times 10^{-8}$) lower and PDR (person-rem per year) is a factor of 75 (30/0.4) lower for LPSD operations compared to full power operations. For Grand Gulf Unit 1, early fatality risk and PDR are essentially the same for LPSD operations and for full power operations. Section E.3.6 of Appendix E of this LR GEIS was revised to provide expanded discussion of these results. However, there are compelling reasons why the risks from LPSD events relative to full power operations are expected to be smaller today:

- *One of the NRC staff conclusions in NUREG-1449 was that "a well-planned, well-reviewed, and well-implemented outage is a major contributor to safety" (NRC 1993, p. 6-2). The report further noted findings where improvements could be made, compared to the current*

practices at that time (early 1990s). As noted above in Section E.3.6, subsequently the NRC Maintenance Rule (10 CFR 50.65), NRC Order EA-12-049 (NRC 2012a), and industry initiatives have implemented many of these improvements for safety, resulting in an expected risk reduction from potential LPSD events today compared to the early 1990s.

- *Nuclear power plants today spend a much smaller fraction of time in LPSD operations compared to the early 1990s. Because risk from low power and shutdown events is proportional to the percentage of time spent in LPSD operating states, spending less time in LPSD conditions reduces its relative contribution to risk (all else being equal). This can be seen in the capacity factor trends over the years, which show ~60–70 percent time at full power operations in the 1980s to early 1990s, versus over 90 percent today. (See for example, Figure 1 in ANS (2020).*

Given these additional considerations, the NRC anticipates that the probability-weighted impacts of an accident during LPSD operations would be on the same order as full power if calculated today. Section E.3.6 of Appendix E of this LR GEIS was revised to provide expanded discussion of these results.

The NRC agrees that conditions assessed under LPSD conditions include both containment open and containment closed conditions. Section E.3.6 of Appendix E of the LR GEIS was revised to include the containment closed condition.

The NRC agrees that conditional offsite consequences could be higher for certain LPSD operating states than for full power operations. The NRC agrees that decay of short-lived isotopes is more relevant to shutdown conditions than to low power conditions. The NRC also agrees that decay of short-lived isotopes is mostly relevant to the estimate of early fatality risk and much less relevant to the estimate of latent fatality risk. The NRC understands that "longer times available to take mitigative action" is not applicable to all plant operating states, including mid-loop configurations. Section E.3.6 of Appendix E of the LR GEIS was revised to clarify that the conditional consequences and risks of accidents under LPSD conditions can vary substantially depending on the plant operating conditions and provide compelling reasons for why the risks from LPSD events relative to full power operations are expected to be smaller today.

The NRC disagrees that the conclusion of the 1996 LR GEIS that the estimates of the environmental impact of severe accidents bound the potential impacts from accidents under LPSD conditions with significant margin is inconsistent with the data presented for Surry Unit 1 in Table E.3-18 of Appendix E of this LR GEIS. Specifically, the 95 percent UCB values from the 1996 LR GEIS for the PDR (person-rem/year) metric are a factor of 3,000 times (1,200/0.4) greater than that for LPSD accidents, the early fatality risk (/year) metric is a factor of 320,000 times ($1.6 \times 10^{-2}/5 \times 10^{-8}$) greater, and the latent fatality risk (/year) metric is a factor of 45 times ($0.9/2 \times 10^{-2}$) greater than that for LPSD accidents. A similar result is provided in Table E.3-18 of Appendix E of the LR GEIS for Grand Gulf Unit 1. Specifically, the 95 percent UCB values from the 1996 LR GEIS for the PDR (person-rem/year) metric are a factor of 166 times (1,441/8.7) greater than those for LPSD accidents, the early fatality risk (/year) metric is a factor of 280,000 times ($2.8 \times 10^{-3}/1 \times 10^{-8}$) greater, and the latent fatality risk (/year) metric is a factor of 250 times ($1.0/4 \times 10^{-3}$) greater than those for the LPSD accidents. For all three metrics for both Surry Unit 1 and Grand Gulf Unit 1 nuclear power plants, the environmental impact in terms of probability-weighted consequences estimated in the 1996 LR GEIS bounds by a significant margin the estimated probability-weighted consequences from the NUREG/CR-6143 (SNL 1995) (Grand Gulf Unit 1) and NUREG/CR-6144 (BNL 1995) (Surry Unit 1) studies.

Section E.3.6 of the LR GEIS was revised to provide an expanded discussion of these results. The NRC made clarifying changes to Appendix E of the LR GEIS as a result of these comments.

A.2.13.13 Comments Regarding LR GEIS Appendix E.3.7, Impacts from Accidents at Spent Fuel Pools

Comment: Consequences of pool fires
Multiple authorities, including the NRC, have now recognized that contamination from spent fuel pool fires can have devastating social and economic consequences in addition to health consequences. These include relocating whole populations and involve billions of dollars in expenses. See Von Hippel, et al, Reducing the Dangers From Spent Fuel Pool Fires (2016) https://www.tandfonline.com/doi/full/10.1080/08929882.2016.1235382 for a comprehensive survey of these authorities. And the devastating consequences of the Fukushima accident continue to wreak havoc on that region. Yet, the Draft GEIS ignores these devastating effects. The GEIS should thoroughly explain the consequences of spent fuel fires, including the long-lasting devastation they may wreak on huge areas. (**24-1-20** [Curran, Diane])

Comment: References
NUREG-1150 Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants:

In considering these objectives and the risk analyses in this and supporting contractor reports, it is important to consider both what NUREG-1150 is and what it is not:

*NUREG-1150 is a snapshot in time of severe accident risks in five specific commercial nuclear power plants. This snapshot is obtained using, in general, PRA techniques and severe accident phenomenological information of the mid-1980's, but with significant advances in certain areas. The plant analyses reflect design and operational information as of roughly March 1988.

*NUREG-1150 is an estimate of the actual risks of the five studied plants. It is a set of modern PRAs, having the limitations of all such studies. These limitations relate to the quantitative measurement of certain types of human actions (errors of commission, heroic recovery actions); variations in the licensee's organizational/management safety commitments; failure rates of equipment, especially to common-cause effects such as maintenance, environment, design and construction errors, and aging; sabotage risks; and an incomplete understanding of the physical progression and consequences of core damage accidents.

*NUREG-1150 is not the sole basis for making plant-specific or generic regulatory decisions. Such decisions must be more broadly based on information on the extant set of regulatory requirements, reflecting the present level of required safety, cost-benefit studies (in some circumstances), risk analysis results (from this and other relevant PRAs), and other technical and legal considerations.

*NUREG-1150 is not an estimate of the risks of all commercial nuclear power plants in the United States or abroad. One of the clear perspectives from this study of severe accident risks and other such studies is that characteristics of design and operation specific to individual plants can have a substantial impact on the estimated risks.

Seismic Accident Frequency Analysis Methods: A nuclear power plant is designed to ensure the survival of buildings and emergency safety systems in earthquakes less than one of a specific magnitude (the "safe shutdown" earthquake).

In contrast, the analysis of seismic risk requires consideration of the range of possible earthquakes, including those of magnitudes less than and greater than the safe shutdown earthquake. Seismic risk is obtained by combining the frequencies of the spectrum of possible earthquakes, their potential (and very uncertain) effects on equipment and structures within the plant under study, and the subsequent effects on core and containment building integrity. In considering this, it should be noted that during an earthquake, all parts of the plant are excited simultaneously. Thus, during an earthquake, redundant safety system components experience highly correlated base motion, and there is a high likelihood that multiple redundant components would be damaged if one is damaged. Hence, the "planned-for" redundancy of equipment could be compromised. This common-cause failure mechanism represents a potentially significant risk to nuclear power plants during earthquakes.

The scope of NUREG-1150 is narrowly defined, making the risk study incomplete. Many types of accident initiators are unaccounted for, including earthquakes, floods, and other external events; reactor coolant pump seal failure; steam generator tube ruptures; and instrument air losses. Other phases of plant operation need to be considered in addition to normal full-power operation, including power ascension and descension; shutdown; and operation with Mark I containment buildings de-inerted. Accidents in spent fuel pools should be taken into account.

To confirm that the scope is appropriate, the NRC is initiating a separate study of the risk associated with low power and shutdown conditions for two of the plants studied in NUREG-1150. The results are expected to be available in FY 1990. The risk associated with spent fuel pool accidents is being assessed separately in studies responding to NRC's Generic Issue 82, "Beyond Design Bases Accidents in Spent Fuel Pools." When completed, these will be examined to determine if further efforts are advisable.

Reference Comments
NUREG-1150 does not support the Category 1 classification of SFP accidents.
Extracts of NUREG-1150 are included for future reference. (**33-2-2** [Magnuson, Brian])

Comment: Draft NUREG-1437 Revision 2
E.3.7 Impact From Accidents at Spent Fuel Pools
As a result of the terrorist attacks of September 11, 2001, the NRC issued EA-02-026, "Order for Interim Safeguards and Security Compensatory Measures" (NRC 2002b), referred to as the ICMs Orders, dated February 25, 2002. The ICMs Orders modified then-operating licenses for commercial power reactor facilities to require compliance with specified interim safeguards and security compensatory measures.

Section B.5.b of the ICMs Orders requires licensees to adopt mitigation strategies using readily available resources to maintain or restore core cooling, containment, and SFP cooling capabilities to cope with the loss of large areas of the facility due to large fires and explosions from any cause, including beyond-design-basis aircraft impacts. Information about the historical evolution of mitigating measures implemented in response to the ICMs Orders is described in the NRC memorandum dated February 4, 2010 (NRC 2010a).

Magnuson Comments
The NRC withdraw Order EA-02-026. It is imprudent to make any pending or future GEIS conclusions or decisions based on withdrawn NRC Orders. Reference www.morganlewis.com.

EA-02-026/B.5.b equipment and strategies do not support Draft NUREG-1437 Revision 2.
(**33-3-20** [Magnuson, Brian])

Response: *The NRC disagrees that this LR GEIS does not provide an analysis of the severe accident consequences of an SFP accident. The NRC agrees that SFP severe accidents are low-probability and potentially high-consequence events. However, this LR GEIS considers the probability-weighted consequences of SFP accidents to provide a balanced estimate of the environmental impacts of license renewal. This is because, unlike the other environmental impacts evaluated in the LR GEIS predicated on routine (normal) reactor operations and that are expected to occur, these accidents have a relatively low probability of occurrence.*

In LR GEIS Section E.3.7, Impact from Accidents at Spent Fuel Pools, the purpose is to determine whether new information might challenge the 1996 rule determination during an SLR period. SFP PRAs or risks were not included in the 1996 LR GEIS environmental consequence analysis, nor are SFP PRAs required to be submitted and reviewed by the NRC. In the 2013 LR GEIS and this revised LR GEIS, the NRC reviewed available information to estimate how the SFP risk might affect the 1996 LR GEIS determination regarding the probability-weighted consequences.

The NRC agrees that portions of NRC Order EA-02-026 (NRC 2002b) have been rescinded (e.g., Section B.5.b requiring mitigation strategies for large fires or explosions at nuclear power plants). However, NRC Order EA-02-026 has not been rescinded in its entirety. Section E.3.7 of Appendix E of this LR GEIS was revised to include a footnote explaining that portions of NRC Order EA-02-026 have been rescinded because those requirements were subsequently incorporated into NRC regulations by the 2009 Final Rule on Power Reactor Security Requirements (74 FR 13926).

NUREG-1150, "Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants" (NRC 1990), was not the basis for the determination that SFP severe accidents are resolved by the determination that the issue of severe accidents is a Category 1 issue. As discussed in Section E.3.7 of Appendix E of this LR GEIS, the determination was based, in part, on the regulatory analysis performed to support the resolution of Generic Safety Issue 82 (NRC 1989). The NUREG-1150 risk results for severe accidents during reactor operation were provided for context and comparison with the SFP severe accident risks estimated in NUREG-1738, "Technical Study of Spent Fuel Pool Accident Risk at Decommissioning Nuclear Power Plants" (NRC 2001a). Both the NUREG-1738 and NUREG-1150 results are substantially less than the 95th percentile risk results that were the basis for the conclusions of the 1996 LR GEIS. The purpose of Section E.3.7 of Appendix E of the LR GEIS is to consider relative environmental impacts or change in PDR if an SFP severe accident had been considered in the 1996 LR GEIS analysis or the plant-specific SAMA analyses. Based on the comparison of the NUREG-1738 results to the NUREG-1150 results, and the other assessments performed in Section E.3.7, the NRC staff concluded in this LR GEIS that the increase in environmental impacts from considering SFP severe accidents would be less than that from full power reactor operations, but it is conservatively assumed that the impacts would be comparable. In other words, when assessing the net effect of new information on severe accident risks developed since the 1996 LR GEIS, it was assumed that including SFP severe accident risk essentially doubles the risk from that estimated for internally initiated severe accidents during full power reactor operations. The NRC revised Section E.3.7 of the LR GEIS to clarify the staff's position as a result of this comment.

A.2.13.14 Comments Regarding LR GEIS Appendix E.3.7, Impacts from Accidents at Spent Fuel Pools - Assessment of Offsite Consequences in SMSAB-99-02

Comment: References:

NRC Memorandum: Effect of Fission Product Inventory And Air Ingression On Spent Fuel Pool Accident Consequences (March 29, 2000) And Assessment of Offsite Consequences for a Severe Spent Fuel Pool Accident (SMSAB-99-02)

In this memorandum, we concluded that significant air ingression, influencing fission product release, will occur in spent fuel pool accidents involving quick drain-down, and the consequence assessment we performed should accommodate any reasonable uncertainty in the progression of the accident with the possible exception of an increase in the ruthenium release. Small-scale Canadian experiments show that, in an air environment, significant ruthenium releases begin after the oxidation of 75% to 100% of the cladding.

For cases with late evacuation (beginning after the fission product release), the effect on prompt fatalities is an increase of one to two orders of magnitude as a result of ruthenium's high radiological dose per curie inhaled relative to that of cesium which was previously the dominant fission product released.
We also assessed the effect of ruthenium releases on long-term consequences by-calculating societal dose and cancer fatalities within 100 miles and within 500 miles. The effect of ruthenium releases on societal dose ranged from no increase to a factor-of-two increase. The effect on cancer fatalities ranged from no increase to a factor-of-four increase.

[See ML23123A408 for a copy of the Table 6 discussing cases varying the amount of fuel assemblies releasing fission products.]

Reference Comments
Whenever an NRC research project, such as SMSAB-99-02 and NUREG-1738, refers to "early fatalities" or "prompt fatalities," it is important to recognize which populations are potentially impacted. Virtually all severe accident radiological consequence assessments are limited to off-site populations at some distance from the respective nuclear plant; they fail to assess the on-site consequences. Given that "early fatalities" or "prompt fatalities" could occur off-site, what are the radiological conditions on-site (ground zero)?

The on-site (e.g., control room, in-plant, site boundary) radiological consequences of a severe SFP accident may likely impede actions to maintain or restore cooling to the spent fuel and reactor core cooling.

Reference Appendix B to Part 50, General Design Criterion 19 - Control Room and applicable on-site dose regulations. (**33-1-17** [Magnuson, Brian])

Response: *The NRC agrees in part and disagrees in part with the comment regarding the memorandum SMSAB-99-02 (NRC 1999). The NRC agrees that NRC research evaluating severe accident risk, which is the estimated probability-weighted consequences or likelihood of the accident times its estimated consequences, typically considers in the consequence assessment portion only the consequences to the public from postulated releases. This is done to compare the estimated risks to the NRC safety goals for individual latent cancer fatality risk and early fatality risk.*

The NRC disagrees with the comment that onsite consequences are not considered because all plant-specific SAMA evaluations address both onsite and offsite consequences in accordance with NRC-endorsed guidance in NEI 05-01 (NEI 2005). As discussed in Section E.3.7 of this LR GEIS, the NRC has determined that the consequences of SFP accidents would be comparable to reactor accidents.

Moreover, the risk insights from the totality of the NRC SFP accident risk assessment studies are considered in this LR GEIS, including studies completed since the 1996 LR GEIS and after the Fukushima Dai-ichi accident (specifically, NUREG-2161 [NRC 2014b]). The composite of the SFP accident risk assessments and NRC actions taken that directly reduce SFP severe accident risk discussed in Section E.3.7 of Appendix E of this LR GEIS, including measures that would protect onsite individuals taken in response to the Fukushima Dai-ichi accident and the attacks of September 11, 2001, provides a strong basis for the NRC staff conclusion that the risk from accidents at SFPs is low and bounded by the probability-weighted consequences reported in the 1996 LR GEIS.

As discussed in Section E.4 of Appendix E of the LR GEIS, the NRC Full-Scope Site Level 3 PRA study is evaluating integrated site risk. If new and significant information arises out of this study, then that information will need to be considered in license renewal applications. No changes were made in the LR GEIS, final rule, or guidance as a result of this comment.

A.2.13.15 Comments Regarding LR GEIS Appendix E.3.7, Impacts from Accidents at Spent Fuel Pools - Use of NUREG-1738

Comment: My review of Draft NUREG-1437 Revision 2 is limited to Section E.3.7 'Impact From Accidents at Spent Fuel Pools.' I found the referenced studies of Section E.3.7 do not support its casual assumptions and conclusions.

For example, Section E.3.7 misapplies NUREG-1738, "Technical Study of Spent Fuel Pool Accident Risk at Decommissioning Nuclear Power Plants," to the risk of operating nuclear power plants (that may request License Renewal). The risks and consequences at decommissioned nuclear plants are lower than operating plants. The SFP at decommissioned nuclear plants contain no 'hot' fuel bundles and their reactors are defueled. Accordingly, there is no risk of a severe SFP accident causing a concurrent reactor accident at a decommissioned nuclear plant. (**33-1-3** [Magnuson, Brian])

Comment: Draft NUREG-1437 Revision 2 E.3.7 Impact From Accidents at Spent Fuel Pools

Since issuance of the 1996 LR GEIS, additional analysis of the risk from SFP accidents has been performed and documented. These analyses and associated regulatory actions provide further justification for the conclusion that risk from accidents at SFPs is low. For example, in 2001, the NRC published NUREG-1738 (NRC 2001), which evaluated SFP risk during decommissioning.

Magnuson Comments
NUREG-1738 is a "Technical Study of Spent Fuel Pool Accident Risk at Decommissioning Nuclear Power Plants." The risk at Decommissioning Nuclear Power Plants is not applicable to the License Renewal of operating nuclear power plants.

It is unacceptable to base any LR GEIS regulatory conclusions or decisions on NUREG-1738—without explicitly explaining the specific aspects that are applicable to operating nuclear plants. (**33-1-18** [Magnuson, Brian])

Comment: Draft NUREG-1437 Revision 2 E.3.7 Impact From Accidents at Spent Fuel Pools

The 2013 LR GEIS considered the risk from severe accidents in SFPs relative to the risk from severe accidents in reactors, including a comparison to the findings in the 1996 LR GEIS. The 2013 LR GEIS concluded that the environmental impacts from accidents at SFPs, as quantified in NUREG-1738 (NRC 2001), can be comparable to those from reactor accidents at full power, as estimated in NUREG-1150 (NRC 1990).

Subsequent analyses performed, and mitigative measures employed since 2001, have further lowered the risk of this class of accidents. In addition, even the conservative estimates from NUREG-1738 are much less than the impacts from full power reactor accidents as estimated in the 1996 LR GEIS.

Comments
NUREG-1738 is a "Technical Study of Spent Fuel Pool Accident Risk at Decommissioning Nuclear Power Plants." It is not applicable to the License Renewal of operating nuclear power plants.
It is fundamentally unacceptable to base any LR GEIS regulatory conclusions or decisions on NUREG-1738—without explicitly explaining the specific aspects are applicable to operating nuclear plants. (**33-2-1** [Magnuson, Brian])

Response: *The NRC disagrees with these comments regarding the use of NUREG-1738 (NRC 2001a). As discussed in Section E.3.7.1 of Appendix E of this LR GEIS, the NRC considers the analyses in NUREG-1738, which is based on a decommissioning facility, to be conservative in comparison to an operating reactor because a decommissioning reactor would have fewer protective features available to prevent or mitigate a release. Moreover, NUREG-1738 includes an assessment of SFP risk for time periods after shutdown of the reactor that are within the window for temporary shutdown of operating reactors. Specifically, scenarios are evaluated in which the reactor has been shutdown for 30 days and up to 2 years or longer. It is common for refueling outages at operating reactors to last up to 30 days or longer and, occasionally, for maintenance outages to last months. Therefore, the risk assessment in NUREG-1738 considers a facility that is comparable to the period of operation considered for license renewal. The NRC revised Section E.3.7.1 in Appendix E in this LR GEIS to clarify the description of scenarios evaluated in NUREG-1738.*

A.2.13.16 Comments Regarding LR GEIS Appendix E.3.7, Impacts from Accidents at Spent Fuel Pools - Use of GSI 82 and NUREG-1353

Comment: Draft NUREG-1437 Revision 2 E.3.7 Impact From Accidents at Spent Fuel Pools:
The 1996 LR GEIS did not include an explicit assessment of the environmental impacts of accidents at the SFPs located at each reactor site. The 1996 LR GEIS did, however, discuss qualitatively (see Section 5.2.3.1) the reasons why the impact of accidents at SFPs would be much less than that from reactor accidents. Thus, in Table B-1 of 10 CFR Part 51, it was concluded that accidents at SFPs could be classified as Category 1 and not require further analysis in support of license renewal.

This was primarily because of the resolution of Generic Safety Issue 82, "Beyond Design Basis Accidents in Spent Fuel Pools," concluded that the risk from accidents at SFPs was low and, accordingly, no additional regulatory action was necessary. The analysis supporting this conclusion is contained in NUREG-1353 (NRC 1989c).

Comments:
Contrary to Draft NUREG-1437 Revision 2, the NRC knows that the environmental impacts of SFP could be greater than reactor accidents.

NUREG-2161 explains why the radiological consequences of a severe SFP accident could be greater than that of a reactor core melt accident. "This is because a spent fuel pool stores significantly more fuel assemblies than a reactor core. Additionally, radionuclides released during a spent fuel pool accident have longer half-lives (e.g., Cesium-137) than those that would be released during a reactor accident."
Furthermore, the NRC has not evaluated the integrated environmental impacts of multi-reactor/SFP accidents as recommended by the Fukushima NTTF.

Reference NUREG-2161 Table 35, Average Land Interdiction and Table 33, Overall Consequence Results, which lists the radiological and environmental consequences of a single SFP accident.
Given these NRC references, it seems wrong to classify SFP accidents as Category 1.

The Fukushima Near Term Task Force (NTTF) recommendations, and NRC Orders EA-12-051 and EA-12-049, expose the fact that NUREG-1353 did not resolve the Generic Safety Issue of "Beyond Design Basis Accidents in Spent Fuel Pools." It is unacceptable to base pending or future LR GEIS regulatory conclusions or decisions on Generic Safety Issue 82 and NUREG-1353.

The 1996 LR GEIS information is stale. It does not reflect the current state of knowledge or the lessons learned from Fukushima. It is unacceptable to base pending or future LR GEIS regulatory conclusions or decisions on the 1996 LR GEIS.

This information is new and significant.

Until the NRC takes a 'hard look' at the environmental impacts of integrated plant-specific multi-reactor/SFP accidents—that include on-site dose consequences, it seems imprudent to consider any license renewals.

Again, I believe it is unacceptable to classify SFP accidents as Category 1.
(**33-1-15** [Magnuson, Brian])

Comment: References:
Generic Safety Issue 82, "Beyond Design Basis Accidents in Spent Fuel Pools":

The staff concluded that reducing the risk from spent fuel pools due to events beyond the SSE would still leave a comparable risk due to core damage accidents. Because of the large inherent safety margins in the design and construction of spent fuel pools, this issue was RESOLVED and no new requirements were established.

NUREG-1353, "Regulatory Analysis for the Resolution of Generic Issue 82 'Beyond Design Basis Accidents in Spent Fuel Pools.'" (U.S. Nuclear Regulatory Commission, April 1989)

Reference Comments:
The Fukushima Near Term Task Force (NTTF) recommendations, and NRC Orders EA-12-051 and EA-12-049, expose the fact that NUREG-1353 did not resolve the Generic Safety Issue of "Beyond Design Basis Accidents in Spent Fuel Pools." It is unacceptable to base pending or future LR GEIS regulatory conclusions or decisions on Generic Safety Issue 82 and NUREG-1353. (**33-1-16** [Magnuson, Brian])

Response: *The NRC disagrees with the comment regarding the use of Generic Safety Issue (GSI) 82 and NUREG-1353 (NRC 1989). The determination that severe accidents at spent fuel pools (SFPs) are subsumed in the overall severe accidents Category 1 finding was not based solely on the conclusions of GSI 82 and NUREG-1353 or on information that was only available at the time of the 1996 LR GEIS. Rather, as discussed extensively in Section E.3.7 of Appendix E of this LR GEIS, the risk insights from the totality of the NRC SFP accident risk assessment studies are considered in the LR GEIS, including studies completed since the 1996 LR GEIS and after the Fukushima Dai-ichi accident (specifically, NUREG-2161 [NRC 2014b]).*

The NRC also disagrees with the comment's suggestion that the impacts of an SFP accident would be greater than a reactor accident because of the larger inventory in an SFP. Rather, the environmental impact of severe accidents is based on risk or probability-weighted consequences, not just the consequences of accidents. This is because, unlike the other expected environmental impacts evaluated in the LR GEIS predicated on routine (normal) reactor operations, accidents have a probability of occurrence. The composite of the SFP accident risk assessments discussed in Section E.3.7 of Appendix E of this LR GEIS provides a strong basis for the NRC conclusion that the risk from accidents at SFPs is low, because of the small frequency of occurrence, and is bounded by the probability-weighted consequences reported in the 1996 LR GEIS.

Furthermore, none of the NTTF recommendations in SECY-11-0093 (NRC 2011) are related to the evaluation of consequences of multi-reactor/SFP accidents. Rather, the NTTF recommendations with regard to multi-unit events and concurrent related events are to strengthen emergency preparedness at nuclear power plants to be capable of responding to prolonged station blackout and multi-unit events and to enhance accident mitigation capability. Section E.2 of Appendix E of the LR GEIS provides a summary of the NRC staff actions taken to address the NTTF recommendations, and Section E.3.7 provides a summary of actions taken that directly reduce SFP severe accident risk. The NRC conclusion after consideration of the Fukushima accident and implementation of the NTTF recommendations is that the probability-weighted consequences of severe accidents reported in the 1996 LR GEIS remain bounding.

As discussed in Section E.4 of Appendix E of this LR GEIS, the NRC Full-Scope Site Level 3 PRA study is evaluating multi-unit or integrated site risk. If new and significant information arises out of this study, then that information will need to be considered in license renewal applications. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.

A.2.13.17 Comments Regarding LR GEIS Appendix E.3.7, Impacts from Accidents at Spent Fuel Pools – NUREG-1738 and Emergency Response

Comment: References

NUREG-1738, Technical Study of Spent Fuel Pool Accident Risk at Decommissioning Nuclear Power Plants:

The end state used for these accident sequences was an SFP water level 3 feet above the top of the fuel. This simplified end state was used because recovery below this level, given failure to recover before reaching this level, was judged to be unlikely given the significant radiation field in and around the SFP at lowered water levels.

The endstate for this analysis is defined as loss of coolant inventory to the point of fuel uncovery from either leakage or boil-off. Dose calculations (Ref. 5) show that when there is less than 3 feet of water above the top of the fuel, an environment that is rapidly lethal to anyone at the edge of the pool can result. Therefore, 3 feet has been adopted as an effective limit for recovery purposes. In other words, the endstate for this analysis is effectively defined as loss of coolant inventory to a point 3 feet above the top of the fuel.

In conjunction with the frequency of the uncovery of the spent fuel, it is important to know the time it takes the fuel to heat up once it has been uncovered fully or partially. Figures 2.1 and 2.2 in Section 2 show the time needed with and without air circulation to heat up the fuel from 30°C to 900°C (the temperature at which zirconium oxidation is postulated to become runaway oxidation and at which fission products are expected to be expelled from the fuel and cladding). The staff realizes that the volumetric rate of air flow that a fuel bundle receives during a loss of cooling event significantly influences the heatup of the bundle. To achieve sufficient long-term air cooling of uncovered spent fuel, two conditions must be met: (1) an air flow path through the bundles must exist, and (2) sufficient SFP building ventilation flow must be provided. The presence of more than about 1 foot of water in the SFP, as in a seismically induced SFP failure or the late states of a boildown sequence, would effectively block the air flow path. Seismically induced collapse of the SFP building into the SFP could have a similar effect. Loss of building ventilation would tend to increase fuel heatup rates and maximum fuel temperatures, as described in Appendix 1A.

In its thermal-hydraulic analysis, documented in Appendix 1A, the staff concluded that it was not feasible, without numerous constraints, to establish a generic decay heat level (and therefore a decay time) beyond which a zirconium fire is physically impossible. Heat removal is very sensitive to these additional constraints, which involve factors such as fuel assembly geometry and SFP rack configuration. However, fuel assembly geometry and rack configuration are plant specific, and both are subject to unpredictable changes after an earthquake or cask drop that drains the pool. Therefore, since a non-negligible decay heat source lasts many years and since configurations ensuring sufficient air flow for cooling cannot be assured, the possibility of reaching the zirconium ignition temperature cannot be precluded on a generic basis.

The change in risk due to relaxation of offsite EP is small because the overall risk is low, and because even under current EP requirements, EP was judged to have marginal impact on evacuation effectiveness in the severe earthquakes that dominate SFP risk.

Insurance does not lend itself to a "small change in risk" analysis because insurance affects neither the probability nor the consequences of an event. As seen in figure ES-2, as long as a

zirconium fire is possible, the long-term consequences of an SFP fire may be significant. These long-term consequences (and risk) decrease very slowly because cesium-1 37 has a half-life of approximately 30 years. The thermal-hydraulic analysis indicates that when air flow has been restricted, such as might occur after a cask drop or major earthquake, the possibility of a fire lasts many years and a criterion of "sufficient cooling to preclude a fire" cannot be defined on a generic basis. Other policy considerations beyond the scope of this technical study will therefore need to be considered for insurance requirements.

The staffs risk analyses were complicated by a lack of data on severe-earthquake return frequencies, source term generation in an air environment, and SFP design variability. Although the staff believes that decommissioning rulemaking can proceed on the basis of the current assessment, more research may be useful to reduce uncertainties and to provide insights on operating reactor safety. In particular, the staff believes that research may be useful on source term generation in air, which could also be important to the risk of accidents at operating reactors during shutdowns, when the reactor coolant system and the primary containment may both be open.

The study provides insights for the design and operation of SFP cooling and inventory makeup systems and practices and procedures necessary to ensure high levels of operator performance during off-normal conditions. The study concludes that, with the fulfillment of industry commitments and satisfaction of a number of important staff assumptions, the risks from SFPs can be sufficiently low to evaluate exemptions involving small changes to risk parameters and to contribute to the basis for related rulemaking. (**33-1-19** [Magnuson, Brian])

Comment: The analyses in Appendix 1A determined that the amount of time available (after complete fuel uncovery) before a zirconium fire depends on various factors, including decay heat rate, fuel burnup, fuel storage configuration, building ventilation rates and air flow paths, and fuel cladding oxidation rates. While the February 2000 study indicated that for the cases analyzed a required decay time of 5 years would preclude a zirconium fire, the revised analyses show that it is not feasible, without numerous constraints, to define a generic decay heat level (and therefore decay time) beyond which a zirconium fire is not physically possible. Heat removal is very sensitive to these constraints, and two of these constraints, fuel assembly geometry and spent fuel pool rack configuration, are plant specific. Both are also subject to unpredictable changes as a result of the severe seismic, cask drop, and possibly other dynamic events which could rapidly drain the pool. Therefore, since the decay heat source remains nonnegligible for flow many years and since configurations that ensure sufficient air[2] for cooling cannot be assured, a zirconium fire cannot be precluded, although the likelihood may be reduced by accident management measures.

[2]Although a reduced air flow condition could reduce the oxygen levels to a point where a fire would not be possible, there is sufficient uncertainty in the available data as to when this level would be reached and if it could be maintained. It is not possible to predict when a zirconium fire would not occur because of a lack of oxygen. Blockage of the air flow around the fuel could be caused by collapsed structures and/or a partial draindown of the SFP coolant or by reconfiguration of the fuel assemblies during a seismic event or heavy load drop. A loss of SFP building ventilation could also preclude or inhibit effective cooling. As discussed in Appendix 1A, air flow blockage without any recovery actions could result in a near-adiabatic fuel heatup and a zirconium fire even after 5 years.

Depending on the time since reactor shutdown, fuel burnup, and fuel rack configuration, there may be sufficient decay heat for the fuel clad to heat up, swell, and burst after a loss of pool water. The breach in the clad releases of radioactive gases present in the gap between the fuel

and clad. This is called "a gap release" (see Appendix 1 B). If the fuel continues to heat up, the zirconium clad will reach the point of rapid oxidation in air. This reaction of zirconium and air, or zirconium and steam is exothermic (i.e., produces heat). The energy released from the reaction, combined with the fuel's decay energy, can cause the reaction to become self-sustaining and ignite the zirconium. The increase in heat from the oxidation reaction can also raise the temperature in adjacent fuel assemblies and propagate the oxidation reaction. The zirconium fire would result in a significant release of the spent fuel fission products which would be dispersed from the reactor site in the thermal plume from the zirconium fire. Consequence assessments (Appendix 4) have shown that a zirconium fire could have significant latent health effects and resulted in a number of early fatalities. Gap releases from fuel from a reactor that has been shutdown more than a few months involve smaller quantities of radionuclides and, in the absence of a zirconium fire, would only be of concern onsite. (**33-1-20** [Magnuson, Brian])

Comment: Reference Comments
In isolation, specific aspects of NUREG-1738 appear to be applicable to operating nuclear plants. For example, "EP was judged to have marginal impact on evacuation effectiveness in the severe earthquakes that dominate SFP risk."

Emergency Preparedness Evacuation Time Estimates (ETE) are plant-specific. They are a function of Emergency Planning Zone (EPZ) population density and the local infrastructure. It stands to reason, that beyond-design-basis seismic accidents/events could adversely impact local infrastructures; however, there are no regulatory requirements to evaluate evacuation delay times caused by a design-basis or a beyond-design-basis seismic event. Nuclear plants Emergency Preparedness plans are not required to prepare for these types of emergencies, they need only to consider the loss of infrastructure after the fact.

NUREG/CR-7002 (Revision 1), Criteria for Development of Evacuation Time Estimate Studies, states:

"In the unlikely event that the conditions of an EPZ change significantly because of major construction projects, persistent conditions as a result of natural phenomena, or for other reasons, such as a bridge collapse on a primary evacuation route, the licensee should update the ETE analysis if a sensitivity study is not already included in the ETE study."

Given this, undue credit should not be given to Emergency Preparedness evacuations when evaluating beyond-design-basis, seismic SFP accidents. Reference NUREG-2161, Consequence Study of a Beyond-Design-Basis Earthquake Affecting the Spent Fuel Pool for a U.S. Mark I Boiling Water Reactor
In any nuclear power plant accident, the off-site radiological consequences (population doses and environmental impacts) are a function of on-site mitigative actions taken, primarily, by main control room operators. For this reason, main control room ventilation systems were 'back' fitted with emergency air filtration systems (NUREG-0737 III.D.3.4, Control Room Habitability) to restore 'compliance' with General Design Criterion 19.

Unfortunately, severe SFP accidents cannot be mitigated from main control rooms. NEI 12-06, Diverse and Flexible Coping Strategies (Flex) Implementation Guide (NRC Order EA-12-049 and EA-12-051) describes SFP accident mitigation strategies, which include actions to route multiple hose sections (hundreds of feet) to use portable pumps to add water to SFP.

In-plant operators would be required to perform plant-specific time-critical actions under extreme environmental conditions. In addition to the radiological conditions, SFP heat up and boil-off

would exacerbate the on-site environmental hazards (e.g., high temperatures, high humidity, steam environments, condensation, poor visibility, etc.).

Whatever natural phenomenon that may have instigated the severe SFP accident would also complicate mitigative actions. The loss of infrastructure caused by seismic events or subfreezing temperatures would complicate mitigative actions taken by in-plant operators.

In virtually any nuclear accident, it stands to reason that in-plant/on-site radiological consequences would be more adverse than the off-site consequences. This difference must be considered and appropriately evaluated to determine the environmental impacts from severe SFP accidents.

Sometime before off-site radiological conditions would cause "early fatalities" or "prompt fatalities," on-site radiological conditions would incapacitate staff or otherwise delay or, prevent SFP water additions, which could lead to a zirconium fire and result in one or more reactor accidents.

Given the Fukushima NTTF recommendations to assess the consequences of multi-reactor/SFP accidents, what are the insurance requirements? Is American Nuclear Insurers (ANI) aware of the consequences of multi-reactor/SFP accidents?

Is American Nuclear Insurers (ANI) aware of the consequences of a single SFP accident (i.e., NUREG-2161 Table 33, Overall Consequence Results?

Given the NRC has not evaluated the consequences of multi-reactor/SFP accidents, how could ANI possible insure nuclear plants for of these accidents? It would be imprudent, if not unlawful, to renew the license of nuclear plants that are under insured.

NUREG-1738 does not support classify SFP accidents as Category 1.

Additional extracts of NUREG-1738 are listed for future reference.

It seems that NUREG-1738 acknowledged the on-site radiological concerns only to dismiss them. (**33-1-21** [Magnuson, Brian])

Response: *The NRC disagrees with the comments regarding NUREG-1738 (NRC 2001a) and emergency response. Nuclear power plants are required to produce comprehensive emergency preparedness programs that assure the adequate protection of the public in the event of a radiological emergency. Emergency preparedness planning incorporates the means to rapidly identify, evaluate, and react to a wide spectrum of emergency conditions. Emergency plans are dynamic and are routinely reviewed and updated to reflect an ever-changing environment during plant operation. Each of the NRC SFP severe accident studies discussed in Section E.3.7 of Appendix E of this LR GEIS made numerous assumptions about evacuation following an accident, including, but not limited to, the evacuation rate or speed, percentage of population evacuated, and delay time to initiation of evacuation after declaration of a general emergency. The base assumptions reflect typical NRC-approved emergency plans. Each of the SFP studies also performed various sensitivity studies to assess the sensitivity to uncertainties in the assumptions. For example, both NUREG-1738 (NRC 2001a) and NUREG-2161 (NRC 2014b) considered the sensitivity of the risk results to slower evacuation times, which may be due to such conditions as inclement weather and seismic-induced infrastructure damage. The conclusion in NUREG-2161 is that evacuation uncertainty is unlikely to significantly affect the*

conclusion that the risk of early fatalities from SFP accidents is very low. Furthermore, the conditional individual latent cancer fatality risk from 0 to 10 miles for the scenarios studied in NUREG-2161 is several orders of magnitude below that reported in NUREG-1738.

The NRC does not regulate American Nuclear Insurers or the amount of annual insurance premiums paid to insure nuclear power plants, and so the topic of insurance coverage is outside the scope of this LR GEIS and rulemaking. However, in accordance with the Price-Anderson Nuclear Industries Indemnity Act, the NRC requires that all nuclear power reactors have and maintain financial protection, or insurance, to cover liability claims of members of the public for personal injury and property damage caused by a commercial nuclear power plant accident.

The NRC agrees that in-plant/onsite radiological consequences should be considered and appropriately evaluated to determine the environmental impacts of severe SFP accidents. In the most recent NUREG-2161 (NRC 2014b) SFP study, the ability of workers to take mitigative actions was explicitly considered. No "heroic" human worker actions were credited—only those that could be safely performed. "When SFP water is drained to the top of fuel rack, the radiation level is considered too high to deploy SFP mitigation strategies on the refuel floor" (see NUREG-2161, p. 179). So, in those very low-probability scenarios where drain down reaches the top of the fuel rack, no worker mitigation near the SFP is credited, and hence those losses are built into the overall risk assessment. Moreover, the NRC has undertaken a number of measures in response to 9-11 and Fukushima that would further worker safety onsite in the event of an SFP accident, such as the requirement in the post-Fukushima orders to provide reliable instrumentation for monitoring SFPs following an accident. Appendix E of this LR GEIS demonstrates that the impacts of an SFP accident would be similar to an at-power reactor accident, and other portions of Appendix E specifically address onsite impacts during an accident, such as the SAMA analyses. No changes were made to the LR GEIS as a result of this comment.

As discussed in Section E.4 of Appendix E of the LR GEIS, the NRC Full-Scope Site Level 3 PRA study is evaluating integrated site risk. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.

A.2.13.18 Comments Regarding LR GEIS Appendix E.3.7, Impacts from Accidents at Spent Fuel Pools – Use of NUREG-2161

Comment: 3. Contrary to the regulations listed in Regulatory Guide 1.29, 'Seismic Design Classification,' some existing SFP structures and SFP gates are not designed to withstand the effects of the design-basis earthquake (Safe Shutdown Earthquake), much less a beyond-design-basis earthquake. Instead of identifying and addressing the vulnerabilities created by these design deficiencies (as recommended by the Fukushima NTTF), the NRC simply proffers that (Non-Seismic Category I) SFP structures and gates are "robust" and are not expected to fail in beyond-design-basis seismic events. (**33-1-6** [Magnuson, Brian])

Comment: 3. Contrary to the regulations listed in Regulatory Guide 1.29, '*Seismic Design Classification*,' some existing SFP structures and SFP gates are not designed to withstand the effects of the design-basis earthquake (Safe Shutdown Earthquake), much less a beyond-design-basis earthquake. Instead of identifying and addressing the vulnerabilities created by these design deficiencies (as recommended by the Fukushima NTTF), the NRC simply proffers that (Non-Seismic Category I) SFP structures and gates are "robust" and are not expected to fail in beyond-design-basis seismic events. (**33-1-13** [Magnuson, Brian])

Comment: Draft NUREG-1437 Revision 2 E.3.7 Impact From Accidents at Spent Fuel Pools
More recent analysis demonstrates even lower risk and safety improvements. For example, the NRC performed a consequence study in NUREG-2161, Consequence Study of a Beyond-Design-Basis Earthquake Affecting the Spent Fuel Pool for a U.S. Mark I Boiling Water Reactor (NRC 2014a), referred to as the Spent Fuel Pool (SFP) Study, to continue its examination of the risks and consequences of postulated SFP accidents.

NUREG-2161 (NRC 2014a) provides publicly available consequence estimates of a hypothetical SFP accident initiated by a low-likelihood seismic event at a specific reference plant. The study compares high-density and low-density loading conditions and assesses the benefits of post-9/11 mitigation measures.

The NUREG-2161 results are consistent with earlier research conclusions that SFPs are robust structures that are likely to withstand severe earthquakes without leaking. The NRC continues to believe, based on this study and previous studies, that high-density storage of spent fuel in pools protects public health and safety.

Comments: Contrary to Draft NUREG-1437 Revision 2, NUREG-2161 does not necessarily demonstrate lower risk of severe SFP accidents. Among its limitations, NUREG-2161 does not asses multi-reactor/SFP accidents.

The plant-specific qualifications made in NUREG-2161 do not support classifying SFP accidents as Category 1.

NUREG-2161 results are consistent with earlier research conclusions that rely on the seismically 'robust' contravention; however, the results defy reason.

Claiming that the storage of high volumes of hazardous, irradiated fuel in spent fuel pools—protects public health and safety is nonsense and an insult to the intelligence of the reader and the public. -Public comment by Janet Novotny

Reference NUREG-2161 Table 33, Overall Consequence Results, copied below, and the NUREG-2161 extracts that refer to high-density storage.

Please see the Reference Comments below. (**33-2-3** [Magnuson, Brian])

Comment: References
NUREG-2161, Consequence Study of a Beyond-Design-Basis Earthquake Affecting the Spent Fuel Pool for a U.S. Mark I Boiling Water Reactor:
The study uses best-estimate ruthenium release rates calculated by the MELCOR code. These release rates are most similar to the low ruthenium release case from NUREG-1738.

For the high-density cases, the releases are limited to a few percent of the cesium inventory, except for a few cases that predicted hydrogen combustion and resulted in releases of one to two orders of magnitude higher than the other cases. In these cases, the spent fuel heats up in a steam environment leading to oxidation of zirconium and releasing hydrogen gas into the reactor building. The mixing and reaction of hydrogen and oxygen leads to a hydrogen combustion and substantially damages the reactor building. That damage could breach structures that would retain radioactive material, along with allowing more oxygen into the building, potentially increasing the severity of the spent fuel fire.

The additional water can have a non-intuitive negative impact in certain situations. For a leak at the bottom of the SFP, the additional water at the elevation of the fuel causes it to take longer to "clear" the baseplate (i.e., for the level of the receding water to drop below the bottom of the baseplate). In situations where natural circulation of air under and up through the racks is effective for preventing fuel heatup, this actually temporarily inhibits cooling of the fuel.

In the context of a seismic event, the elevation of the pool will affect the transmission of seismic loads through the structure, can potentially inhibit accessibility for taking mitigative action, and can potentially lead to flooding of safety-related equipment, if the pool and surrounding structures are significantly damaged.

In reality, there are differences between the major design types (PWRs versus BWRs) that make each more or less susceptible to SFP accidents on a scenario-specific basis. Similarly, the selection of a site that has a separate SFP for each reactor (as opposed to a shared pool) is also not intended to suggest that these situations are inherently more vulnerable.
Because this study strives to be site-specific, it does not account for the variability in design and operation across the operating fleet, but rather, represents one point within that spectrum (Unit #3 of the Peach Bottom Atomic Power Station (PBAPS), circa 2011.)

Qualitative arguments are provided to show that the likelihood of core damage from SFP boiling accidents is low for most U.S. commercial nuclear power plants. The INL study also showed that, depending on the design characteristics of a given plant, the likelihood of either (1) core damage from SFP-associated flooding or (2) spent fuel damage from pool dryout may not be negligible.

The study focuses on the SFP, not the reactor, though for instances in which the two are hydraulically connected, both are considered to a certain extent. (**33-2-4** [Magnuson, Brian])

Comment: Item #(5)"effects of a concurrent reactor accident" generally have not been studied in prior efforts. The frequency and consequences of a reactor accident is not considered and the effect of a reactor accident on a spent fuel pool scenario is partially considered here, but not rigorously.

Multi-unit / concurrent reactor accidents are not, in general, considered. Specifically, the reactor (and its decay heat) is treated during the outage until the level in the reactor well / SFP drops to below the bottom of the fuel transfer canal. Beyond that point, and in all portions of the post-outage scenarios, the reactor is not considered as a source of steam, fission products or hydrogen.

Inadvertent criticality events are not considered.

Seismic hazard models -this study used the existing USGS 2008 model instead of the model in the ongoing program. While the USGS (2008) hazard model is not sufficiently detailed for regulatory decisions, it is appropriate to use for this study because it was the most recent and readily available hazard model for the selected site at the start of the study.
No significant debris generated by the seismic event enters the SFP. -Based on the expected structural response of the building, overhead crane, etc. there is no expectation that heavy debris that would damage the pool and fuel will be generated as a direct result of the seismic event itself.

The seals of the refueling gate do not fail. -Finite element analysis does not predict large deformations in this area that would suggest such an event is likely. Details of the gates provided by the licensee show that there are two gates with a gap in between and that each gate has mechanical seals to prevent leakage. These seals are kept under pressure by passive mechanical means (i.e., do not depend on air pressure, ac power, or dc power) that are unlikely to fail under the earthquake.

Failure of nearby dams is not explicitly addressed.
50.54(hh)(2) mitigation capacities (i.e., 500 gpm makeup delivered or 200 gpm spray delivered) are based on the generic NRC endorsed capacities in NEI-06-12, Revision 2.

The study does not consider debris entering the pool as a result of any modeled hydrogen combustion event. Such debris could be generated and could fall into the pool. However, the occurrence of a hydrogen combustion event in this study denotes that the fuel in the SFP has already become uncovered and is undergoing a fission product release. Thus, debris would primarily serve to inhibit longer term recovery actions not considered in this study. The occurrence of a hydrogen combustion event from a concurrent reactor accident has the potential to generate debris which could impair SFP natural circulation air or steam cooling (should the fuel in the SFP become uncovered) for conditions in which the fuel might otherwise be cooled by means of these passive cooling modes.

However, this latter situation is inherently tied to the study's lack of a comprehensive treatment of multiunit aspects.

The study does not consider the effects of molten core-concrete interaction (MCCI). -The MELCOR code models heat transfer from the debris to the pool floor, as well as the fission product release from hot debris. In some cases, the debris temperature remains above typical concrete ablation temperatures (~1500 K). MCCI may occur in selected scenarios in which the fuel relocated to the bottom of the pool following the failure of the rack baseplate and its temperature exceeded the concrete ablation temperature. These cases involve large-scale debris relocation and large releases of volatile fission products. Even without MCCI, the fuel in debris form continues to release fission products resulting in very large releases of volatiles.

Calculated results are from atmospheric-type releases only.
The seismic event has a limited effect on emergency response. --The study assumed that the seismic event would not significantly affect emergency response. This is based on an assessment in NUREG-1935 of the same site and seismic event that assumed the damage to local infrastructure is limited to 12 bridges, partly due to the few large structures in the area. Also, the extended loss of ac power is assumed to be limited to the EPZ (~10 miles) due to the assumption that the strength of the seismic event is from the proximity of the seismic event to the site, rather than being a wider impact from a larger magnitude.

Decontamination will occur only if it will eventually allow for the return of land to habitability, and if it is economic to do so. --A long-term cleanup policy for severe accidents does not currently exist, although guidance is currently being drafted. In addition, guidance could recommend the development of localized cleanup goals after an accident, to account for sociopolitical, technical, and economic considerations. Given that a policy for long-term cleanup does not currently exist (and because a developed policy may not contain explicit cleanup goals), the project instead uses dose levels associated with habitability to decide what land is to be decontaminated. (**33-2-5** [Magnuson, Brian])

Comment: Observations Regarding a Multiunit Event:

There are four broad interplays that can be defined between the SFP and the reactor:
(1) an initiating event that directly affects both the reactor and the SFP

(2) a reactor accident that prevents accessibility to the SFP for a prolonged period of time (e.g., due to high radiation fields), leading to a SFP accident

(3) a reactor accident that includes ex-containment energetic events (e.g., a hydrogen combustion event) or other ex-containment interplays (e.g., steaming through the drywell head that affects refuel floor combustible gas mixtures) and creates a hazard to the SFP (e.g., by causing debris to fall in to the pool) or otherwise changes the SFP event progression5

(4) an SFP accident that prevents accessibility to key reactor systems and components for a prolonged period of time or which creates a hazard for equipment used to cool the reactor (e.g., the flooding of low elevations of the reactor building due to a leak in the pool or excessive condensation from continuous boiling of SFP water), leading to a reactor accident.

For each of these interplays, large seismic events and severe weather SBO events are logically the most relevant initiators, as they are the type of initiators that are most likely to initiate an accident at the reactor and SFP, while simultaneously hampering further accessibility to key areas, key systems and components, and key resources.

Along with the possibility of a concurrent SFP and reactor accident, there is the possibility for a concurrent accident at the SFP of one unit with an accident at the SFP or reactor of the other unit. Again, a large seismic event or a severe weather SBO are the events that are most likely to lead to a multiunit event. In general, if accidents at both SFPs proceed in similar manners and similar timeframes, and both pools have similar inventories of spent fuel, then the resulting source term from a dual-unit event would be roughly twice the single-unit source term. In reality, this type of perfect symmetry is unlikely because the two (or more) SFPs are very unlikely to have the same total pool heat load or peak assembly heat load. (Recall that for multiunit sites, the reactors did not usually start operation at the same time and outages are intentionally staggered.) Even if this symmetry did exist, the offsite consequences would not follow a linear scaling because of a number of nonlinearities associated with that portion of the analysis. Again, capturing these effects was not a focus of this study, and future work (the SECY-11-0089 Level 3 PRA) will attempt to more rigorously treat these effects. (**33-2-6** [Magnuson, Brian])

Comment: 2.3 Inadvertent Criticality:
Inadvertent criticality events (ICEs) may be possible for specific combinations of conditions (e.g., during reflood of a drained pool for a region of the pool storing higher reactivity fuel assemblies where the boron poison in the rack panels has been significantly displaced as a result of the earthquake). If such an event affected a region of the pool (as opposed to only a portion of a particular assembly), and if it occurred at a point in the accident where the fuel was only partially covered, the event could have an important impact on onsite dose rates. Further, if an ICE were severe enough to produce significant heat, the fuel will be harder to cool and short-lived radionuclides will be produced. Design requirements and safety analyses ensure that the spent fuel stored in the pool, under normal conditions, will not result in a critical configuration.

"Advantageous" considerations, including the following:
*BWR SFPs do not use borated water so the fact that the SFP may be refilled with unborated water is not a deviation from the norm.

Counter considerations:
*The poison material in the rack panels contribute significantly to the net reactivity of the SFP configuration (i.e., they are a key component to ensuring subcriticality for high reactivity assemblies).

*The effects of large seismic events on already degraded SFP rack poison material are not easy to quantify.
*The rack panels and poison material have a lower melting temperature than the cladding and fuel.
*Termination of a SFP ICE during an event that required deployment of mitigation equipment could be difficult.
*The possibility of a criticality event cannot be summarily dismissed.

Finally, the offsite consequences of a criticality event (especially if it occurs when overlying water is present) are believed to be less severe from a public health and safety standpoint than the offsite consequences from a potential large release of radioactive material associated with a prolonged uncovering of the fuel in the SFP resulting from not attempting to reflood. In consideration of all of the above, common accident management practices in the United States call for the use of any available water in responding to fuel uncovery in either the reactor or SFP. This study shows the precedent, while recommending that future work be done to better understand the specific combinations of conditions that could lead to ICEs during a large seismic event. (**33-2-7** [Magnuson, Brian])

Comment: Damage States for the Spent Fuel Pool Structure
Define three initial states for the subsequent accident progression analysis as follows:
(a) A state with no leakage, and no loss of coolant, from the bottom of the SFP. This state corresponds to concrete cracking at the base of the walls (estimated to be through-wall cracking for the event considered as shown in subsequent subsections) but without tearing of the liner.

(b) A state with moderate leakage rate from the bottom of the SFP, corresponding to through-wall concrete cracking at the bottom of the walls with tearing of the liner that propagates to an extent such that water leakage is controlled by the size of the cracks in the concrete.

(c) A state with small leakage rate from the bottom of the SFP, corresponding to through-wall concrete cracking at the bottom of the walls and tearing of the liner that remains localized such that water leakage is controlled by the size of the tearing in the liner. (**33-2-8** [Magnuson, Brian])

Comment: Other Damage States
Assessment of other damage stages is primarily based on (1) finite element deterministic response spectra analysis to estimate maximum vertical displacements of the water surface (sloshing), (2) seismic fragilities used in conjunction with the NUREG-1150 seismic PRA study (Lambright et al., 1990), (3) the examination of design details for certain appurtenances such as the refueling gate, and (4) maximum displacements (vertical and horizontal) of the SFP floors and walls under the applied loads.

Damage to Refuel Gate, SFP Penetrations, Spent Fuel Assemblies and Racks

Refuel gate: A site visit and examination of the refueling gate structural drawings revealed the following:

* The steel gate next to the water is backed by a similar gate.

*Each of these gates consists of a steel-plated decking with steel stiffeners.

*Each gate has a polymeric seal around its perimeter that is pressed against the concrete by passive mechanical means that are not expected to be lost during the seismic event. Since these are passive mechanical means the effectiveness of the seals does not depend on the availability of ac or dc power.

*Tolerances around the seals are sufficient to accommodate the already small distortions of the biological concrete shielding in the refueling area from the seismic event.

Based on the above, the study assumes that the refueling gate will not fail for the seismic event considered and will continue to maintain its intended function during the accident progression.

Spent fuel racks and assemblies: Damage to the spent fuel assemblies and racks was not calculated as part of this study. The study assumes that under the applied seismic loads a coolable configuration would be maintained. This assumption is consistent with the seismic assessments made in conjunction with the resolution of GI-82 and reported in NUREG/CR-5176 (Prassinos et al., 1989). As in the case considered in GI-82, the spent fuel racks for the site considered are allowed to slide, which tends to reduce the magnitude of the seismic accelerations on the racks and partially decouple their dynamic response from the response of the SFP. In addition, the high-frequency components (greater than 10 Hz) of the motion would not be expected to induce large sliding or rocking motions. (**33-2-9** [Magnuson, Brian])

Comment: Treatment of Mitigation
One of the objectives of this study is to provide insights into the effectiveness and benefits of mitigation measures currently employed at nuclear power plants. In addition to the redundant and diverse physical systems designed to prevent severe accidents, NRC requires plant owners to have preplanned emergency measures in the unlikely event an accident occurs.

When they are successfully implemented, NRC expects these emergency measures will mitigate accident consequences by preventing, delaying, or reducing a potential release of radioactive material from the SFP. These measures include a site-specific emergency plan, emergency operating procedures, severe accident management guidelines, and 10 CFR 50.54(hh)(2) mitigation measures put in place to respond to the loss of large areas of the plant due to fires or explosions.

NRC requires its licensees to train and practice emergency measures to ensure that they have proper equipment, procedures, and training. NRC inspectors periodically observe these activities to help ensure that NRC regulations are met at each plant. The study assumes that the licensee's emergency response organization would implement these measures in accordance with approved emergency plans, procedures, and guidelines.

The uncertainties associated with the response to a beyond design-basis seismic event, and the resultant effects on the SFP, make consideration of unmitigated scenarios prudent from an informed decision-making standpoint.

However, for the large beyond-design-basis seismic event under consideration in this study, it is possible that significant damage to local infrastructure could occur, requiring emergency resources to also be needed in other areas. Additionally, radiation and other hazards (discussed in Section 5.3.2 of this report) could hinder access to the SFP and key equipment, making prevention or truncation of an ongoing SFP release challenging. (**33-2-10** [Magnuson, Brian])

Comment: Rationale for Producing Unmitigated Results
The large seismic event could damage onsite (and offsite) infrastructure designed to facilitate accident response, as well as cause general disruption at the site.
*If circumstances led to the uncovery of fuel in the SFP, radiation fields on the refueling floor might hamper mitigative actions.
*A concurrent reactor event (resulting from the loss of ac power or other damage), or an ongoing accident at the other unit's SFP, could hamper mitigative actions by reducing accessibility because of radiation fields, impeding accessibility because of other hazards such as hydrogen accumulation, or diverting resources (both personnel and equipment).
(**33-2-11** [Magnuson, Brian])

Comment: Refueling Floor Dose Rate Analysis Using SCALE
This study included analyses to predict the radiological conditions on the refuel floor for a range of conditions associated with loss of water in the SFP. Note that the analyses described in this section only account for the radiological conditions stemming from neutron and gamma "shine" from exposed radioactive material and do not account for the concern of radiological conditions associated with the release of that material following fuel heatup. It is expected that, if a radiological release of fission products from the SFP were to commence, radiation fields in the vicinity of the pool would be extremely high. (**33-2-12** [Magnuson, Brian])

Comment: Discussion of Repair and Recovery
This study makes no attempt to account for repair or recovery of onsite equipment or offsite power. This is a simplifying assumption, and is motivated in part by the lack of quantitative information available to support such a determination for the large seismic event being considered. Procedures would direct the operators to attempt to recover failed equipment and pursue alternate means of establishing ac power, such as the ability to obtain ac power from an SBO cross-tie line to the Conowingo Dam. The study assumes that the damage sustained by the onsite and offsite electrical distribution systems from the earthquake is enough to significantly delay these recoveries until after the 48-or 72-hour truncation times. That being said, and as covered previously in this section, the scenarios with successful deployment of mitigation do assume that onsite and offsite resources are able to extend operation of the 10 CFR 50.54(hh)(2) equipment indefinitely, which could represent a situation in which ac power is recovered at an intermediate point and ac-dependent means of SFP makeup are brought back online.

Identification of Key Events
* The 10 CFR 50.54(hh)(2) equipment (when credited) is available for the duration of the event, following delays associated with diagnosis and deployment.

*Initial water loss from "sloshing" will be 0.5 m (1.5 ft) (see Section 4.2 of this report).

*Tearing of the SFP liner is not the most probable outcome, but is possible.
*There is no failure of penetrations, including the refueling transfer canal gate.

*The overhead structures (building debris, crane) do not pose a threat to the SFP in terms of failure resulting from the initiating event.

*Inadvertent criticality, including seismic effects on the integrated poison rack material, is not treated.

A complete reactor building has been developed for the reference plant (NRC, 2012d). However, the bulk of the reactor building does not play a significant role in SFP accidents, given that the study does not explicitly model (1) the effect of the SFP accident on reactor systems or (2) specific obstacles to deploying mitigation (e.g., presence of steam on lower elevations). Consequently, the reactor building model was simplified to only model the refueling room. [See ML23123A408 for a copy of Table 27 Summary of Release Characteristics for High-Density Scenarios] (**33-2-13** [Magnuson, Brian])

Comment: Emergency Response Modeling
Since actions beyond the emergency planning zone (EPZ) would be ad hoc, there is no procedural guidance or exercise performance documentation upon which to base assumptions.

For each of the accident sequences, staff determined that a General Emergency would be declared promptly (within 15 minutes), based on the emergency action levels for the operating reactor. The timing of significant radiological release varied among the accident sequences and was an important factor in the response modeling. A release from a SFP with a moderate leak begins earlier than a damage state with a small leak, but these still do not begin until evacuation is well underway or completed within the EPZ.

General Public Evacuation: Residents evacuate the affected area when the official order to evacuate is received.

Early Evacuation: Residents evacuate after the earthquake, but before the official order to evacuate is received.

[See ML23123A408 for a copy of Table 32 Summary of Evacuation Models.]

The MACCS2 potassium iodide (KI) model used in this analysis assumes that KI would be distributed only within the EPZ. Half the residents within the EPZ are assumed to have access to their KI and to take it within the specified timeframe.

The seismic event is assumed to cause the loss of all onsite and offsite power within the EPZ, which can affect the response timing and actions of the public. Sirens would be sounded following the GE declaration, and because the reference plant will have a fully backed up siren system in 2013, it is assumed sirens sound for this analysis. The residents within the EPZ would have felt the earthquake, which effectively serves as the initial warning; however, the loss of power would affect the number of residents receiving instructions via emergency alert system messaging. It is expected that the residents use multiple methods of communication, such as cell phones, telephones, websites (where power is available), and direct interface to communicate the emergency message.

A long-term cleanup policy for recovery after a severe accident does not currently exist. The actual decisions regarding how land would be recovered and populations relocated after an accident would be decided by a number of local, state, and federal jurisdictions and would most likely be based on a long-term cleanup strategy, which is currently being developed by the NRC,

EPA, and other Federal agencies. Furthermore, a cleanup standard may not have an explicit dose level for cleanup. Instead, the cleanup strategy may give local jurisdictions the ability to develop localized cleanup goals after an accident, to allow for a number of factors that include sociopolitical, technical, and economic considerations.

[See ML23123A408 for a copy of Table 33 Overall Consequence Results.]

[8] Largest releases here are associated with small leaks (although sensitivity results show large releases are possible from moderate leaks). Assuming no complications from other SFPs/reactors or shortage of available equipment/staff, Section 8 shows that there is a good chance to mitigate the small leak event. (**33-2-14** [Magnuson, Brian])

Comment: 7.2.1 Individual Early Fatality Risk

For all scenarios, no offsite early fatalities attributable to acute radiation exposure are predicted to occur. Due to radioactive decay, spent fuel pools tend to have significantly less shorter-lived radionuclides (e.g. I-131) than reactors. Despite this, in at least one case that was analyzed, doses close to the site did reach levels that can induce early fatalities. Therefore, the potential (although remote) for early fatalities exists. However, emergency response as treated in this study effectively prevents any early fatality risk from acute radiation exposure, at least in part because the modeled accident progression results in releases that are long compared to the implementation of emergency response in the areas of most concern.

The projections of no early fatalities in this study is lower than that reported in some previous studies of risks from spent fuel pool accidents, such as NUREG/CR-6451 and NUREG-1738, and consistent with the earlier studies documented in NUREG-1353. Tables 4.1 and 4.2 of NUREG/CR-6451 project anywhere from approximately one to one hundred early fatalities within a 500 mile radius in the event of an accident involving the full spent fuel pool, with the higher values associated with high release fractions. NUREG-1738 (Table 3.7-1 and Table 3.7-2) reported similar values, ranging from no fatalities for low Ruthenium source terms with early evacuation to up to 192 early fatalities for an accident shortly (30 days) after shutdown with high Ruthenium source terms and late evacuation. NUREG-1353 does not provide quantitative estimates of early fatality risk but states that "...there are no "early" fatalities and the risk of early injury is negligible". On balance, the scenarios analyzed here are consistent with the lower end of the reported range from previous studies, in that no early fatalities are projected to occur. (**33-2-15** [Magnuson, Brian])

Comment: 7.2.3 Land Contamination

As the values in Table 33 suggest, conditional on a release (with a frequency of 1E-7 per year, or lower) occurring, the total land contamination area can be considerable. The low-frequency, large releases are significantly affected by hydrogen combustion events, which are currently predicted in some high-density loading situations without successful mitigation for 3 days, but not in other scenarios. For relatively small releases from a SFP, the extent of contaminated land could range to hundreds of square miles. For a large release, such as a release from a high-density pool without successful deployment of 50.54(hh)(2) mitigation that leads to a hydrogen combustion event, the amount of contaminated land can be two orders of magnitude higher (Table 35 partially reflects this range, although it reports average values). The levels of potential land contamination in the event of a release should be weighed against the likelihood of the accident.
[See ML23123A408 for a copy of Table 35 Average Land Interdiction.]

A release in the high-density fuel loading situation without successful 50.54(hh)(2) mitigation is capable of large releases, and therefore an average release from this situation is capable of causing significantly more land contamination at longer distances than in the other situations. In contrast, releases from situations with low density fuel loading (and/or successfully deployed 50.54(hh)(2) mitigation equipment) cause a relatively smaller amount of land contamination beyond 50 miles, and none beyond 100 miles when using land interdiction as a measurement of land contamination. This is because on average, a release in these situations contaminates significantly less area. However, because of the release magnitude of any of the analyzed SFP releases, the total amount of land contamination that remains within ten miles is relatively small.

On land contamination, past results are expected to be broadly consistent with this study. However some previous studies did not report land contamination and some reported different metrics for estimating areas, so a direct comparison is not possible. NUREG/CR-6451 reports values for condemned farmland that includes hundreds of square miles within a 50-mile radius and thousands of square miles within a 500 mile radius, albeit for a full core off-load. NUREG-1353 reports values for land contamination based on NUREG/CR-4982 that range into the hundreds of square miles, albeit largely within a 50-mile radius of the plant. These differences, as well as different choices for the land contamination criteria that can significantly affect the estimated areas, make a quantitative comparison less meaningful. However, it is clear that both this study and past studies have predicted that SFP accidents can lead to significant land contamination. (**33-2-16** [Magnuson, Brian])

Comment: 7.2.4 Displaced Individuals

Consistent with the results for land contamination, relatively large numbers of people may be impacted following a large release from a spent fuel pool. Displaced individuals, also known as relocated individuals, are people who are predicted to be temporarily or permanently relocated due to interdiction of contaminated land, based on the dose limit for land interdiction starting in the first year following an accident. These individuals are not necessarily the same as evacuees, who evacuate during the emergency phase (although an individual could be both of these).

Conditional on a release (with a frequency of 1E-7 per year or lower) occurring, the total number of temporarily relocated individuals could be considerable. For relatively small releases of an SFP, the number of displaced individuals could range into the hundreds of thousands. For a large release, which is predicted in some high-density loading situations early in the operating cycle without successful 50.54(hh)(2) mitigation, the number of displaced individuals can be two orders of magnitude higher. (Table 36 partially reflects this range, although it reports average values).

Also consistent with the observations related to the amount of land contamination with distance, the results of the analysis indicate that protective actions such as temporary relocation may be needed at long distances. The table below displays the average number of displaced individuals for different distances for high (1x4) and low density fuel loading.

[See ML23123A408 for a copy of Table 36 Average Number of Long-term Displaced Individuals.]

Contrary to what might be expected, 50.54(hh)(2) mitigation is predicted to slightly increase the average conditional consequences of a release from a low-density fuel loading pattern. While successful deployment of 50.54(hh)(2) equipment is usually effective at preventing releases, it is

not as effective at mitigating release from the low-density fuel loading pattern when deployed in a capacity specifically to provide makeup water through injection, as sometimes assumed. In these conditions, release from a SFP can sometimes be somewhat larger with deployed mitigation. In addition, the situations for which 50.54(hh)(2) equipment prevented release for the low-density loading events were the situations with the smallest release magnitudes, which has the non-intuitive effect of increasing the average consequence of a release.
(**33-2-17** [Magnuson, Brian])

Comment: 8.1.2 Key Factors Affecting Available Time for Mitigation

The SFPS groups the SFP damage caused by the earthquake into three classes: (1) no leakage, (2) small leakage, and (3) moderate leakage with a corresponding conditional probability of 90 percent, 5 percent, and 5 percent, respectively. The small leakage scenario is represented by 40 small tears in the stainless steel liner at the backup bar locations. The small cracks create an initial leakage rate of about 250 gpm. The leakage flow rate depends on the SFP water level. As the SFP water level decreases, the leakage rate reduces. The moderate leakage is represented by a long crack with a combination of the stainless steel SFP liner tear and a through-wall concrete crack at the bottom of the SFP wall. Section 4.1.5 of this report discusses the SFPS damage states in detail. The moderate leak creates an initial leakage rate of about 1,900 gpm. The HRA assumes that the SFP leak rate affects the available time necessary for mitigation because, when the SFP fuel is not covered by water, the radiation level at the locations in which mitigative equipment is stored and mitigative actions are performed is assumed to be too high for performance of the mitigative actions in this study. Thus, the SFP leak rate directly affects the SFP fuel uncovery time. Table 41 shows the time to SFP fuel uncovery in the various scenarios.

[See ML23123A408 for a copy of Table 41 Approximate Time of Fuel Uncovery.]

Figure 98 shows the approximate dose rate contours in the refueling area at the time of defueling when the SFP water level is at the top of the fuel rack. The radiation at the mitigation equipment storage location ranges from 3-30 rem per hour and the radiation level at the locations of the spray nozzles for SFP makeup is in the range of 10 to 300 rem per hour. Working at this radiation level could cause emergency responders who perform mitigation actions to receive doses greater than those in EPA's PAGs (EPA, 1992). This radiation map is the basis for specifying that the SFP makeup must be deployed before the SFP water level reaches the top of the fuel rack in order to credit mitigation success.

In addition to radiation, high temperature on the refueling floor is another factor that affects mitigation success. In this study, 140 °F (60 °C) is used as the temperature threshold. The refueling floor reaches 140 °F before the SFP water level is drained to the top of fuel rack only in the OCP 1 and 2 small leak scenarios. In these scenarios, the reactor head is open. Boiling in the reactor cavity significantly increases the temperature on the refueling floor. Figure 99 shows the time history of the refueling floor temperature of the OCP 1 small leak scenarios. The temperature reaches 140 °F in about 13.5 hours. Figure 100 shows the time history of the refueling floor temperature of the OCP 2 small leak scenarios. The temperature reaches 140 °F in about 26 hours. Because of the long available response time and steep temperature increase at the time of 140 °F reached, changing the temperature threshold to a higher temperature does not affect the HRA results.

In summary, successful deployment of the mitigation strategy has to be done before the earliest of either the SFP water reaching the top of the fuel rack or the reactor building atmosphere reaching 140 °F. Table 42 shows these available times for the scenarios of interest.

[See ML23123A408 for a copy of Table 41 The Available Time.] (**33-2-18** [Magnuson, Brian])

Comment: 8.2.1 Staffing, Procedures, Training, and Response Time

This HRA assumes that sufficient plant staff is available for Unit 3 SFP mitigation. In the situation that the hypothetical earthquake causes damage to multiple SSCs, additional events (e.g., fire), and personnel injury, the assumption may not be applicable to some scenarios.

To augment staffing, except calling for the off-site plant staff (e.g., to mobilize emergency response facilities), the reference plant can also call for the nearby Delta-Cardiff Volunteer Fire Company to assist in tasks such as SFP mitigation, fire mitigation, and treatment of injured personnel. The fire company could send engines, tankers, a ladder fire truck, an air unit, an ambulance and personnel to the reference plant site. Based upon the above assumptions, this analysis assumes that there is sufficient staff for Unit 3 SFP mitigation. No detailed analysis is performed on the staffing situation for all scenarios.

Response Time
NEI 06-12, Revision 2, "B.5.b Phase 2 & 3 Submittal Guidance," states that plants should be able to deploy a flexible means of providing SFP makeup (i.e., either 500 gpm of injection or 200 gpm of spray per unit) within 2 hours from the time in which plant personnel diagnose that external SFP makeup is required. This HRA study uses the 2-hour deployment time as the action time for deploying mitigation. The total mitigation time is the sum of delay time, diagnosis time, and action time (discussed in Section 8.3.2.2). (**33-2-19** [Magnuson, Brian])

Comment: 8.2.2 Mitigation Equipment

This HRA study assumes that portable mitigation equipment is available but the installed equipment is not available for Unit 3 SFP mitigation. The portable equipment includes the two portable diesel pumps discussed in this section. The installed equipment includes the fire system and residual heat removal system. If the earthquake causes damage to multiple reactors and SFPs that consequently requires mitigation equipment, there may not be sufficient portable equipment for the Unit 3 SFP mitigation. For the purposes of this study, portable mitigation equipment was assumed to be available. (**33-2-20** [Magnuson, Brian])

Comment: Reference Comments

NUREG-2161 excluded the high ruthenium release case from NUREG-1738 to remove "prompt fatalities" from the potential consequences of severe SFP accidents. This omission does not reflect a "hard look" at the environmental impacts of severe SFP accidents.

-i.e., hydrogen explosion

SFP failures, at most BWR plants, would resulting internal flooding of the reactor building with radioactive water.

The NRC NTTF acknowledges the reality of multi-reactor/SFP accidents, but the NRC has yet evaluated the radiological and environmental consequences of multiunit accidents.

The Fukushima NTTF states:

*While the U.S. EP framework has always noted that the plume exposure pathway EPZ provides a basis for expansion, insights from real-world implementation at Fukushima, including the realities of multiunit events, might further enhance U.S. preparedness for such an event. The Task Force acknowledges that every situation will differ, so detailed preplanning in this area is not plausible."

A review of NUREG-2161 Table 33, *Overall Consequence Results*, may explain why the preplanning of a SFP accident the ultimately displacement of 4.1 million people would be problematic.

NUREG-2161 assumptions, admittedly, omit credible consequences of multi-reactor/SFP accidents and beyond-design-basis seismic events that induce SFP structure accidents.

NUREG-2161 choose to ignore the fact that the NRC knows that fuel pool gate and cavity seals have failed. They documented these failures in NUREG-1275. Given that failures occurred without a seismic event, it is wrong of the NRC to assume that SFP gates will not leak in a beyond-design-basis earthquake.

NUREG-1275 (Vol. 12) Operating Experience Feedback Report -Assessment of Spent Fuel Cooling:

Finally, inventory loss could occur directly owing to SFP liner leakage or gross failure of the SFP structure. The impacts of a dropped heavy (a load weighing more than one fuel assembly) load or a seismic event are potential causes of gross failure, although SFPs are designed to survive seismic events. Radiological and structural response and makeup capability for dropped light loads (those weighing no more than a fuel assembly) are bounded by analyses of a fuel handling accident. On the other hand, dropped heavy loads have the potential to exceed the design basis of the fuel pool structure and the make-up system.

A more likely sequence would be a loss of inventory through a gate or seal that would terminate when the level reached the elevation of the leak. Then, because of the decreased inventory of water in the SFP and the loss of suction to the SFP cooling system, the remaining water in the pool would boil away until the fuel was uncovered.

Loss of SFP coolant inventory events for which corrective actions are taken before severe consequences occur can potentially cause other problems. Even a minor loss of SFP coolant inventory can lead to loss of SFP cooling because the lower SFP level causes loss of suction to the SFP cooling system. Losses of SFP coolant inventory may produce flooding or environmental problems in other areas of the plant. Ventilation and drain systems can transport water and steam to other parts of the plant and affect emergency equipment. A significant amount of water vapor may be generated either by direct boiling or evaporation from the SFP. Various SFP equipment and ventilation configurations may allow the water vapor to accumulate on SEP cooling equipment and cause it to fail, further exacerbating the loss of inventory.

Where the SFP area atmospheric water vapor can be transported to areas which house other that equipment important to safety, Equipment may be affected. This potential problem is multiunit sites during and important in some immediately following full core off-loads. In these units, the fuel pool atmospheric water vapor from the unit refueling can be transported to areas housing safety equipment when the unit near full power. This transport is operating at or could cause equipment required for a safe shutdown of the operating unit to be damaged or to fail. (**33-3-1** [Magnuson, Brian])

Comment: What is the basis for not considering the consequences of a hydrogen explosion or other credible events?

Missing from NUREG-2161 is the disadvantage or courter consideration that exist at PWR plants that borate their SFP.

It seems the consequences of a concurrent SFP and reactor accident, and a concurrent accident at the SFP of one unit with an accident at the SFP or reactor of the other unit, should be assessed to determine the environmental impacts.
Given that spent fuel racks and their poison material have a lower melting temperature than the cladding and the fuel, mitigative actions to resubmerge or spray water on spent fuel may result in criticality— which is extremely problematic. Could SFP criticality be prevented without allowing the SFP to dry out and creatr a zirconium fire?
NUREG-2161 describes the SFP modeled in MELCOR:

The SFP, 40 ft (12.2 m) wide by 35.3 ft (10.8 m) long by 38.75 ft (11.8 m) deep, is located on the refueling floor of the reactor building. The pool is constructed of reinforced concrete with a wall and floor lining of 1/4-in.-(0.63-cm-) thick stainless steel. The walls and the floor of the SFP are approximately 6 ft (1.83 m) thick.

In each damage state analyzed, NUREG-2161 assumes 6 ft thick reinforced concrete SFP walls would crack completely through.

After the earthquake at Fukushima, it seems imprudent to assess the consequences of beyond-design-basis seismic SFP failure using a 1990 PRA study.

Without specifying seismic category of SFP gates, NUREG-2161 leads the reader to believe that steel-plated decking with steel stiffeners (SFP gates) will not fail in a seismic event that causes 6 ft thick reinforced concrete walls to fail. This seems implausible.
The size and construction of SFP gates vary. Some SFP are designed such that the depth of SFP gates is above the elevation the spent fuel racks. This design considers the failure of SFP gates and prevents the uncovery of spent fuel should they fail. Other SFP designs would allow spent fuel to be uncovered if the gates fail.

In both designs, the SFP gates are a vulnerability. Seismic failure of SFP gates may rapidly drain the SFP to within a few feet of spent fuel or rapidly uncover spent fuel.

Reference the SFP and reactor cavity draining events documented in NUREG-1275 (Vol. 12) *Operating Experience Feedback Report -Assessment of Spent Fuel Cooling.*

It is unreasonable and fundamentally wrong to assume that Non-Seismic Category I SFP structures (and components)—that are <u>not</u> designed to remain functional during a design-basis earthquake—would remain functional during a beyond-design-basis (worse) earthquake.

It is impractical, if not impossible, to physically reinforce Non-Seismic Category I SFP structures (and components), such that they would could satisfy remain functional during a design-basis earthquake. The same is true for Seismic Category I SFP structures (and components)—such that they would remain functional during a beyond-design-basis earthquake.

Ultimately, there are no feasible engineering solutions that would protect people and the environment from beyond-design-basis seismic SFP accidents. This is why the nuclear industry concocted the seismically 'robust' contravention. (**33-3-2** [Magnuson, Brian])

Comment: Spent fuel damage caused by a seismic event or seismic debris would result in the immediate release of noble gasses, that may limit or prevent mitigative actions. Refence NRC Information Notice 90-08, Kr-85 Hazards From Decayed Fuel.

What is the seismic category of spent fuel racks that are allowed to slide in a seismic event?

10 CFR 50.54(hh)(2) mitigation measures are not applicable to seismic events. It is unreasonable to assume that portable non-seismic equipment would survive a beyond-design-basis seismic event.

As described in NEI 12-06, the (EA-12-049) FLEX strategies assume (1) "all boundaries of the SFP are intact, including the liner, gates, transfer canals," and (2) "although sloshing may occur during a seismic event, the initial loss of SFP inventory does not preclude access to the refueling deck around the pool."

FLEX (NEI 12-06) equipment and strategies are insufficient to mitigate SFP failure/draining accidents.

In addition to neutron and gamma shine, seismic induced spent fuel damage would release of noble gasses, resulting in potentially large inhalation doses that may delay or prevent mitigative actions.

"Early evacuation" seems misleading. It seems unlikely that residents, harmed or otherwise 'distracted' by a major earthquake (beyond-design-basis) would evacuate away from a nuclear plant before they were somehow notified to evacuate.

The loss of infrastructure would likely delay any evacuations.
The standard Emergency Planning Zone (EPZ) is a 10-radius from the respective nuclear plant. NUREG-2161 states: "Since actions beyond the emergency planning zone (EPZ) would be ad hoc, there is no procedural guidance or exercise performance documentation upon which to base assumptions."

Shelter in Place, offers limited protection from inhalation doses for a short period of time.

Evacuations out to 30 miles may likely involve large population centers.

Overall, it seems that Emergency Preparedness evacuations would provide little benefit or protection of the public in the event of a beyond-design-basis single SFP accident.

Reference NUREG-2161 Table 33. (**33-3-3** [Magnuson, Brian])

Comment: 50.54(hh)(2) mitigation should not be credited in design-basis or beyond-design=basis seismic events. The portable equipment is not seismically qualified.

Reference NUREG-2161 Table 33. If single SFP accident could result in the interdiction of 9400 square miles of land, what are the projected are the projected surface and ground water consequences?
Based on Fukushima NTTF recommendations and Pubic Law 112-074, it seems that credible complications from other SFPs/reactors and their radiological consequences should be evaluated to determine the environmental impacts.
The release of millions of curies of radiation would certainly and adversely affect the on-site staff.

If off-site doses or "doses close to the site did reach levels that can induce early fatalities," it stands to reason the early fatalities would occur on-site. On-site/in-plant doses and staff losses may likely prevent mitigative actions and lead to complications from other SFPs/reactors. It is this multi-reactor/SFP accident that should be evaluated.

NUREG-2161 extracts are listed for future reference (**33-3-4** [Magnuson, Brian])

Comment: References

NEI 06-12, "B.5.b Phase 2 & 3":
Equipment associated with these strategies is not to be treated as safety-related equipment. As such, it is not subject to any of new special treatment requirements under 10 CFR (e.g., QA, seismic, EQ, etc.).

Reference Comments
B.5.b equipment is not designed nor intended to survive a beyond-design-basis seismic event.

It is imprudent to assume that B.5.b equipment and strategies would successfully mitigate severe SFP accidents induced by beyond-design-basis seismic events. Reference NUREG-2161. (**33-3-21** [Magnuson, Brian])

Comment: Draft NUREG-1437 Revision 2

E.3.7 Impact From Accidents at Spent Fuel Pools
Neither the analyses in NUREG-1738 (NRC 2001) nor those in the NUREG-2161 (NRC 2014a) addressed the impacts with respect to the other pathways (open bodies of water and groundwater). The 1996 LR GEIS estimated these impacts for reactor accidents from full power (internal events only) using the results from plant-specific reactor accident analysis to assess the contamination of open bodies of water and from the Liquid Pathway Generic Study (NUREG-0440; NRC 1978) to assess the contamination of groundwater from basemat melt-through accidents.

In both cases, the impacts on human health from surface water and groundwater contamination are only a small fraction of impacts from the airborne pathway, except in a few cases where the impacts are comparable. With the impacts from the airborne pathway associated with SFP accidents (as stated in NUREG-1738) being comparable to the impacts from reactor accidents, as stated in NUREG-1150 (NRC 1990), the impacts from SFP-related surface water and groundwater contamination may also be comparable, even though the SFP fuel inventory is several times that of the reactor. This is due to the lower probability of occurrence of SFP

accidents, the effects of decay of the fission products on the radionuclide inventory, and the lower energy density of the fuel inventory, which makes basemat melt-through more unlikely.

Magnuson Comments
Reference NUREG-2161 Table 33. If a single SFP accident could result in the interdiction of 9400 square miles of land, what are the projected are the projected surface and ground water consequences? (**33-3-22** [Magnuson, Brian])

Response: *The NRC acknowledges the comments with regard to the use of NUREG-2161 (NRC 2014b) results in Appendix E of this revised LR GEIS. A draft of NUREG-2161, or the Spent Fuel Pool (SFP) Study, was made available for public comment, and the final report was subsequently published after public comments were addressed. The scope of NUREG-2161 was limited to the assessment of the severe accident risk of a beyond–design-basis earthquake affecting the SFP for a BWR having a Mark I containment. The purpose of the study was to inform the NRC's safety oversight of SFPs following the Fukushima event. Nonetheless, the final NUREG-2161 represents the NRC staff's current best information about the risk of SFP severe accidents, and therefore, the study provides useful information for describing the likely probability-weighted impacts of an SFP severe accident for NEPA purposes. The following responses address the specific comments on the use of NUREG-2161 in this revised LR GEIS:*

- *The NRC acknowledges the comments regarding the potentially large consequences of an SFP severe accident. However, the LR GEIS supports the rulemaking regarding the generic determination that the probability-weighted consequences to the public and environment, which account for both the likelihood and consequences of postulated severe accidents to the public and environment, are SMALL. This is because, unlike the other environmental impacts evaluated in the LR GEIS predicated on routine (normal) reactor operations that are expected to occur, accidents have a probability of occurrence. In other words, the environmental impact of severe accidents in the 1996 LR GEIS and in this revised LR GEIS is based on severe accident risk or probability-weighted consequences, not just the consequences of accidents.*
- *The NRC agrees that multi-reactor/multi-SFP risk is not addressed in NUREG-2161. However, as discussed in Section E.3.7 of Appendix E of this LR GEIS, individual latent cancer fatality risk results reported in NUREG-2161 are more than 4 orders of magnitude less than the NRC safety goal and individual early fatality risk is negligible, so conservatively increasing the NUREG-2161 risk results by an order of magnitude to account for sites having multiple SFPs will not affect the conclusions of the LR GEIS. As discussed in Section E.4 of Appendix E of this LR GEIS, the NRC Full-Scope Site Level 3 PRA study is evaluating multi-unit or integrated site risk. If new and significant information arises out of this study, then that information will be considered in license renewal applications.*
- *The NRC agrees that NUREG-2161 uses a best estimate for actual releases of ruthenium (Ru) based on the current state of knowledge in this area. NUREG-1738, a much older analysis, assumed source terms spanning a very large range of uncertainty rather than using mechanistic and integrated modeling.*
- *With regard to failure of fuel pool gate and cavity seals during plant operation, the NRC disagrees with this comment. With regard to the performance of the gate and seal system during a severe accident, the NRC determined that, for the reference SFP evaluated in the study, the passive mechanical seals are unlikely to fail under the earthquake conditions evaluated. The study assumed seismic forces greater than the maximum earthquake reasonably expected to occur at the reference plant location.*

- *The NRC disagrees that the fuel pool is modeled incorrectly. NUREG-2161 provides updated, publicly available consequence estimates of a representative, postulated SFP severe accident from a beyond–design-basis earthquake under high-density and low-density loading conditions. MELCOR Accident Consequence Code System (MELCOR) is the NRC's best estimate tool for severe accident analysis, and it has been validated against experimental data (e.g., new air oxidation kinetics as documented in NUREG/CR-6846; ANL 2004). Section 6.1.1 of NUREG-2161 details the modeling approach used for this analysis. The study relied on specific SFP models that have been integrated into MELCOR over the past 10 years. In addition, MELCOR was validated against NRC-sponsored zirconium fire experiments conducted at Sandia National Laboratories (see NUREG/CR-7143; SNL 2013).*
- *The NRC disagrees that hydrogen combustion was not considered. As stated in Table 3 of the NUREG-2161 report, no significant debris generated by the seismic event is expected to enter the SFP based on the structural response of the building and overhead crane. In addition, as stated in Table 3, some debris could be generated and could fall into the pool as a result of hydrogen combustion. However, the occurrence of a hydrogen combustion event in this study denotes that the fuel in the SFP has already become uncovered and is undergoing a fission product release.*
- *The NRC agrees that NUREG-2161 did not explicitly include the contribution to risk from the ingestion pathway in the estimates of health risk from SFP severe accidents, but it did conclude that including this pathway would increase the health effect risks by about 5 percent. This is consistent with the conclusions of the 1996 LR GEIS and this revised LR GEIS that the environmental impacts on human health from surface water and groundwater contamination are only a small fraction of impacts from the airborne pathway, except in a few cases where the impacts are comparable.*
- *The NRC disagrees that the evacuation models are deficient. The evacuation models used in the study are based on research conducted at Sandia National Laboratories on the evacuation behavior of residents living within the vicinity of nuclear power plants (see NUREG/CR-6953; SNL 2007).*
- *The NRC disagrees that the evacuation model did not consider unsuccessful mitigation strategies. The study analyzed scenarios with and without successful deployment of mitigation capabilities (such as required by Section B.5.b of NRC Order EA-02-026 [NRC 2002b], which was subsequently incorporated into the regulations by the Final Rule on Power Reactor Security Requirements) and thus reasonably characterizes the range of possibilities. The risk results summarized in Figure E.3-4 and the text of Appendix E of this LR GEIS report that the average individual latent cancer fatality risk is more than 4 orders of magnitude less than the NRC safety goal and individual latent cancer fatality risk is negligible. When compared to the individual early fatality risk results from NUREG-1738 (NRC 2001a), for low Ru release, summarized in Table E.3-19 of Appendix E of this revised LR GEIS, the NUREG-2161 (NRC 2014b) SFP risk is more than 3 orders of magnitude less than that of NUREG-1738 for the unmitigated scenarios and more than 5 orders of magnitude less than that of NUREG-1738 for the mitigated scenarios.*

While NUREG-2161 (NRC 2014b) did not evaluate total early fatality risk, the NUREG-1738 (NRC 2001a) results for total early fatality risk are substantially less than the 95th percentile risk results that were the basis for the conclusions of the 1996 LR GEIS, and the NUREG-2161 risk results indicate that this margin has likely increased. While the results from NUREG-2161 are not directly comparable to the results from NUREG-1738, because the NUREG-2161 study is for a BWR SFP and the NUREG-1738 study is for a PWR SFP, the improvements in analytical

methodologies and severe accident phenomena since the issuance of the 1996 LR GEIS continue to show that the environmental impact (i.e., probability-weighted consequences) of SFP severe accidents is small.

NUREG-2161 represents the NRC staff's current best information about the risk of SFP severe accidents. The comments provide no new information that would change the NRC staff conclusion that the probability-weighted consequences reported in the 1996 LR GEIS continue to bound the impact of severe accidents, that the impacts of SFP accidents would at most be comparable to the impacts from accidents at full power, and that the issue of severe accidents is a Category 1 issue. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.

A.2.13.19 Comments Regarding Hardened Vents and Spent Fuel Pool Accidents

Comment: Today's nuclear power plants were not designed to protect people and the environment from severe accidents that would release large quantities of radioactive material into the environment.

Still, in 2013, the NRC issued Order EA-13-109, requiring a hardened containment vent to be installed at specified nuclear plants because, I quote, because of the relatively high probabilities that those containments would fail, should an accident progress to melting the core.
This NRC order is intended to mitigate the primary containment vulnerabilities learned from the accident at Fukushima, which is a U.S.-designed reactor.

In such accidents, the NRC essentially requires plant operators to intentionally release large amounts of highly radioactive material to the environment, because containment barriers were not designed to survive the hydrogen explosions like those that occurred at Fukushima. Given this NRC requirement, environmental reviews should include plant-specific radiological impacts to the environment that would result from severe accidents that require use of hardened vents. It seems the NRC should have performed environmental reviews before ordering the issue to install hardened vents.

I recommend that plant-specific environmental reviews and accident dose calculations be performed to evaluate the radiological impacts to the environment that would result from severe accidents that require the use of hardened vents.

To continue, before the accident at Fukushima, the design of nuclear plants did not include reliability spent fuel pool level instrumentation. The NRC issued NRC Order EA-12-05 because, and I quote, the events at Fukushima demonstrated that the confusion in this application of resources that can result from beyond-design-basis external events when adequate instrumentation is not available.

Given this NRC requirement for a reliable spent-fuel pool level indication, and zirc [zirconium] fire windows [unclear], it seems that environmental reviews should include the plant-specific radiological impacts to the environment that would result from the consequences of severe accidents that include spent-fuel pool-draining events and zirc [zirconium] fires. This is also a recommendation.

Given these recommendations, I am opposed to the proposed rule package that reclassifies the current Category 2, severe accidents, as a Category 1 generic issue. (**8-2-2** [Magnuson, Brian])

Response: *To the extent the comment suggests the NRC should require an additional barrier to protect against release, the NRC disagrees with this comment. Nuclear power plants are designed to operate safely, without significant effect on public health and safety and the environment. Any industrial activity, however, involves some risk. To prevent the dispersal of radioactive material from a hypothetical accident, nuclear power plants are constructed with several barriers. The first barrier is the sealed metal tubes, or "cladding," which encase the ceramic uranium fuel pellets. The second barrier is the heavy steel reactor vessel, in the range of nine inches to a foot thick, and the primary cooling water system piping. The third barrier is the containment building, a heavily reinforced structure of concrete and steel up to several feet thick that surrounds the reactor and is designed to contain radioactivity that might get past the first two barriers in the unlikely event of a serious accident. The risk of a nuclear power plant accident releasing a significant amount of radioactivity affecting the public is very small. The NRC minimizes that risk in several ways. The agency's requirements for nuclear power plants include diverse and redundant barriers and numerous safety systems, properly trained reactor operators, and ongoing testing and maintenance activities. NRC inspectors provide oversight in all these areas.*

The NRC disagrees with the comment that plant-specific radiological impacts should be performed for severe accidents that require use of hardened vents. The LR GEIS concludes that the environmental impacts of a severe accident are SMALL because they remain bounded by the probability-weighted consequences reported in the 1996 LR GEIS (i.e., 95 percent UCB for predicted early and latent fatalities and dose). This conclusion is based on the results of plant-specific SAMA analyses and various NRC risk assessments that, for the most part, did not credit the plant improvements required by NRC Order EA-13-109 (NRC 2013b) (installation of reliable hardened containment vents). Use of hardened vents to allow for a controlled release to the environment to preserve containment would avert a more significant release resulting from containment failure; therefore, the NRC concludes that the impacts of this scenario would likely be bounded by the existing analysis.

The environmental impacts associated with potential severe accidents at SFPs during the license renewal term are discussed in Section 4.9.1.2 and Appendix E of the LR GEIS. Section E.7 of Appendix E of the LR GEIS considers the impact of severe accidents at SFPs. This assessment considered severe accidents that result in the spent fuel in the pool becoming uncovered, resulting in a zirconium fire. Based on the results of this assessment, the NRC concludes in this LR GEIS that the environmental impacts of severe accidents at SFPs, in terms of probability-weighted consequences, is comparable to those from reactor accidents at full power. No changes were made in the LR GEIS, final rule, or guidance as a result of this comment.

A.2.13.20 Comments Regarding LR GEIS Appendix E.3.9, Uncertainties

Comment: Lack of Detailed Uncertainty Analysis

As discussed in the Mitman Report at page 13, uncertainty analysis is a fundament component of risk analysis, it is addressed extensively in the industry's consensus standard: Standard ASME/ANS RA-Sa-2009, "Standard for Level 1/Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications," Addendum A to RA-S-2008, February 2009 and the NRC endorsement of the standard: Regulatory Guide 1.200 Rev. 3, December 2020 (ML20238B871). The NRC documents acceptable approaches to performing uncertainty analysis in NUREG-1855, Revision 1, "Guidance on the Treatment of Uncertainties Associated with PRAs in Risk-Informed Decisionmaking," March, 2017 (ML17062A466). The NRC

considers uncertainty analysis to be fundamental component of PRA. In the guidance on uncertainty it says “In its safety philosophy, the U.S. Nuclear Regulatory Commission (NRC) has always recognized the importance of addressing uncertainties as an integral part of its decisionmaking. Probabilistic risk assessment (PRA) is yet another analytical tool being used to support both licensee and regulatory decisions. As such, licensees and the NRC need to consider the implications of uncertainties associated with PRA on the decision under consideration.” RG-1.200 Rev. 3., Page v.

These methodologies require propagating uncertainty through the entire risk quantification and then using that quantification to inform the final decision. Id. (**24-1-4** [Curran, Diane])

Comment: Lack of Detailed Uncertainty Analysis

Uncertainty analysis is a fundament component of risk analysis, it is addressed extensively in the industry’s consensus standard: Standard ASME/ANS RA-Sa-2009, “Standard for Level 1/Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications,” Addendum A to RA-S-2008, February 2009 and the NRC endorsement of the standard: Regulatory Guide 1.200 Rev. 3, December 2020 (ML20238B871). The NRC documents acceptable approaches to performing uncertainty analysis in NUREG-1855, Revision 1, “Guidance on the Treatment of Uncertainties Associated with PRAs in Risk-Informed Decisionmaking,” March, 2017 (ML17062A466). The NRC considers uncertainty analysis to be fundamental component of PRA. In the guidance on uncertainty it says “In its safety philosophy, the U.S. Nuclear Regulatory Commission (NRC) has always recognized the importance of addressing uncertainties as an integral part of its decisionmaking. Probabilistic risk assessment (PRA) is yet another analytical tool being used to support both licensee and regulatory decisions. As such, licensees and the NRC need to consider the implications of uncertainties associated with PRA on the decision under consideration.” RG-1.200 Rev. 3., Page v.

These methodologies require propagating uncertainty through the entire risk quantification and then using that quantification to inform the final decision.

While NRC performed some uncertainty analysis in support of the risk analyses discussed in 1996 LR GEIS, the 2013 Revised GEIS and the Draft GEIS, it was limited. The major application of uncertainty analysis in these GEIS’s is the use of the upper confidence bound (UCB) which is the 95th percentile of the internal events CDF. However, the uncertainty analysis appears to start and end there. None of the quantitative CDF values reported in these revisions of the GEIS includes the uncertainty band for the individual plants. Nor does the NRC provide the uncertainty for mean or median values reported in these GEIS revisions. Likewise, uncertainty is not propagated through to the health effect estimates.

This lack of thorough uncertainty analysis makes the Draft GEIS inadequate, because there is insufficient understanding of the estimates and their relationship to the regulatory thresholds. (**24-3-14** [Curran, Diane])

Comment: 51., E-66, 31, Assertion that “assumed parameter values” for extended loss of alternating current power (ELAP), FLEX success probability, and conditional individual latent cancer fatality (LCF) risk “resulted in a conservatively high estimate of a frequency-weighted individual LCF risk within 10 mi of approximately 7×10^{-8} per RY (labeled as “High-Level Conservative Estimate” in Figure E.3-5), which is over an order of magnitude less than the QHO for an average individual LCF risk of approximately 2×10^{-6} per RY.”

While the text does not state this, it appears these calculation were performed for at power conditions. But during shutdown, the loss of offsite power initiating event frequency is generally an order of magnitude higher that at power (see “Analysis of LOOP Event 2021 Update,” August 2022, INL/RPT-22-68809, Table 4 LOOP events and max. likelihood est. of frequencies 2007-2021). EDG maintenance is often performed during outages. These two factors would significantly increase the ELAP frequency calculated (7E-5 per year), potentially by two orders of magnitude. In addition, as previously discussed in these comments, BWR Mark I and II containments are always non-functional during refueling outages. These factors could lead to significantly higher LCF risk calculated here. (**24-6-9** [Curran, Diane])

Response: *NRC disagrees with the comment regarding lack of detailed uncertainty analysis. The NRC concluded that even with uncertainties, the environmental impacts estimated in the 1996 LR GEIS were adequate for use.*

Section E.3.9 provides the details regarding uncertainties considered in this analysis. Many of these same uncertainties also apply to the analysis used in this revised LR GEIS. However, as discussed in Sections E.3.1 through E.3.8 of this LR GEIS, more recent information is used to supplement the estimate of the environmental impacts contained in the 1996 LR GEIS. In effect, the assessments contained in Sections E.3.1 through E.3.8 of this LR GEIS provide additional information about, and insights into, items that could be considered areas of uncertainty associated with the 1996 LR GEIS. This updated information also provides insights into sources of uncertainty in addition to those discussed in the 1996 LR GEIS. Each of the insights from these additional sources of uncertainty is summarized in Appendix E.

Since the issuance of the 1996 LR GEIS and 2013 LR GEIS, the NRC has completed several studies that provide insights into the quantitative effects of uncertainties related to consequences. One set of studies stemmed from a potential rulemaking technical bases analysis on Containment Protection and Release Reduction that covered a subset of potential accident scenarios for a few reactors and spent fuel pool designs and sites. A second set of studies include the NRC’s SOARCA (state-of-the-art reactor consequence analysis) uncertainty analyses, which treated accident progression, radiological release, and health effect uncertainties for one accident scenario each at three different sites in the United States with different reactor designs. Uncertainty insights from the regulatory analyses and from the three SOARCA uncertainty analyses are discussed and summarized in Section E.3.9 of this revised LR GEIS. The scope of the cited studies focused on the important class of severe accidents involving station blackouts (SBOs) and treated BWRs with two different containment types, PWRs with two different containment types, and eight different sites in the United States. Also see Section E.3.9 in this LR GEIS regarding details of the uncertainty analysis.

The NRC disagrees with the comments to the extent they suggest that the NRC should have used American Society of Mechanical Engineers/American Nuclear Society (ASME/ANS) PRA standard, Regulatory Guide 1.200 (NRC 2020d), and NUREG-1855 (NRC 2017c) in this NEPA review. This NRC-endorsed guidance is primarily for applying PRAs in risk-informed licensing actions. The LR GEIS is a NEPA assessment, not a risk-informed licensing action; therefore, these NRC guidance documents, including propagation of uncertainty (which apply only to Level 1+ LERF PRA results used in risk-informed licensing actions, not Level 2 or Level 3 PRA where uncertainties are considered “model” uncertainties), are not applicable to this LR GEIS and associated rulemaking. Moreover, this LR GEIS update did not include a new PRA analysis to support the finding regarding severe accidents but rather considered whether information developed since 1996 would call into question the analysis in the 1996 LR GEIS. Therefore, the NRC’s treatment of uncertainties focused on considering new information developed regarding

uncertainty analyses with respect to the conclusions in the 1996 LR GEIS rather than following the recommended approach for uncertainty analysis for new PRAs in NRC guidance.

In the 1996 LR GEIS, because limited information was available, very conservative 95th percentile UCB values were used to account for uncertainty for determining the probability-weighted consequences to the public and environment. There was still a large margin compared to the NRC safety goals. The SOARCA uncertainty analyses also identified a large margin compared to the QHO limits (for the important class of SBO scenarios studied), which confirms the 1996 LR GEIS determination. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.

A.2.13.21 Comments Regarding LR GEIS Appendix E.4, Severe Accident Mitigation Alternatives

Comment: 1. Multi-unit accidents

The Draft GEIS does not address the environmental impacts of concurrent multi-unit accidents. See Appendix E, Page E-84, lines 33 – 34 ("Multi-unit or integrated site-level risk was not explicitly addressed in Section E.3.3 of this appendix"). This is a significant omission, given the well-recognized independent contribution that multi-unit accidents make to accident risk. As discussed in a 2013 paper by NRC Staff member Suzanne Schroer and University of Maryland Professor Dr. Mohammed Modarres, *multi-unit site risk is neither formally nor adequately considered in either the regulatory or the commercial nuclear environment [citations omitted] despite the fact that the questions of multi-unit accident is not one of possibility, but of probability." Schroer and Modarres, An Event Classification Schema for Evaluating Site Risk in a Multi-Unit Nuclear Power Plant Probabilistic Risk Assessment, p. 1 (2013) (ML13217A335). See Mitman Report at 11-12. (**24-1-18** [Curran, Diane])

Comment: Multiunit Impacts
The Draft GEIS does not address the environmental impacts of concurrent multi-unit accidents. See Appendix E, Page E-84, lines 33 – 34 ("Multi-unit or integrated site-level risk was not explicitly addressed in Section E.3.3 of this appendix"). This is a significant omission, given the well-recognized independent contribution that multi-unit accidents make to accident risk. As discussed in a 2013 paper by NRC Staff member Suzanne Schroer and University of Maryland Professor Dr. Mohammed Modarres, "multi-unit site risk is neither formally nor adequately considered in either the regulatory or the commercial nuclear environment [citations omitted] despite the fact that the questions of multi-unit accident is not one of possibility, but of probability." Schroer and Modarres, An Event Classification Schema for Evaluating Site Risk in a Multi-Unit Nuclear Power Plant Probabilistic Risk Assessment, p. 1 (2013) (ML13217A335).

As recognized by Schroer and Modarres, "the events at Fukushima Daiichi in 2011 underlined the significance and importance of accident events involving multiple units." *Id*, p. 1. And indeed, the NRC "has been discussing how to address the issue of multi-unit nuclear power plant PRAs for many years," including a "lessons learned" report after the Chernobyl accident. *Id*. The Near Term Task Force Review of Insights from the Fukushima Dai-ichi Accident (July 12, 2011) (ML111861807) specifically identified multi-unit accidents as an issue that should be investigated and addressed. As noted by the Task Force:

The accident at Fukushima has shown that prolonged SBO [station black out] and multiunit events are realities that must be addressed as part of EP [emergency planning]. While of low probability, these events have the potential for severe consequences that require an effective

EP response. The Task Force's evaluation in this section focuses on a licensee's capability to respond during these types of events. Currently, the United States has 29 single-unit sites, 33 dual-unit sites, and 3 triple-unit sites. The agency is currently reviewing new reactor applications that may add units to existing sites; however, no applicant has requested to bring the total number of units at a single site to more than four. In most cases, proposed quadruple-unit sites have physical separation between the two existing and the two proposed units.
Id., p. 51. While the NTTF focused its recommendations on safety improvements related to emergency planning, its conclusion that multi-unit accidents are "realities" with potentially severe consequences demonstrates their relevance to risk analysis for environmental impact studies.

The differences between single-unit PRAs and multi-unit PRAs are well-understood, as is the risk-significance of failing to address interdependent multi-unit events. As described in a recent paper by Taotao Zhou, Mohammad Modarres, Enrique López Droguett:

Conventional PRA studies have traditionally been restricted to single reactor units and are referred to as single-unit PRAs (SUPRAs). The SUPRAs include accident scenarios exclusive to one reactor unit, assuming the effects of other units are not critical. Hence, SUPRAs only consider the dependencies between the structures, systems, and components (SSCs) within a single reactor unit. These dependencies, referred to as intra-unit dependencies, are likely to induce multiple failure events that may overcome redundancies or diversities and ultimately lead to a class of SSC failures called dependent failures. **Although these dependent events are usually much less frequent than the independent events, they have proven to be the most critical contributors to the likelihood of reactor core damage, environmental radioactive exposure, and overall plant risk.** Typically, the influence of these dependencies is explicitly modeled in the PRA event tree and fault tree logics or implicitly treated as the type of dependencies commonly referred to as common cause failure events.

"Multi-unit nuclear power plant probabilistic risk assessment: A comprehensive survey," Taotao Zhou, Mohammad Modarres, Enrique López Droguett, Reliability Engineering & System Safety, Volume 213, September 2021 (emphasis added).
(https://www.sciencedirect.com/science/article/abs/pii/S0951832021003070) As further explained by Profs. Zhou, Modarres, and Droguett:

These inter-unit dependencies can play critical roles in nuclear accident risks with the **possibility of multiple core damages, including damages to the spent fuel pool and other radioactive waste storage facilities. Proper characterization of these site-level dependencies is thus critical to obtain an accurate risk profile of a nuclear power plant site.** Examples of these inter-unit dependencies include certain initiating events simultaneously occurring in multiple units, a transient event in one unit affecting some or all of the other units, the proximity of the units to each other, shared structures, components (e.g., Shared batteries and diesel generators), common operation practices, and substantial procedural and other organizational similarities.

(emphasis added). Three important conclusions can be drawn from the study of multi-unit accidents by the NRC and independent researchers. First, multi-unit accident risks – including risks to reactors and fuel storage pools – are well-understood as reasonably foreseeable. Second, multi-unit accidents have unique characteristics that are not bounded by single-unit accident risk studies. Finally, the risks of multi-unit accidents are unique to reactor sites, and must consider the relative location of reactor units, fuel storage pools, and other onsite facilities.

Therefore, multi-unit accident risks must be independently evaluated for each separate reactor site for which license renewal is considered. (**24-3-13** [Curran, Diane])

Comment: 55., E-85, 10-11, Assertion that "[t]he Level 3 PRA project is in an advanced stage, but no results for the integrated site risk assessment have yet been published."

This is not accurate. As of 4/22/2022 draft reports were published (https://www.federalregister.gov/documents/2022/04/22/2022-08617/level-3probabilistic-risk-assessment-project-documentation-volume-3x). (**24-6-13** [Curran, Diane])

Comment: 56., E-86, 28, Description of a mitigation measure as "procedures for operating steam-turbine-driven pumps without power"
This description is erroneous, and appears to contain a clerical error. Because the motive power for steam driven pumps is steam and not electrical power, the word "control" should be inserted before "power." (**24-6-14** [Curran, Diane])

Response: *The NRC agrees with the comment regarding the description of a mitigation measure as "procedures for controlling steam-turbine-driven pumps without power." The NRC modified the text in Section E.4 of the LR GEIS as a result of this comment.*

The NRC acknowledges the comment and clarified the text in Appendix E regarding the consideration of multi-unit risk and SAMA. As explained in NEI 05-01, "Severe Accident Mitigation Alternatives (SAMA) Analysis Guidance Document, Revision A" (NEI 2005), SAMA analyses do address multi-unit risk by either assuring that the benefits and implementation costs of SAMAs are on a per-site basis (for example, multiply the maximum benefit of a SAMA for a single unit by the number of units at the site to fully account for its potential benefit), or if SAMA benefits and costs are on a per unit basis, the impact associated with implementation of the SAMA is reflected in the estimated implementation costs (for example, the estimated cost of a SAMA is divided by the number of units to account for economies-of-scale in its implementation at each unit). Also, SAMAs that can mitigate risk at all units on the site (e.g., installation of an additional backup power supply) are identified and evaluated. Based on the discussion in Appendix E of this LR GEIS, additional information regarding multi-unit risk would not change the Commission's determination to require one SAMA analysis for each facility. While multi-unit risk may result in modest increases in severe accident risk, other new information regarding these factors suggests that the probability-weighted environmental consequences of severe accidents may be, on average, substantially lower than previously estimated. The mean PDR is reduced by a factor of 120. This considerable margin justifies the NRC conclusion that the PDR has decreased from the values used to make the probability-weighted consequences determination of small in the 1996 LR GEIS. As a result, this LR GEIS analysis further supports the generic findings from the 1996 and 2013 LR GEIS that the probability-weighted consequences of severe accidents would be SMALL.

The NRC agrees with the comments that safety must be considered in the design of the plant for consideration of LPSD, multi-unit risk, and SFPs. Design issues are considered during plant-specific safety reviews and are addressed on an ongoing basis through the reactor oversight process and other NRC safety programs. No changes were made in the LR GEIS, final rule, or guidance as a result of this comment.

The NRC agrees that increases in risk may require further study for LPSD, multi-unit risk, and SFPs. The NRC Full-Scope Site Level 3 PRA study, which has not been completed, will perform an integrated site risk assessment that includes all major site radiological sources, all internal

and external initiating event hazards typically considered in internal and external event PRAs, and all modes of plant operation. Major site radiological sources being addressed in this study include multi-unit reactor cores, SFPs, and dry cask storage.

The Level 3 PRA project is based on a reference site that includes two Westinghouse four-loop PWRs with large dry containments. The Level 3 PRA project team is leveraging the existing and available information about the reference plant and its licensee PRAs, in addition to related research efforts (e.g., SOARCA), to enhance the study's efficiency. In addition, the Level 3 PRA project is being developed consistent with many of the modeling conventions used for the NRC's standardized plant analysis risk models. Information is available on the NRC website at https://www.nrc.gov/about-nrc/regulatory/research/level3-pra-project.htm. Preliminary results (NRC 2022b) published in April 2022 reported individual latent cancer fatality risks and early fatality risks from reactor, at-power, internal events and internal floods. Those results showed the latent cancer fatality risks to be about a couple of orders of magnitude below the QHO and showed the early fatality risks to be many orders of magnitude below the QHO, even when flexible coping (FLEX) strategies (which could mitigate accidents) are not credited. Although the full scope of results from the Level 3 PRA project are not yet available, the preliminary results show significant margins compared to the QHOs, even in the case using more conservative assumptions. Hence, the available results from the NRC's Level 3 PRA study provide further corroborating evidence that, as concluded in the 1996 LR GEIS, the probability-weighted consequences of severe accidents are SMALL.

The Level 3 PRA project is in an advanced stage, but no results for the integrated site risk assessment have yet been published. In addition to plant CDF and LERF results, the Level 3 PRA project will provide quantitative results for consequences of severe accidents (i.e., Level 3 PRA results), as well as a complete risk profile for a multi-unit site (87 FR 24205). If new and significant information arises out of this project, then that information will need to be considered in license renewal applications. Thus, even though severe accidents are considered to be a Category 1 issue, mechanisms are in place to conduct a full plant-specific review if new and significant information warrants such a review. The NRC made clarifying edits to Appendix E as a result of these comments.

A.2.13.22 Comments Regarding LR GEIS Appendix E.4, Endorsement of NEI 17-04

Comment: IV. **Reclassification of Severe Accidents as a Category 1 Issue**

The proposed rule would reclassify the Category 2 "Severe accidents" issue as a Category 1 issue.[97] In the 2013 LR GEIS, the NRC classified the issue of severe accidents as a Category 2 issue only insofar as alternatives to mitigate severe accidents needed to be considered for all nuclear power plants for which the licensee had not previously performed a severe accident mitigation alternatives (SAMA) analysis. The NRC now views this issue as suitable for generic resolution due to the prior completion of SAMA analyses by anticipated license renewal applicants and the low likelihood of finding cost-effective significant plant improvements.[98]

[97] Proposed Rule, 88 Fed. Reg. at 13,344, 13,355.
[98] Id.

NEI supports the reclassification of severe accidents as a Category 1 issue. Historically, the conduct and review of SAMA analyses by license renewal applicants and the NRC staff, respectively, have required substantial resources. Those analyses have confirmed the Commission's expectation – as noted in the 1996 rulemaking codifying the SAMA analysis

requirement – that SAMA analyses are unlikely to identify "major plant design changes or modifications that will prove to be cost-beneficial."[99] In fact, none of the SAMA analyses performed by license renewal applicants to date has identified plant-specific "major" cost-beneficial SAMAs that significantly reduce the risk of a severe accident.[100] In contrast, improvements in plant safety have been achieved due to initiatives such as Fukushima Near-Term Task Force (NTTF) and post-September 11 mitigation strategies.

[99] Environmental Review for Renewal of Nuclear Power Plant Operating Licenses; Final Rule, 61 Fed. Reg. 28,467, 28,481 (June 5, 1996) (noting that any additional plant enhancements identified by license renewal SAMA analyses as cost-beneficial "generally would be procedural and programmatic fixes, with any hardware changes being only minor in nature and few in number").

[100] Revised LR GEIS, Vol. 2 at E-83.

We agree that the performance and safety record of U.S. nuclear operating fleet has continually improved.[101] As discussed in Appendix E of the revised LR GEIS, this is confirmed by analysis that, in many cases, shows improved plant performance and design features have resulted in reductions in initiating event frequency, core damage frequency (CDF), and containment failure frequency. Based on that analysis, the NRC has correctly concluded that the reduction in environmental impacts from the use of new information substantially outweighs any increases resulting from this same information for initial LR or SLR, such that the probability-weighted consequences of severe accidents during the initial LR and SLR terms remains SMALL for all operating plants. Furthermore, the NRC has appropriately concluded that further mitigation analysis would not contribute sufficiently to reducing the environmental impacts of severe accident risk to warrant further SAMA analysis, because the likelihood of finding cost-effective significant plant improvements is small.

[101] *Id.* At E-4, E-88

An applicant still must address any new and significant information as it relates to the probability-weighted consequences of a severe accident and to the SAMA analysis. The revised LR GEIS indicates that guidance for the analysis of new and significant SAMA-related information is provided in NEI 17-04, Revision 1, "Model SLR New and Significant Assessment Approach or SAMA" (Aug. 2019) (ML19318D216).[102] NEI appreciates the NRC's formal endorsement of NEI 17-04, Revision 1, as now reflected in the draft revised LR GEIS, as well as in DG-4027 and Draft NUREG-1555, Supplement 1, Revision 2. NEI notes that the industry is evaluating the need for any conforming changes to NEI 17-04, Revision 1 associated with various regulatory and regulatory guidance document references throughout that document that may be impacted by this rulemaking activity.

[102] By letter dated December 11, 2019, the Staff had found NEI 17-04, Revision 1 acceptable for interim use by applicants. Letter from Anna Bradford, NRC to Chris Earls, NEI (Dec. 11, 2019) (ML19323E740). (**19-1-19** [Uhle, Jennifer])

Comment: 12. Section/Page 5 Assessment of New and Significant Information 71, Comment/Recommendation: To minimize the need for future administrative revisions of the Regulatory Guide when revisions associated with this rulemaking are made to NEI guidance documents, NEI recommends the addition of the following language: "If a SAMA review has previously been completed, an applicant must provide an assessment of new and significant information with respect to a prior SAMA analysis. Guidance is provided in NEI 17-04,

Revision 1, “Model SLR New and Significant Assessment Approach for SAMA,” dated August 2019 (Ref. 68) **or subsequently endorsed guidance.** NEI 17-04 is endorsed in this RG for plant-specific environmental reviews.” (**19-2-19** [Uhle, Jennifer])

Response: *The NRC agrees in part with this comment. The NRC revised Section E.4 of Appendix E of the LR GEIS and Section 5.2.1 of NUREG-1555, Supplement 1, Revision 2 (NRC 2024b) to state that NEI 17-04, Revision 1 (NEI 2019b) is endorsed by the NRC in Regulatory Guide 4.2, Supplement 1, Revision 2 (NRC 2024a). Additionally, Regulatory Guide 4.2, Supplement 1, Revision 2 was added as a reference to Section E.6 of Appendix E of the LR GEIS.*

The NRC disagrees with the specific comment and qualifying text, “or subsequently endorsed guidance” regarding the endorsement of future revisions. When the NRC endorses a specific revision of a non-NRC-produced product, any future revisions would need to be reviewed prior to receiving endorsement by the NRC staff. To include the proposed text in this instance suggests that similar qualifying text should be included whenever NRC endorses a product. No changes were made in the LR GEIS, final rule, or guidance as a result of this comment.

A.2.13.23 Comments Regarding LR GEIS Appendix E.5, Summary and Conclusion

Comment: Beyond Nuclear and the Sierra Club challenge the NRC’s proposal to codify a universal finding that the environmental impacts of accidents in an initial license renewal or SLR term are “SMALL” or insignificant. See Proposed 10 C.F.R. Rule, Table B-1, 88 Fed. Reg. at 13,351-55, which designates environmental impacts of postulated “Design-basis accidents” and “Severe accidents” as “Category 1” impacts which do not require any “further analysis” in a site-specific Supplemental EIS for an individual facility. The NRC has failed utterly to justify its generic approach to accident risk analysis for the re-licensing of a broad and variable array of distinct operating nuclear power plants, or to support its finding that accident risks are not significant for a single reactor, let alone a whole fleet. The lumping together of environmental analyses for distinct reactors and reactor environments is not only technically indefensible, but perhaps the worst blow that could be delivered to environmental justice communities. Not only are the true risks to which they are subjected distorted, but a generic environmental analysis fails entirely to take into account the particular vulnerabilities of their communities to the effects of radiological contamination, relocation and economic disruption. (**24-1-2** [Curran, Diane])

Comment: 57., E-89, 9, “Given the difficulty in conducting a rigorous aggregation of these results (due to the differences in the information sources used and in the impact metrics evaluated), a fairly simple approach is taken.”

Given that the NRC is considering relicensing plants out to 80 year and possibly beyond and considering the economic potential benefits for the licensees, it might just be worthwhile to conduct those “rigorous aggregation” of all these previously unconsidered risks.
(**24-6-15** [Curran, Diane])

Comment: 58., E-89, 30-33, Assertion that “[b]ecause the 1996 LR GEIS did not consider the environmental impact contribution from external events, consideration of these events results in an increase in the environmental impact. The net result when all hazards are considered is that the All Hazards CDF, **on average**, is comparable to that assumed for just internal events in the 1996 LR GEIS.” (emphasis added).

With the tools and data available today there is no need to rely on averages. And reliance on averages does not address environmental impacts that are specific to individual reactors, and that could be addressed by mitigation measures that are specific to individual reactors. (**24-6-16** [Curran, Diane])

Comment: 59., E-90, 13-15, "This GEIS update provides the technical basis for classifying severe accidents as a Category 1 issue **because SAMA analyses are not likely to be required at the vast majority, if not all,** of the facilities that would reference this LR GEIS."(emphasis added).

As discussed above, broad generalizations about the environmental impacts of renewing nuclear reactor licenses are not justified. By the same token, generalizations about SAMAs are unjustified. (**24-6-17** [Curran, Diane])

Comment: 60., E-91, Assertion that "the SOARCA offsite consequence calculations for the three sites evaluated are generally smaller than reported in earlier studies."

To base a regulatory decision on a small fraction of the US plants, i.e., the three SOARCA plants, is inappropriate --especially absent any demonstration that the three sites in some way bound the industry. For all the NRC knows, these three plants could have significantly lower risk than every other plant in the fleet. (**24-6-18** [Curran, Diane])

Comment: 61., E-92, Assertion that "safety during low power and shutdown operations has been improved since issuance of the 1996 LR GEIS as a result of . . . industry initiatives taken during the early 1990s ..."

The vast majority of the safety improvements from the late 1980s onward were completed by 1996. See EPRI "Analysis of Loss of Decay Heat Removal Trends and Initiating Event Frequencies (1959-2000)," 2001, Figure 3-1 Number of Loss of DHR and Los of Inventory Incidents from 1989 through 2000 Page 3-2. Thus, they did not improve safety after 1996. (**24-6-19** [Curran, Diane])

Comment: 62., E-92, Assertion that "[s]**ubsequent analyses performed** and mitigative measures employed since 2001 **have further lowered the risk**" of spent fuel pool accidents."

This statement is grossly misleading. Analysis can improve the understanding of risk and may show that the risks were lower than previously understood but analysis does not lower the risk experienced by the public. (**24-6-20** [Curran, Diane])

Response: *The NRC disagrees that using the results of the SOARCA studies are inappropriate. The results of the SOARCA studies represent important new information that has become available since the issuance of the 1996 LR GEIS. Consideration of this information in the LR GEIS satisfies the "hard look" requirement of NEPA. Furthermore, the SOARCA results represent trends in improved information regarding Level 3 analysis since the NUREG-1150 (NRC 1990) studies were conducted. The three plants evaluated in the SOARCA studies (i.e., Peach Bottom [NRC 2013c], Surry [NRC 2013d], and Sequoyah [NRC 2019c] with different designs and containment types) were also evaluated in NUREG-1150, the results for which were reported in Table 5.12 of the 1996 LR GEIS and compared to the estimated 95 percent UCB for early fatality risk and latent fatality risk. The comparison in Table 5.12 of the 1996 LR GEIS shows that the 95 percent UCB for these risk metrics is more than two orders of magnitude greater than the same metrics estimated for each of the three plants in*

NUREG-1150. The results of the SOARCA studies show that there has been a substantial reduction in these risk metrics since NUREG-1150 was published in 1990.

The NRC disagrees that a generic environmental analysis fails entirely to take into account the particular vulnerabilities of environmental justice communities to the effects of radiological contamination, relocation, and economic disruption. This generic analysis is based, in part, on the assumption that each power plant has had a site-specific SAMA Level 3 analysis. Regarding the Level 3 SAMA analysis, the objective of the Level 3 calculation is to model the extent and magnitude of radiological contamination, offsite doses, protective actions, socioeconomic impacts and costs, and health effects that would result from a release of radioactive material into the atmosphere. Site-specific population distributions are constructed from census data on a polar coordinate grid. To better represent the region around a nuclear site, Level 3 calculations can consider spatial variations in populations, economic data, land use data, emergency response characteristics, and other information as inputs on the spatial grid. Environmental justice issues are a Category 2 issue that will be considered on a plant-specific basis.

The NRC disagrees with the assertion that the vast majority of safety improvements during LPSD operations were completed by 1996 and would have been considered in the 1996 LR GEIS. The Maintenance Rule, 10 CFR 50.65(a)(4), is an example. As noted in the 1996 LR GEIS, the estimate of probability-weighted consequences was based on information available in the plant-specific Final Environmental Statements and in NUREG-1150 (NRC 1990). As a result, plant improvements made since about 1990 were not considered in the 1996 LR GEIS. Therefore, the addition of Section (a)(4) of the Maintenance Rule (10 CFR 50.65) in 2007, regarding risk assessments before maintenance, is an example of a safety improvement during LPSD operations that would not have been fully considered in the 1996 LR GEIS.

The NRC disagrees that the conclusion that "SAMA analyses are not likely to be required at the vast majority, if not all, of the facilities that would reference this LR GEIS" is not justified and with comments that the revised LR GEIS does not provide a technical basis for its conclusion to classify severe accidents as a Category 1 issue. Most facilities expected to reference this LR GEIS have already completed a SAMA or SAMDA analysis and therefore need not undertake a second one per the NRC existing policy and regulations. The totality of the studies and regulatory actions discussed in Section E.4 of Appendix E confirm the robust basis for the Commission's decision to not require applicants to perform a SAMA analysis in an initial LR or SLR application if the NRC has previously completed a SAMA analysis for that facility in a NEPA document and determined that impacts of severe accidents will be SMALL. Furthermore, impacts of all new information in this revised LR GEIS do not contribute sufficiently to the environmental impacts to warrant further SAMA analysis because of the low likelihood of finding cost-effective significant plant improvements. Alternatives to mitigating severe accidents still 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. Section E.5 of Appendix E of the LR GEIS was updated to provide this clarification.

The NRC disagrees that a more rigorous aggregation of risks not considered in the 1996 LR GEIS is warranted. The purpose of this LR GEIS update is to show that the environmental impacts of severe accidents estimated in the 1996 LR GEIS, which are evaluated in terms of environmental probability-weighted consequences, remain bounding after consideration of the new information about severe accident risk. Using site-specific Level 3 PRAs during the SAMA analysis, all plants demonstrated that the environmental probability-weighted consequences had gone down (see Table E.3-1). The purpose of Section E.5 is to discuss the aggregate effect of

the new information and risk insights considered in this revised LR GEIS on the environmental impacts and uncertainties estimated in the 1996 LR GEIS and site-specific SAMA analyses and to state what conclusions can be drawn, in general (using site-specific PDR values, mean values, qualitative assessments, SAMA results, etc.). The different sources of new information can be generally categorized by their effect of decreasing, not affecting, or increasing the best-estimate environmental impacts associated with postulated severe accidents. The approach used in this revised LR GEIS, which is the same approach used in the 2013 LR GEIS, shows that the probability-weighted consequences estimated in the 1996 LR GEIS bound by a significant margin the new information about estimated risks and risk insights discussed in this revised LR GEIS.

The NRC disagrees that this LR GEIS relies solely on averages to draw its conclusions. Site-specific results from the plant-specific SAMA evaluations and from plant-specific LAR submittals are used to show that the probability-weighted consequences, in terms of population dose risk, are bounded for all plants by the 1996 LR GEIS estimates for each plant. Because plant-specific risks for many of the hazards not considered in the 1996 LR GEIS (e.g., SFP risk) are not available, averages are used to show the potential environmental impact from consideration of these hazards. This approach is appropriate for satisfying the "hard look" requirement of NEPA. Furthermore, as part of the license renewal process, the NRC looks for any new and significant plant-specific information during its independent review of the applicant's initial LR or SLR environmental report, during its site visit, the scoping process, and evaluation of other available information.

The NRC agrees with the comment regarding the revised LR GEIS statement "[s]ubsequent analyses performed and mitigative measures employed since 2001 have further lowered the risk of spent fuel pool accidents." The NRC acknowledges the comment and deletes "[s]ubsequent analyses performed, and" from the sentence in Section E.3.7.3. This does not change the intent of the paragraph. The NRC made clarifying revisions to Appendix E as a result of these comments.

A.2.13.24 Comments Regarding LR GEIS Appendix E, General – Accidents: Outdated Data and Methods

Comment: A. The Draft GEIS Is Grossly Outdated and Fails to Use Readily Available Methods and Information.

1. **Technical methods are grossly outdated.**
   Throughout the Draft GEIS, the NRC uses outdated methods and information dating back almost thirty years to the 1996 GEIS. These outdated methods and information were perpetuated in the 2013 Revised GEIS. The NRC should have updated its methods for the first GEIS revision in 2013. It is now long past time to do so. Mitman Report at 3.

   For instance, as discussed in the Mitman Report, core damage frequency (CDF) is a "basic building block" of a nuclear reactor risk analysis. Id. at 1. And every licensee for a currently operating nuclear plant has a detailed internal events Probabilistic Risk Analysis (PRA) which calculates. At a minimum, each licensee's PRA is capable of calculating CDFs for internal events and internal floods. While not all licensees have the capability to calculate external event CDF such as fire, seismic, high winds, tornado, external flooding risks, many do have that capability. In addition to these licensee PRA models, the NRC's Office of Research has developed and maintains Standardized Plant Analysis Risk (SPAR) PRA models for every currently operating reactor. All of the SPAR

models are capable of calculating internal events and internal flood CDFs. In addition, the SPAR models also have varying capability to calculate external event risks. Id. at 2.

Given the ready availability of this up-to-date analytical capability, it is reasonable to expect that the Draft GEIS would present up-to-date quantitative CDF information for internal and external events at each operating nuclear plant in the U.S. and base its environmental impact analysis on that information and would contain a rigorous analysis of that information. Instead, the tables in the Draft GEIS that purport to present sufficient CDF information to support the NRC's environmental analysis contain only a patchwork of incomplete and outdated information. And the analysis is distorted and misleading. Id. at 2-3.

Similarly, information provided by the Draft EIS on external events (such as earthquakes and external flooding and fires) is decades out of date - even though the Draft GEIS acknowledges that "risks from severe accidents initiated by external events (such as an earthquake) could have potentially high consequences." Appendix E, Page E-4, lines 28-34. As Mr. Mitman contends, there is no justification for continuing to follow the now-outdated approach of hypothesizing external event CDFs by applying a multiplier to internal event CDFs. Id. at 3.

In addition to providing incomplete information on CDF values, the NRC analyzes the information in a distorted and misleading manner. Id. at 3. For instance, the Draft GEIS makes incorrect and insupportable use of "mean values" for CDF. Id. The NRC also makes unfounded claims of conservatism that cannot be squared with the limited amount of CDF information provided. Id. at 3-5.

Table E.3-1 of the Draft GEIS demonstrates that the NRC is aware of and has access to much more comprehensive data than is provided for public review in the Draft GEIS. As shown by this table, the NRC has gathered fatality data for the entire fleet from a combination of the 1996 LR GEIS and the subsequent SAMA submittals, all of which is based on CDF values for internal events. The Draft GEIS also discusses the availability of licensee external events models including fire (Page E-26) and seismic (Page E-29). This is all the more reason that the NRC lacks any excuse for failing to provide the information clearly and comprehensively in the Draft GEIS. (**24-1-3** [Curran, Diane])

Comment: In the Draft License Renewal GEIS, the NRC reports a generic conclusion that the environmental impacts of operating the US's 92 different nuclear reactors at 53 different sites will be "SMALL" or insignificant if they are allowed to operate beyond their license expiration dates for 20 or 40 additional years or perhaps even longer. I would reasonably expect such a conclusion to be supported by up-to-date and complete data for each reactor, and a rigorous analysis of all relevant factors that would affect that conclusion. Unfortunately, I found neither. Instead, I found significant errors, misleading and unsupported statements, and a failure to use up-to-date available information or to consider key factors affecting accident risk during extended operation.
My criticisms will be organized under the following topics:

1. Failure to use available and up-to-date risk information (**24-3-1** [Curran, Diane])

Comment: (1) Failure to Use Available and Up-to-Date Information
Several aspects of the analysis in the Draft GEIS are notable for their unnecessary and inappropriate reliance on outdated and incomplete information regarding a fundamental element

of the Draft GEIS' risk analysis: core damage frequency (CDF). All aspects of any analysis of the environmental consequences of postulated accidents analysis derive from this basic building block. For instance, CDF values are used to estimate source terms, i.e., the magnitude and mix of the radionuclides released from the fuel and the timing of their release.

In 1996, when the first License Renewal GEIS was prepared, available information on CDF was limited to mostly internal event CDF. External event information for CDF was limited and therefore the NRC hypothesized that they were "comparable" to internal event risks. (Id., Page 5-17). But this is no longer the case. Every licensee for a currently operating nuclear plant has a detailed internal events Probabilistic Risk Analysis (PRA) which calculates CDF. At a minimum, each licensee's PRA is capable of calculating CDFs for internal events and internal floods. While not all licensees have the capability to calculate external event CDF such as fire, seismic, high winds, tornado, external flooding risks, many do have that capability.

In addition to these licensee PRA models, the NRC's Office of Research has developed and maintains Standardized Plant Analysis Risk (SPAR) PRA models for every currently operating reactor. All of the SPAR models are capable of calculating internal events and internal flood CDFs. In addition, the SPAR models also have varying capability to calculate external event risks.

Given the ready availability of this up-to-date analytical capability, it is reasonable to expect that the Draft GEIS would present up-to-date quantitative CDF information with uncertainties for internal and external events at each operating nuclear plant in the U.S. and base its environmental impact analysis on that information and would contain a rigorous analysis of that information. Instead, the tables in the Draft GEIS that purport to present sufficient CDF information to support the NRC's environmental analysis contain only a patchwork of incomplete and outdated information. And the analysis is distorted and misleading. (**24-3-4** [Curran, Diane])

Comment: (2) Is plant safety improving?

In Section 4.9.1.2, the Draft GEIS asserts that "[t]he internal events core damage frequency (CDF) has decreased, on average, by a factor of 4 to 6." (Id., Page 4-146, lines 29 - 30). Appendix E restates this argument twice. At page E-19, lines 15-19, the Draft GEIS states:

To summarize, based on just the contribution to plant risk from internally initiated events, the general contribution to decreased estimated doses are a factor of 4 to 6 lower simply due to the conservatism built into the 1996 LR GEIS estimated CDF values in comparison to license renewal SAMA internal event CDF values.

And at page E-89, lines 26-27, the Draft GEIS states: "The internal events CDF has decreased, on average, by a factor of 4 to 6." At Page E-17, lines 27-31, the GEIS also asserts that *the risk of severe accidents that result in core damage is significantly less for both PWRs and BWRs than that used as the basis for the 1996 LR GEIS." But the Draft GEIS does not provide the technical basis for this conclusion. The only assertion that comes close is the statement on Page E-17 that:

The means of the SAMA PDR estimates listed in Table E.3-4 and Table E.3-5 are lower than the corresponding mean 1996 LR GEIS expected value PDR by more than a factor of 30 for PWRs and just under a factor of 30 for BWRs.

But Appendix E does not explain how the PWR or the BWR "factor of 30s" on PDR are derived. Nor does the GEIS provide any explanation of how this supposed improvement in PDR relates to an alleged conservatism in CDF values. Absent any technical basis or explanation, these assertions must be disregarded as unsupported.

Equally concerning, this discussion in the Draft GEIS fails to account for CDF values cited elsewhere in the GEIS that show an **increase in CDF** at individual plants. Even the following partial list shows a significant trend in the opposite direction: over 85 percent of reactors providing Fire CDF (FCDF) information reported an increased FCDF (Table E.3-10) and 65 percent of reactors providing Seismic CDF (SCDF) information reported an increase in seismic risk (Table E.3-11):
The following is a partial list of examples:

[See the partial list in ML23123A411]

In considering the above, it is important to keep in mind that FCDF and SCDF values were not supplied for all reactors. Thus, this is only a partial list. But the information that is available demonstrates no basis for the suggestion of a downward trend, and even suggests the trend may go up. More information is needed before any conclusion can be reached.

The Draft GEIS also fails to support another broad assertion that "almost all key trends and developments, with one exception, are favorable (i.e., show improved plant safety or performance) or flat (i.e., show no discernable change in plant safety or performance)." (Draft GEIS Page E-3, lines 2 - 3).

While the Draft GEIS cites a reference for this assertion --"Perspective on Safety Improvements for Commercial Nuclear Power Plants," 34th Annual Regulatory Information Conference (March 8-10). Washington, D.C. - no ADAMS Accession number is provided, nor could the document be found in a Google search. Therefore, it is not possible to determine the basis for the assertion. In any event, the document appears to be a PowerPoint presentation, not a technical study. As a general matter, a presentation lacks the data and analysis necessary to demonstrate how the NRC reached such a significant conclusion. For these reasons, the claim cannot be credited.

The Draft GEIS also fails to identify the alleged "one exception" to the alleged "favorable trends and developments." Thus, the reviewer is left to guess what this exception might be or how significant it is. This is far from the degree of accountability one would reasonably expect from a risk assessment for a single nuclear reactor, let alone dozens.

In keeping with its failure to account for evidence contradicting its claim to reduced CDFs, the Draft GEIS also fails to address a significant amount of evidence showing that "general trends" are not "favorable." For instance:

-A 2022 Idaho National Laboratory report shows a significant increasing trend on how long LOOPs last indicating that LOOP duration has increased fivefold from 1 hour to 5 hours. See *Analysis of Loss-of-Offsite-Power Events 2021 Update," INL/RPT-22-68809, August 2022, Figure 16," Statistically significant increasing trend for LOOP recovery times (all event types) from 1997-2021." (Page 22).

-In 2021 the NIST test reactor melted fuel after violating a safety limit. (ML22066B312). The event was caused by human errors. While the NIST reactor is a test reactor, it was not

conducting a test at the time of the event, but rather it was conducting a normal plant startup post-refueling. Therefore, the NIST event caused by human errors is relevant to the risks of operating power reactors.

-In 2020, for the first time in the history of the US nuclear industry, a reactor was prematurely closed by a weather-related event that involved extensive damage to the plant (ML21139A091). Before being retired Duane Arnold was hit an external event (a Derecho) involving wind speeds that exceeded 100 mph. Ten hours after the event began, the emergency service water system cooling one of the two emergency diesel generators (EDGs) cooling the reactor became seriously degraded when debris clogged the safety related suction strainers and thus required bypassing. The clogging of the suctions strainers rendered the service water system and emergency diesel generator inoperable as defined by the plant's technical specifications.

Not one of these significant events has been captured in the NRC's inadequate assessment of trends. Clearly, the assertion of an improving trend has not been demonstrated.
(**24-3-8** [Curran, Diane])

Response: *The NRC disagrees with comments suggesting that the NRC used outdated data and methods. A summary of the scope of the postulated accidents analysis in this LR GEIS and associated rulemaking is provided below.*

Section 5.2 of the 1996 LR GEIS discusses the impacts of potential accidents. It contains a discussion of plant accidents and consequences. The discussion addresses general characteristics of design-basis (and severe) accidents, characteristics of fission products, meteorological considerations, possible exposure pathways, potential adverse health effects, avoiding adverse health effects, accident experience and observed impacts, and emergency preparedness. This revised LR GEIS reexamined the information from the 1996 LR GEIS and concluded that it is still valid. Because the information about design-basis accidents is valid and has not changed, this LR GEIS does not repeat the information from the 1996 LR GEIS.

The purpose of the 2013 LR GEIS was to consider information updated since the 1996 analysis and examine whether it would collectively change the determination of the probability-weighted consequences of severe accidents. For nuclear power plants for which a SAMA analysis had been completed, the SAMA analysis was the functional equivalent of a Category 1 issue. Severe accidents continue to be a Category 1 issue, except for cases of plants for which no SAMA or SAMDA analysis had been performed, which makes them Category 2 issues. This LR GEIS reexamined the information from the 1996 LR GEIS and concluded that it is still valid.

This update does not simply rely on existing analyses. Rather, the intent of this update was to review new material developed since the 2013 LR GEIS with respect to postulated accidents and determine whether the conclusion that the probability-weighted consequences of severe accidents would be SMALL remained valid. The purpose of this revised LR GEIS is similar to the 2013 LR GEIS, except with the assumption that plant licensees using the LR GEIS have completed at least one SAMA or SAMDA analysis. Thus, the issue of "Severe accidents" continues to be a Category 1 issue, and consideration of a SAMA analysis is changed to a Category 1 issue for plants having a SAMA or SAMDA analysis. The NRC has revised Appendix E of this LR GEIS to clarify the NRC position in this regard.

Regarding how the data are used in Appendix E of the LR GEIS, the NRC disagrees with the comment regarding failure to use available and up-to-date information regarding CDF and SPAR models. Appendix E specifically considered completed SAMA analyses, which use CDF.

As provided in Sections 3.1 to 3.5 of NEI 05-01 (NEI 2005), CDF values are inputs to a much more comprehensive assessment of probability-weighted consequences in the Level 3 probabilistic safety assessment (PSA) analysis (NEI 05-01 refers to PRA as "PSA"; these two terms are interchangeable). In license renewal environmental reports, the applicant typically describes the PSA models used to calculate severe accident risk such as the Level 1 PRA model (internal and external), the Level 2 PRA model, PRA model review history, and the Level 3 PSA model, as indicated in Section 3.1 through Section 3.4 of NEI 05-01 (NEI 2005). Section 3.5 describes the results of the severe accident risk calculation, the Level 3 PRA. Level 3 PRA models determine the offsite dose and economic impacts of severe accidents based on Level I PRA results, Level 2 PRA results, atmospheric transport, mitigating actions, dose accumulation, early and latent health effects, and economic analyses. In many SAMA analyses, the MELCOR Accident Consequence Code System (MACCS2) (SNL 2021) is used to calculate the offsite consequences of a severe accident.

The NRC disagrees that the LR GEIS "fails to account for CDF values cited elsewhere in the LR GEIS that show an increase in CDF at individual plants." The comment lists specific values for estimated FCDFs and SCDFs from risk-informed submittals that are greater than the corresponding values used in plant-specific SAMA analyses. These values are repeated from Tables E.3-10 and E.3-11 of Appendix E of the LR GEIS. The discussion in Section E.3.2.1 of Appendix E of the LR GEIS associated with these tables specifically acknowledges there has been an increase in the FCDF and SCDF values since the plant-specific SAMA analyses were completed. However, as discussed in the "Integrated Assessment of New Information on All Hazards" section of Section E.3.2.1 of Appendix E of this LR GEIS, the totality of the new information about internal events and external events CDF, referred to as the total All Hazards CDF, shows that the All Hazards CDFs are essentially comparable to the internal events CDFs that formed the basis for the 95th percentile UCB population dose estimates reported in the 1996 LR GEIS.

As referenced in the LR GEIS, CDF values for the plant-specific analysis were either obtained from risk-informed LAR submittals that have been reviewed and approved by the NRC or which were updated and submitted in the applicant's license renewal environmental report, which is considered the best available information by the NRC. For this LR GEIS update, the latest available information regarding plant CDF was used. For example, the seismic CDFs reported in Table E.3-11 of Appendix E of the LR GEIS were obtained from the applicable licensee-submitted seismic PRA reports and NRC staff evaluations, unless otherwise noted, and compared to the corresponding SCDF values used in the SAMA analysis provided in the plant-specific supplemental EIS. The NRC has revised Appendix E of this LR GEIS to clarify the NRC position with regard to CDF. Consideration of new information regarding CDF in Appendix E confirmed the validity of the 1996 and 2013 LR GEIS's discussion of the probability-weighted impacts of severe accidents for NEPA purposes.

The NRC agrees in part and disagrees in part with the comment critical of the use of samples and increases to severe accident risk that may go up and down. Because the SAMA or SAMDA is only performed once to determine the plant-specific PDR and it was determined for all plants to be less than the predicted value in the 1996 LR GEIS, the NRC evaluated new information that might significantly affect (up or down) the probability side of the equation, which is CDF. This evaluation of new information is described in Sections E.3.1 through E.3.9 (along with new information about source terms and consequences) to make a generic conclusion regarding probability-weighted consequences. In Sections E.3.1 and E.3.2 of Appendix E of this LR GEIS, the NRC evaluated impacts of internal and external events using the best available information regarding CDF. The best available information is considered CDFs during the plants' initial

license renewal or LARs that were reviewed and approved by the NRC and provided in tables. The plants evaluated in these new tables were normally the plants that were in the 1996 LR GEIS so that a similar comparison could be made. There is no intent to provide an exhaustive catalog of every plant's CDF in Appendix E of this revised LR GEIS, because plant licensees provide their latest plant-specific information during the submittal of their license renewal application. Similarly, potential generic impacts regarding CDF on the probability-weighted consequences were evaluated for power uprates and population increases. Potential impacts regarding LPSD and the consideration of the SFP, if these hazards were included in the Level 3 consequence analysis, were considered using published NRC information.

*As explained in Sections E.3.1 to E.3.9 of this LR GEIS, while several of the factors may result in modest increases in severe accident risk, other new information regarding these factors suggests that the risk of severe accidents may be, on average, substantially lower than previously estimated. Recall PDR = CDF*PD. The mean PDR is reduced by a factor of 120. Even if the total CDF increases by a factor of 10, since the left side of the equation is roughly proportional to the PD and CDF factors, the margin compared to the 1996 mean PDR value is still a factor of 12 [120*(PDR)/10*(CDF*PD)]. This considerable margin supports the NRC conclusion that the PDR has decreased from the values used to make the probability-weighted consequences determination of small in the 1996 LR GEIS. As a result, this LR GEIS analysis further supports the generic findings from the 1996 and 2013 LR GEIS that the probability-weighted consequences of severe accidents would be SMALL.*

Although the quantitative evaluation supported the NRC's conclusion that the probability-weighted consequences remain small, other factors also were considered. For example, plant operators have implemented improvements in response to NRC orders and industry initiatives. These have contributed to the improved safety of all plants during both power operation and LPSD operation (such as the contribution of FLEX), which may not be modeled fully in some PRAs. These qualitative conservativisms further support the NRC's conclusion that probability-weighted consequences remain SMALL.

In summary, the NRC concludes that the CDFs from severe accidents initiated by all hazards (i.e., internal and external events), as quantified in recent risk-informed LARs and the other sources cited above, are, in some cases, higher than the internal events CDFs that formed the basis for the 1996 LR GEIS and, on average, are about 35 percent higher than the All Hazards CDFs used in the license renewal SAMA analyses. However, the environmental impacts from events initiated by all hazards (specifically, consequence-weighted population dose) are generally significantly lower (one to two orders of magnitude) than those used in the 1996 LR GEIS. In addition, as cited above, plant improvements made in response to NRC orders and industry initiatives have contributed to the improved safety of all plants during both power operation and LPSD operation. The NRC concludes that the new information from the external event PRAs is not significant for the purposes of this LR GEIS revision, that external event risk is being effectively addressed and reduced by the various NRC orders and other initiatives, and that, therefore external event risk is not expected to challenge the 1996 LR GEIS 95th percentile UCB risk metrics during the initial LR or SLR period. Sections E.1 and E.2 of this LR GEIS were updated to clarify the NRC's position.

The NRC disagrees that the 1996 LR GEIS analysis needs to be reperformed using updated methods. The 1996 LR GEIS predicted the 95 percent UCB consequences for 74 nuclear power plants, representing 118 units, from atmospheric releases due to severe accidents. Predicted 95 percent UCB values were developed for early fatalities per reactor-year (RY), latent fatalities per RY, and total population dose per RY as provided in Table E.3-1 of Appendix E of this

LR GEIS in the columns titled, "Predicted Total Early Fatalities/RY (95 percent UCB)," "Non-normalized Predicted Latent Total Fatalities/RY (95 percent UCB)," and "Non-normalized Predicted Total Dose (person-rem/RY) (95 percent UCB)," respectively. In Section 5.5.2.5 of the 1996 LR GEIS, the NRC concluded that the generic analysis "applies to all plants and that the probability-weighted consequences of atmospheric releases, fallout onto open bodies of water, releases to ground water, and societal and economic impacts of severe accidents are of small significance for all plants."

Subsequently, SOARCA values calculated for early or prompt fatalities and latent fatalities were much lower than the values used in the 1996 LR GEIS analysis to determine that the probability-weighted consequences are small. Specifically, the SOARCA results show extremely low individual early fatality risk for important severe accident scenarios at the three sites studied and show a very low individual risk of cancer fatality for the populations close to the plants (i.e., well below the NRC Safety Goal, which currently translates to a chance of less than two in one million that an exposed individual will contract a long-term fatal cancer). Thus, the environmental impacts estimated using the more recent and realistic source term information are expected to be much lower than the impacts used as the basis for the 1996 LR GEIS (i.e., the frequency-weighted consequences). Thus, the determination of probability-weighted consequences in the 1996 LR GEIS is conservative relative to that determined with state-of-the-art information and computer codes (see, for example, Section E.3.3.1 of Appendix E of this LR GEIS).

The SOARCA project was initiated to leverage decades' worth of research into severe accidents and apply modern analytical tools and techniques to develop a body of knowledge about the realistic consequences of severe nuclear reactor accidents (NRC 2020e). The NRC completed an extensive set of uncertainty analyses (UAs) to confirm the original SOARCA results (NRC 2022c). The collection of the three SOARCA UAs covers two different types of light water reactors, three different containment designs, and three different locations in the United States. Each UA comprises plant-specific and scenario-specific analyses. The SOARCA project and the SOARCA UAs corroborated the NRC's conclusion that the probability-weighted consequences of a severe accident remain SMALL.

Furthermore, plant-specific analysis has confirmed for all plants having a SAMA or SAMDA analysis that the probability-weighted consequences have decreased from the 95 percent UCB values reported in the 1996 LR GEIS (as shown in Table E.3-1). Therefore, there is no justification for reperforming the 1996 LR GEIS analysis.

The NRC disagrees with the comment that the draft revised LR GEIS is outdated and does not use readily available methods and information. As has been stated throughout Appendix E of this LR GEIS, the most up-to-date information about plant-specific PRA results and risk information are considered to show that the probability-weighted consequences reported in the 1996 LR GEIS, which supported a small finding, continue to be bounding. For example, Table E.3-1 in Appendix E of the LR GEIS shows that the estimated total PDR, which accounts for severe accidents initiated by internal events and external events during at-power operation, for each plant that has performed a SAMA analysis, is bounded by the corresponding 95 percent UCB population dose reported in the 1996 LR GEIS for each plant. Specifically, the predicted 95 percent UCB population dose values from the 1996 LR GEIS population are higher for each plant by factors ranging from 3 to over 1,000 and are on average a factor of 120 higher than the corresponding total PDR values from the license renewal SAMA analyses. The population-weighted consequences reported in the 1996 LR GEIS are the basis for the determination in the 1996 LR GEIS and rule that the environmental impact of severe accident

risks is SMALL. The risk results provided in the SAMA analyses generally represent the most comprehensive and current plant-specific severe accident risk information available.

The NRC disagrees with the comment regarding NRC's inadequate assessment of trends. The NRC did not intend for revised Appendix E to constitute a comprehensive research report about operating experience trends, although generalizations are made regarding the result of the staff's analysis and review. Rather, the NRC provided a discussion of overall safety trends and knowledge gained to provide greater context for the discussion in Appendix E. The NRC revised Appendix E.2 to clarify the staff's understanding of plant safety and severe accidents.

Another example is Section E.3.2 of Appendix E of the LR GEIS. This appendix provides the most comprehensive and current plant-specific PRA (CDF) results for severe accident fire, seismic, and all hazards events. This information was provided in plant-specific risk-informed LARs submitted to the NRC for review and evaluation and represents PRA results as recent as 2020. All risk-informed LARs use PRAs that have been peer reviewed in accordance with NRC Regulatory Guide 1.200 (NRC 2020d). Only CDF results are presented for the set of plants for which CDFs were available for the 1996 LR GEIS and which were used to develop the 95 percent UCB population dose risk and other population-weighted consequences (i.e., potential early and latent fatalities risk). Furthermore, only CDF and LERF results are provided in risk-informed LARs because the NRC uses these metrics as surrogates for severe accident risk (in other words, probability-weighted consequences are not available nor are they required by the NRC). These results show that after accounting for external events, the All Hazards CDFs are comparable to the internal events only CDFs assumed in the 1996 LR GEIS.

As the comments note, the NRC has developed plant-specific SPAR models that are scope-limited. Specifically, these models are generally limited to evaluation of internal events, including internal flooding, with a very limited capability to evaluate certain external hazards. Furthermore, these models do not assess the consequences of severe accidents. For these reasons, the SPAR models are of limited applicability for the purposes of the LR GEIS.

The NRC staff agrees that internal event CDFs in some cases have increased since the IPE. However, to clarify, the internal event-initiated CDFs from the original (plant-specific) EISs are compared to the CDFs reported in the plant-specific IPEs and in the license renewal SAMA analyses for the PWRs and BWRs considered by the 1996 LR GEIS. Before making this comparison, it is notable that the CDFs from the original EISs are for severe accidents initiated by internal events, while the CDFs from the IPEs and SAMA analyses, in many cases, also include severe accidents initiated by internal flooding events. Table E.3-2 and Table E.3-3 in Appendix E of this LR GEIS show these comparisons. The data in these tables show that CDFs have been steadily declining since the original estimates in the EISs. Specifically, as can be seen in Table E.3-2 and Table E.3-3, for many plants, the IPE CDFs are smaller than those in the original EISs, particularly for BWRs. The mean value of the IPE CDFs listed in Table E.3-2 and Table E.3-3 is lower than the corresponding mean of the 1996 LR GEIS CDFs by 30 percent for PWRs and by about a factor of 3.5 for BWRs. Furthermore, the SAMA internal event CDFs are smaller than those in the original EISs for all plants except one and smaller than those in the IPE for most of the plants. Specifically, the mean value of the SAMA CDFs listed in Table E.3-2 and Table E.3-3 is a factor of almost 4 lower than the corresponding mean of the 1996 LR GEIS CDFs for PWRs (i.e., from Table E.3-2, 8.4×10^{-5}/yr for the 1996 LR GEIS mean CDF divided by 2.2×10^{-5}/yr for the SAMA mean CDF) and more than a factor of 6 lower for BWRs (i.e., from Table E.3-3, 5.4×10^{-5}/yr for the 1996 LR GEIS mean CDF divided by 8.7×10^{-6}/yr for the SAMA mean CDF). Information from recent risk-informed LARs submitted to the NRC show that these CDFs are, on average, further reduced from what were reported in the

license renewal SAMA analyses. Accordingly, the likelihood of an accident that leads to core damage, based on just internally initiated events, is significantly less for both PWRs and BWRs than that used as the basis for the 1996 LR GEIS. The NRC has revised Section E.3 to provide additional detail and further clarify that the approach taken supports the generic conclusion that the probability-weighted consequences remain SMALL for all reactors listed in Table E.3-1.

The NRC agrees that an ADAMS number needs to be provided. The reference section of Appendix E was updated to provide an ADAMS accession number for NRC 2022j: "Perspective on Safety Improvements for Commercial Nuclear Power Plants." The NRC disagrees that the information presented in Section E.2 of the LR GEIS from this reference (NRC 2022j) is not relevant information to include in the LR GEIS because it was presented at the 34th Annual Regulatory Information Conference after being publicly released in accordance with NRC processes. While not of the same pedigree as a peer-reviewed comprehensive report, this information source does provide insight into NRC regulatory activities for the benefit of diverse groups of stakeholders, which is the purpose of the NRC annual regulatory information conferences. Also, this information was not the basis for any of the conclusions in the LR GEIS, rather it was used only as a source of supporting information to the overall observation that there has been an improvement in plant performance and public safety since issuance of the 1996 LR GEIS.

The NRC agrees that the 2022 Idaho National Laboratory report (INL/RPT-22-68809; INL 2022) shows that there has been an increasing trend in duration of LOOP events between 1997 and 2021. This conclusion is consistent with the above-referenced presentation, "Perspective on Safety Improvements for Commercial Nuclear Power Plants" (NRC 2022j). As stated above, the draft LR GEIS noted that there was one exception to the assessment of trends in key safety indicators that they are favorable (i.e., show improved plant safety or performance) or flat (i.e., show no discernible change in plant safety or performance). The one exception or negative trend is LOOP recovery time. Section E.2 in Appendix E of this LR GEIS was revised to specifically specify this exception or negative trend.

The NRC disagrees with the comment regarding the number of facilities referenced in the CDF tables. The point of these tables is to compare the CDF information used for the 28 plants in the 1996 LR GEIS to the most current available information. The CDFs for just these 28 plants were used in the 1996 LR GEIS to develop the probability-weighted consequences (population dose risk, latent fatality risk, and prompt fatality risk) for all operating plants at that time, which are the metrics used to make the determination that the environmental impact of severe accidents was SMALL. To provide the CDFs for other plants provides limited value for the purposes of this LR GEIS because there is no basis for comparison to the 1996 LR GEIS. The NRC updated the text in Appendix E to describe the comparison approach.

The NRC acknowledges the comments regarding external event multipliers. The comment that the external event multiplier is a source of non-conservatism was acknowledged in footnote 13 in Appendix E of the draft LR GEIS (now, footnote 15 in Appendix E of this final LR GEIS) with specific regard to seismic events; however, footnote 15 explains why this non-conservatism is unlikely to affect the overall conclusions in Appendix E. In summary, changes were made in the LR GEIS, as discussed above, in response to these comments to clarify the NRC positions, where appropriate.

A.2.13.25 Comments Regarding LR GEIS Appendix E, General – Aging of Equipment

Comment: 2. Aging equipment

a. Aging issues not addressed by current PRA methods
The Draft GEIS is silent regarding the contribution of equipment aging to accident risks. This is a new and significant issue that was not addressed in the 1996 GEIS or the 2013 Revised GEIS. Therefore, the Draft GEIS is technically inadequate. Mitman Report at 10-11. The Draft GEIS assumes that the effects of aging on reactor equipment are addressed by compliance with NRC safety requirements in 10 C.F.R. Part 54. See Draft GEIS at E-1. Through aging management programs (AMPs), component monitoring systems watch for aging phenomena and advise when repair or replacement are needed. Likewise, there are passive component monitory process that attempt to identify components that are nearing end of life conditions. But aging phenomena are not fully addressed by AMPs, especially in the SLR term when effects of aging on plant equipment may be masked and their behavior uncertain. Id. See also Miranda Declaration.

Regardless of monitoring and maintenance activities, equipment failure rates typical follow a well understood pattern known as the bathtub curve. The initial period of equipment life (or burn-in period) usually witness higher failure rates. The period at the bottom of the curve or useful life, sees failures occurring at a constant rate. As the component ages the failure rate increase. (Module G "Equipment Failure Modes and Data Sources for Parameter Estimation," Idaho National Laboratory, June 8, 2012 (ML12160A317.)

However, these aging effects after the useful life are not incorporated into PRAs.
(**24-1-7** [Curran, Diane])

Comment: Technical knowledge gaps regarding aging equipment

The Draft GEIS is also deficient because it does not discuss aging problems associated with SSCs, including reactor pressure vessel embrittlement, irradiation-assisted stress corrosion cracking of reactor internals, concrete structures and containment degradation, and electrical cable qualification and condition assessment, were identified in SECY-14-0016, Memorandum from Mark A. Satorius, NRC Executive Director of Operations, to NRC Commissioners, re: Ongoing Staff Activities to Assess Regulatory Considerations for Power Reactor Subsequent License Renewal at 1 (Jan. 31, 2014) (ML14050A306) and the NRC's five-volume Expanded Materials Degradation Assessment (EMDA), NUREG/CR-7153 (Oct. 2014) ("EMDA Report").[1]

[1] The five volumes of the EMDA Report are as follows: Volume 1, Core Internals and Piping (ML14279A321); Volume 2, Core Internals and Piping (ML14279A331); Volume 3, Reactor Vessel Aging (ML14279A349); Volume 4, Concrete Aging (ML14279A430); and Volume 5, Cable Aging (ML14279A461).

Going back to at least 2014, the NRC Staff has identified multiple SSCs for which technical gaps in understanding make it difficult to predict the SSCs' behavior over an extended period of operation during a subsequent license renewal term. In early 2014, the NRC Staff issued SECY-14-0016, for the purpose of informing the Commission of "ongoing staff activities to prepare for the anticipated receipt and review of subsequent license renewal applications that, if approved, could extend operation of power reactors beyond 60 years." SECY-14-0016 at 1. ("SECY-140016"). The Staff asserted that it was "currently performing confirmatory reviews of relevant technical issues for long-term operation and will summarize these efforts in several

research reports." Id. at 2-3. The Staff also identified the "most significant technical issues" for operation "beyond 60 years" as reactor pressure vessel embrittlement, irradiation-assisted stress corrosion cracking of reactor internals, concrete structures and containment degradation, and electrical cable qualification and condition assessment. Id., Enclosure 1 at 2-3.

SECY-14-0016 describes a significant feature of the Staff's effort to address the technical challenges posed by operation of certain SSCs during the SLR term: a collaboration with the U.S. Department of Energy on an "expanded materials degradation assessment" ("EMDA"). According to the Staff, the nearly completed EMDA study relied on an "expert elicitation process to identify materials and components which could be susceptible to significant degradation during operation beyond 60 years." Id., Encl. 1 at 3. The study would cover "the reactor vessel, primary system piping, reactor vessel internals, concrete, and electrical cables and qualification." Id. The Staff committed to using the results of the EMDA study:

to identify any gaps in the current technical knowledge or issues not being addressed by planned industry or DOE research, and to identify AMPs that the staff believes will require enhancements for subsequent license renewal. Id. (**24-1-8** [Curran, Diane])

Comment: The aging problems identified in SECY-14-0016 must be addressed in the Draft GEIS because they remain unresolved. As discussed in SRM-SECY-14-0016, the Commission instructed the Staff to:

The staff should keep the Commission informed on the progress in resolving the following technical issues related to SLR: reactor pressure vessel neutron embrittlement at high fluence; irradiation assisted stress corrosion cracking of reactor internals and primary system components; concrete and containment degradation, and electrical cable qualification and condition assessment. The staff should also keep the Commission informed regarding the staff's readiness for accepting an application and any further need for regulatory process changes, rulemaking, or research. The staff should continue to emphasize in communications with industry the need to strive for satisfactory resolution of these issues prior to the NRC beginning a review of any SLR application.

SRM-SECY-14-0016, Memorandum from Annette L. Vietti-Cook, Secretary, to Mark A. Satorius, Executive Director for Operations, re: Ongoing Staff Activities to Assess Regulatory Considerations for Power Reactor Subsequent License Renewal (Aug. 29, 2014) (https://www.nrc.gov/reading-rm/doc-collections/commission/srm/2014/2014-0016srm.pdf). The failure to resolve unresolved safety issues before approving license renewal is inconsistent with the NRC's original approach to unresolved safety issues, which was to resolve them before promulgating the Part 54 license renewal rule. 56 Fed. Reg. 64,943, 64,947-48 (Dec. 13, 1991). The significance of the unresolved safety issues identified in SECY-14-0016 was confirmed ane emphasized when the Staff published the results of the EMDA study in the five-volume EMDA Report. For instance, with respect to pressure vessel embrittlement, the EMDA Report concluded that:

significant technical issues still need to be addressed to reduce the uncertainties in the data and understanding of the changes in RPV material properties following neutron irradiation. The issues regarding irradiation effects are the most significant issues for RPVs.
Id., Vol. 1 at 17. As the EMDA expert panel further explained:

For reactor pressure vessels, a number of significant issues have been identified for future research. Relatively sparse or nonexistent data at high fluences, for long radiation exposure

(duration), and resulting high embrittlement create large uncertainties for embrittlement predictions. The use of test reactors at high fluxes to obtain high fluence data is not the most direct representation of the low flux conditions in RPVs. Late-blooming phases (LBPs), especially for high nickel welds, have been observed and additional experimental data are needed in the high fluence regime where they are expected. Other discussed issues include specific needs regarding application of the fracture toughness master curve, data on long term thermal aging, attenuation of embrittlement through the RPV wall, and the development of an embrittlement trend curve based on fracture toughness measurements.

Id., Vol. 1 at 3 (emphasis added).

With respect to irradiation-assisted stress corrosion cracking [IASCC], the EMDA Report observed:

While all forms of corrosion are important in managing the safe operation of a nuclear reactor, IASCC [irradiation-assisted stress corrosion cracking] has received considerable attention over the last four decades due both to its severity and unpredictability. Despite over thirty years of international study, there does not exist a consensus on the underlying mechanism of IASCC, although more recent work in the open literature has identified several possible causes.

Id., Vol. 1 at 10 (emphasis added). (**24-1-9** [Curran, Diane])

Comment: For core internal structures, the EMDA expert panel observed that design testing was based on far less operational time than an 80-year operating life, thus calling for re-examination of "the assumptions and limits" for core internal structures, due to "the potential for thermal aging and fatigue damage during extended lifetimes." Id., Vol. 1 at 11. As the report explained:
During the initial plant design, each component was designed with a load to expected and specific lifetimes and operating conditions using established guidelines (typically those in Section III of the ASME Boiler and Pressure Vessel Code). An 80-year reactor lifetime corresponds to over 600,000 hours of service (at a 90% service factor) while most creep data used in design comes from tests operating much less than 100,000 hours.
Id. (emphasis added) The panel concluded that "[t]he extension of lifetimes beyond these initial design considerations should be carefully examined." Id.

Similarly, for degradation of carbon steels and low alloy steels, the EMDA Report raised concerns about the wisdom of extrapolating 35-40 years of operating experience to 80 years of extended operation, including concerns regarding synergistic reactions between different types of degradation:

Engineering judgments may offer some justification for reactor operation up to 60 years, since that judgment is based largely on the extrapolation of known phenomena after operating lives of 35-40 years. There are concerns, however, regarding the potential degradation of carbon steels and low alloy steels if the operating license was extended a further 20 years to 80 years since this may lead to events associated with time-limiting degradation modes (such as fatigue or thermal aging) and synergisms between different degradation modes (such as irradiation and SCC).

Id., Vol. 2 at 103 (emphasis added). Similarly, with respect to sustained stress corrosion cracking ("SCC"), the EMDA raised questions about how "combinations of system variables" may "compromise the validity of current design and disposition criteria." Id. at 125-26.

Concrete degradation was another example where the EMDA panel noted "insufficient data" to understand concrete irradiation, "the most important degradation mechanism." Id. at 24. The EMDA expert panel identified concrete irradiation as a "knowledge gap," concluding that the gap was due to a lack of sufficient test data to support a clear evaluation of the significance of such mechanism for long-term operations. Id. at 26. And the panel called for further research on concrete aging, another topic of concern that had been raised earlier in SECY-14-0016:

Concrete structures can also suffer undesirable changes in properties with time, including adverse performance of its cement paste matrix or aggregate constituents under environmental influences (e.g., physical or chemical attack). Changes to embedded steel reinforcement as well as its interaction with concrete can also be detrimental to concrete's service life. Aging effects can be exacerbated if improper concrete specifications were used at the time of construction. A number of areas of research would help assess the long-term integrity of the reactor concrete structures.

Id., Vol. 1 at 3. (**24-1-10** [Curran, Diane])

Comment: In addition, the EMDA expert panel expressed concern about whether the government would have ongoing capacity to address these unresolved issues:

Finally, it must be recognized that the steady decrease in overall R&D funding over the last ~20 years limits capability to perform another evaluation of this type, or retain expertise for other purposes. Many of the experts involved in this evaluation are retired, and several will no longer remain active as consultants in future years. Others are likely to retire and may not be available to consult or transfer knowledge to their replacements.

The combined experience and judgment represented by this panel may not be replaced in the next decade or two because the gap in expertise is so large. Further, the accumulated knowledge and judgment of the next generation of experts will be dramatically more difficult to acquire when the current leaders are no longer available.

Id., Vol. 2 at 203 (ML14279A331) (emphasis added).

Since the issuance of the EMDA Report in 2014, other government experts and industry consultants have examined possible ways to close the technical knowledge gaps and resolve the uncertainties that were identified by the Staff in SECY-14-0016 and confirmed by the EMDA expert panel in the EMDA Report. One tool that has received significant attention is the harvesting of components from decommissioned nuclear reactors. As NRC has recognized, harvested reactor components "[m]ay be the only practical source of representative aged materials;" and could be used to "validate larger aging data set[s]." M. Hiser, P. Purtscher, A. B. Hull and R. Tregoning, Harvesting of Aged Materials from Operating and Decommissioning Nuclear Power Plants at 5 (Oct. 12, 2017) (ML17285A484). Furthermore, "[e]x-plant materials offer unique environmental exposure that cannot be entirely replicated by laboratory testing with fresh materials." M. Hiser and A. Hull, Strategic Approach for Obtaining Material and Component Aging Information at 3 (June 2-4, 2015) (ML20332A097). Nevertheless, neither NRC nor the nuclear industry has established a program for systematic harvesting of components from decommissioned reactors. Nor are Petitioners aware of any other NRC Staff program resolving the knowledge gaps identified in SECY-14-0016 and the EMDA Report. These uncertainties persist as a crucial deficiency in the NRC's knowledge regarding the environmental risks posed by subsequent license renewal. (**24-1-11** [Curran, Diane])

Comment: Aging effects on reactor equipment

The Draft GEIS assumes that the effects of aging on reactor equipment are addressed by compliance with NRC safety requirements in 10 C.F.R. Part 54. See Draft GEIS at E-1. Through aging management programs (AMPs), component monitoring systems watch for aging phenomena and advise when repair or replacement are needed. Likewise, there are passive component monitory process that attempt to identify components that are nearing end of life conditions. But aging phenomena are not fully addressed by AMPs, especially in the SLR term when effects of aging on plant equipment may be masked and their behavior uncertain. This phenomenon is discussed in SECY-14-0016, "Ongoing Staff Activities to Assess Regulatory Considerations for Power Reactor Subsequent License Renewal, ML14050A306, January 31, 2014) NRC's five-volume Expanded Materials Degradation Assessment (EMDA), NUREG/CR-7153 (Oct. 2014) ("EMDA Report"). In particular, the Staff identified the "most significant technical issues" for operation "beyond 60 years" as reactor pressure vessel embrittlement, irradiation-assisted stress corrosion cracking of reactor internals, concrete structures and containment degradation, and electrical cable qualification and condition assessment.

Id., Enclosure 1 at 2-3.

Regardless of monitoring and maintenance activities, equipment failure rates typical follow a well understood pattern known as the bathtub curve. The initial period of equipment life (or burn-in period) usually witness higher failure rates. The period at the bottom of the curve or useful life, sees failures occurring at a constant rate. As the component ages the failure rate increase. (Module G "Equipment Failure Modes and Data Sources for Parameter Estimation," Idaho National Laboratory, June 8, 2012 (ML12160A317.)
However, these aging effects after the useful life are not incorporated into PRAs.

Both active and passive SSC exhibit this failure rate behavior. In PRAs the bulk of the input data is active component failure rate. Passive components are less frequently modeled. They occasionally do appear as input data on tanks (e.g., condensate and refueling water storage tanks). However, most passive equipment is not modeled, e.g., pipe hangers and other supporting components, electrical cables, etc.. There is an exception, some of these passive components are captured in initiating event frequencies such as loss of coolant accident (LOCA) pipe breaks and fires. However, the PRAs assume a constant failure rate thus ignoring the impact of aging on failure rates.

The NRC has long recognized the importance of this aging components phenomena and its implication for PRAs and the risk results and insights that the PRAs generate.

The operation of complex systems, such as light water nuclear reactors, over long periods of time invites **the potential of age-related degradation and a reduction of the strength of passive components in light water reactors.** The U.S. Nuclear Regulatory Commission (NRC) sponsored the nuclear power plant aging research (NPAR) program during 1985-1994 to gather information about nuclear power plant aging. (Vora, 1993) This program collected a large body of information, mainly qualitative, **on plant aging and its potential effects on plant safety. Incorporating this body of knowledge into** modem risk assessment techniques such as **probabilistic risk assessment** (PRA) has been envisioned as an effective and systematic method to assess the impact on plant risk resulting from aging of SSCs (systems, structures, and components). However, this body of knowledge had not yet been formally integrated into modem risk assessment techniques.

(NUREG/CR-5632, Incorporating Aging Effects into Probabilistic Risk Assessment -A Feasibility Study Utilizing Reliability Physics Models," August 2001) (ML012490206) (emphasis added)

More recent work reiterates this concern:

The risk levels of structures, systems, and components (SSC) defined within existing PRA models are traditionally not updated as the SSCs age or as their performance degrades. The current risk assessment is typically a snapshot in time, and the information on plant component condition is often not considered.

(Dynamic PRA with Component Aging and Degradation Modeled Utilizing Plant Risk Monitoring Data, INL/CON-17-41789-Revision-0, September 2017, https://inldigitallibrary.inl.gov/sites/sti/sti/Sort_1827.pdf). Also:
Within the nuclear industry there are several motivating factors to consider physically based DPRA [Dynamic PRA] models. The Light Water Reactor Sustainability (LWRS) Program has demonstrated interest in DPRA to more realistically account for aging systems structures and components (SCCs), using physics models to capture the impact of the aging process (Yadav et al., 2017). **More realistically accounting for component degradation is critical for the extension of existing LWRs in the U.S.**

Dynamic PRA Prospects for the Nuclear Industry," Nathan E. Wiltbank and Camille J. Palmer, November 2021, https://www.frontiersin.org/articles/10.3389/fenrg.2021.750453/full) (emphasis added).

The Draft GEIS is silent regarding the contribution of equipment aging to accident risks. Therefore, it is technically inadequate. (**24-3-12** [Curran, Diane])

Response: *The NRC disagrees with the comments regarding the contribution of aging equipment to accident risks. As stated in the NRC's responses to similar comments in this appendix, nuclear power plant operational safety issues related to the management of aging systems, structures, and components are outside the scope of the NRC's environmental reviews conducted under 10 CFR Part 51 as well as this LR GEIS and rulemaking. Rather, those issues are thoroughly addressed by the NRC's safety review for license renewal under Part 54 for passive systems, structures, and components and the NRC's ongoing regulatory oversight for active systems, structures, and components.*

The Generic Aging Lessons Learned (GALL) report (NUREG-2191; NRC 2017b) provides information regarding degradation of systems, structures, and components and aging management programs related to 10 CFR Part 54 license renewal in-scope systems, structures, and components, including reactor pressure vessel embrittlement, irradiation-assisted stress corrosion cracking of reactor internals, concrete structures and containment degradation, and electrical cable qualification and condition assessment. The NRC has continued to monitor/resolve the issues identified in SECY-17-0016 (NRC 2017d) particularly during the period of extended operation. More recent guidance on managing the effects of aging include the "Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report" (NUREG-2191) issued in May 2017. The new draft of the GALL Report for subsequent license renewal was published July 2023 (NRC 2023g).

The NRC disagrees that further action is needed to minimize the impact of uncertainties regarding the aging of equipment. While there is some uncertainty regarding the future of nuclear power plants in the extended period, the NRC's robust Maintenance Rule and license renewal rule and ongoing oversight activities are designed to minimize the uncertainty due to aging.

The NRC disagrees that a PRA that takes into account an increasing failure rate due to aging is needed. Both active and passive systems, structures, and components exhibit a bathtub curve failure rate behavior. In PRAs, the bulk of the input data is active component failure rate. Passive components are less frequently modeled. They occasionally do appear as input data on tanks (e.g., condensate and refueling water storage tanks). However, most passive equipment is not modeled (e.g., pipe hangers and other supporting components, electrical cables, etc.). There is an exception—some of these passive components are captured in initiating event frequencies such as LOCA pipe breaks and fires. However, the PRAs assume a constant failure rate (random), thus ignoring the impact of aging on failure rates because of the full suite of regulatory programs (license renewal, Maintenance Rule, operational requirements, etc.) that are designed to help keep the appropriate components near a constant failure rate (random). Moreover, as part of the license renewal safety review under Part 54, applicants must update time-limited aging analyses or provide aging management plans for passive systems, structures, and components that will ensure appropriate actions are taken to maintain safety prior to component failure. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.

Comment: 16. Permitting reactor licensees to continue operating past their original operating license expiration dates by two to four decades creates safety issues that are not covered by Part 54 aging management programs. For instance, a nuclear plant's operating lifetime, whether it's extended or not, can be shortened if the plant's limit of allowable design or operational cycles is exceeded. (**24-6-21** [Curran, Diane])

Comment: 22. As demonstrated above, license extension beyond 40 years raises potentially significant safety issues that are not addressed in the NRC's Part 54 safety regulations for renewal of reactor licenses. Assurance of safe operation during a longer lifetime could require some design or operational improvements. The NRC should revisit the adequacy of reactor design and the CLB for the license renewal term, and address the safety and environmental risks that remain. (**24-6-27** [Curran, Diane])

Response: *The NRC disagrees with these comments to the extent that these comments challenge Part 54. As stated in the NRC's responses to similar comments in this Appendix and in Chapter 1 of this LR GEIS, nuclear power plant operational safety issues related to the management of aging systems, structures, and components are outside the scope of the NRC's license renewal environmental review conducted under 10 CFR Part 51 as well as this LR GEIS and rulemaking. Rather, those issues are thoroughly addressed by the NRC's safety review for license renewal under Part 54 for passive systems, structures, and components and the NRC's ongoing regulatory oversight for active systems, structures, and components. Therefore, to the extent these comments challenge Part 54, they are outside the scope of this LR GEIS and rulemaking.*

The original 40-year licensing period for nuclear reactors was dictated by the Atomic Energy Act of 1954 (42 U.S.C. § 2011 et seq.) and was based on economic and anti-trust factors rather than on the technical limitations of the facility. The principal safety concerns associated with license renewal are related to the aging of passive systems, structures, and components

important to the continued safe operation of the facility. During the safety review, the NRC determines whether aging effects will be adequately managed so that the original design assumptions will continue to be valid throughout the period of extended operation, or verify that if aging effects will occur, the nuclear power plant has adequate procedures for managing these effects. For all aspects of operation other than the aging management during the period of extended operation, existing regulatory requirements govern plants that provide assurance of adequate protection if its license is renewed. To the extent that these comments challenge the evaluation of postulated accidents, they do not contain a clear link to the analyses in Appendix E. No changes were made in the LR GEIS, final rule, or guidance as a result of this comment.

Comment: 17. Design or transient cycles are counted and reported in plants' current licensing basis (CLBs). The number of cycles is compared to the number of allowable cycles for each component, to determine the cumulative usage factor (CUF) for each plant component. CUFs, whose values range from zero to one, indicate each component's remaining lifetime. An example of CUFs is available in the San Onofre FSAR. [3] A component with a CUF of 1.0 is fully depleted (i.e., its safety margin is zero).

Extending the lifetime of a plant means that components' safety margins are reduced as more transient cycles are accrued and their CUF values are reduced. This is more the result of continued operation than it is of age. In this way, it is comparable to vessel embrittlement. The applicable industry standard [1] describes Condition III events as: "Incidents, any one of which may occur during the lifetime of a particular plant." Condition III is one of four categories defined by the standard according to their expected frequencies of occurrence. Each category imposes acceptance limits for the consequences that are predicted, by analyses and evaluations, of all the events in the category. The four categories and their consequence requirements are based upon the underlying principle of nuclear safety design and analysis [2], which is expressed in this way:

The nuclear safety criteria … have been established on the premise that: a. Those situations in the plant that are assessed as having a high frequency of occurrence shall have a small consequence to the public, and b. Those extreme situations having the potential for the greatest consequence to the public shall be those having a very low frequency of occurrence.

That is, events that can occur most frequently are those events that produce the least significant consequences. The consequences of Condition II events are predicted to be more serious than those of Condition I events, and so on. Here is a summary of the expected frequencies of the categories that define the categories.

Category	Frequency of Occurrence
Condition I	≥ 1/year
Condition II	≥ 0/year
Condition III	≥ 0/plant-lifetime
Condition IV	= 0/plant-lifetime

(Although Condition IV events are not expected to occur at all, they are analyzed for the purpose of designing protection systems for those events, such as the emergency core cooling system (ECCS). Condition IV events also known as Design Basis Accidents.)

For example, an increase in load is a transient that is expected to occur during normal operation, and this would not require any protective action (i.e., no reactor trip is demanded).

This would be classified as a Condition I event. An inadvertent operation of the ECCS at power (IOECCS) would demand an automatic reactor trip. This event could occur one or more times during a year of operation. Therefore, the IOECCS is classified as a Condition II event. These events do not prevent the plant from being returned to service, after repairs or replacements are made. A stuck open pressurizer relief or safety valve would require a reactor trip and ECCS actuation. This event, which amounts to a small loss of coolant accident (LOCA), would not occur more than about once in a plant lifetime, and could lead to effectively ending the plant's lifetime (e.g., as in the stuck open relief valve at Three Mile Island). Thus, it is classified as a Condition III event. The rupture of a main coolant pipe is a Condition IV LOCA. A LOCA requires core flooding flow from the ECCS. Although a LOCA is not expected to occur during a plant's lifetime, it is nevertheless analyzed and reported in the CLB since it is used to design the ECCS, determine its actuation setpoints and logic, and size its components.

If the expected frequency of Condition III events is defined according to plant lifetime, then the expected frequency of Condition III events in a plant whose lifetime has been doubled would be about double the frequency of those events in a plant whose lifetime has not been extended. This is not a rule or requirement. It does not mean that a plant that has experienced a Condition III event must be compelled to shut down. However, it implies that doubling the lifetime of a plant should be justified by a design or operational improvement that would maintain the CLB margin of safety (i.e., would preserve the expected frequency of Condition III events to one in 40 years, as defined in the CLB. If the expected frequency of Condition III events is not reduced to one in 60 years or 80 years, to account for the increased plant lifetime, then the safety margin is effectively reduced. (See 10 CFR Part 50.92.) The NRC is aware of this concern [8] but does not consider it in its license renewal reviews. (**24-6-22** [Curran, Diane])

Comment: 18. Pressurized Thermal Shock (PTS) is related to PWR plant aging and reactor pressure vessel (RPV) embrittlement.

PTS can occur when relatively cold water (e.g., from the ECCS) enters an RPV while it's pressurized and hot. Rapid cooling of the reactor pressure vessel (RPV) can put a large load or thermal stress on the steel. Embrittled steel would be less capable of surviving this stress. See 10 CFR § 50.61 and 10 CFR § 50.61a.

In the CLB, PTS could be a concern in accidents that can cool the RPV and pressurize it, or in some cases, repressurize it. For example, the inadvertent operation of the ECCS (IOECCS) at power accident will introduce relatively cold ECCS water into the RPV, which will cool the RPV and pressurize it. This will continue until the ECCS flow is manually ended. The PTS due to an IOECCS occurring in a plant that is 60 years old could be more serious than one occurring in a younger plant, since continued operation reduces RPV ductility (i.e., it embrittles the RPV).

A steam line break (SLB) will cool the RPV and depressurize it. The RPV will be repressurized, and further cooled, by the addition of ECCS flow, especially after the steam line break flow is isolated. Again, this will continue until the ECCS flow is manually ended.

The inadvertent opening of a pressurizer power-operated relief valve (IOPORV) is another event that can depressurize and then repressurize the RPV and cool the RPV with the insertion of ECCS flow. ECCS flow will continue until it is manually ended. The IOPORV, analyzed as a mass addition event, is in the CLBs of very few plants. This Condition II event can rapidly fill the pressurizer and cause the PORV to relieve water. Since the PORVs of most plants are not qualified for water relief, they must be assumed to stick open after relieving water. In this way, the Condition II event would become a Condition III event (i.e., a small LOCA) with the expected

frequency of occurrence of a Condition II event. That is, the CLB does not address this relatively high consequence, high frequency event. This is an unanalyzed risk that falls outside the categorization of events that is specified in the controlling standard. [2]
(**24-6-23** [Curran, Diane])

Comment: 19. The inadvertent operation of the ECCS at power (IOECCS) accident is a relatively frequently occurring event. It is classified as a Condition II event or an event of Moderate Frequency. It occurred, for example, in one of the Salem units, in 1994. [4] It also occurred at Millstone, Unit 3. [5] On the morning of April 17, 2005, an IOECCS incident occurred at Millstone that resulted in filling the pressurizer and relieving water through the power operated relief valves (PORVs). The IOECCS originated from the growth of a metallic whisker in a Reactor Protection System (RPS) circuit card that completed a circuit that generated an ECCS actuation signal. In this incident, the PORVs were qualified to relieve water. They opened, relieved water, and reseated. Later, it was noted that there was some leakage detected from the PORVs. In my professional opinion, the growth of metallic whisker on a circuit card could be a symptom of aging that might not be detected in an aging management program.
(**24-6-24** [Curran, Diane])

Response: *The NRC disagrees with these comments. As explained in Chapter 1 and in response to other comments in this appendix, comments raising safety issues related to license renewal and ongoing operations are outside the scope of the NRC's license renewal environmental review conducted under 10 CFR Part 51 as well as this LR GEIS and rulemaking. Rather, the issues are thoroughly addressed by the NRC's safety review for license renewal under Part 54 and ongoing safety oversight under Part 50. To the extent that these comments challenge the NRC existing regulations in Part 54, they are outside the scope of this LR GEIS and rulemaking. To the extent that these comments challenge the evaluation of postulated accidents, they do not contain a clear link to the analyses in Appendix E. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.*

Comment: 20. Sometimes the NRC staff must order licensees to correct omissions or errors in their CLBs, or to make design changes to improve safety. Such orders are controlled by the Backfit Rule (10 CFR § 50.109). In 2015, the NRC ordered Exelon to correct certain omissions and errors in the CLB of its Byron and Braidwood plants. (The order took two years to write.) Exelon appealed the order (twice), with support from the Nuclear Energy Institute (NEI). The first appeal was denied. The second appeal, which was made directly to the NRC's Executive Director of Operations (EDO), was granted. [6] The EDO's decision was based upon the premise that PSVs can relieve water and then reseat. It states, "In the absence of an assumed failure of the pressurizer safety valve to reseat, the concerns articulated in the backfit related to event classification, event escalation, and compliance with 10 CFR 50.34(b) and General Design Criteria 15, 21, and 29 are no longer at issue." This conclusion was based upon the results of PSV water relief tests that were conducted by EPRI and cited by Exelon; but they were not reviewed by the NRC staff.

A year later, the NRC reviewed the EPRI test results and, "determined that test results reveal that valve damage following subcooled liquid discharge is likely. Thus, the staff no longer views the EPRI methodology as a generically acceptable means of justifying that PSVs would reliably reseat and preclude escalation of the RCS mass addition condition." [7]

The NRC's EDO, its highest-ranking career official, overruled his agency staff regarding this backfit order. It is my opinion that this act of overruling a well considered and justified backfit order on an aging plant sets a precedent that will prevent the NRC technical staff from issuing

future backfit orders to compel old plants, operating beyond their original design lifetimes, to correct any errors or otherwise improve safety. That would have to be done by the state regulators. (**24-6-25** [Curran, Diane])

Response: *The NRC disagrees with this comment. Backfit requirements are outside the scope of the NRC's license renewal environmental review conducted under 10 CFR Part 51 as well as this LR GEIS and rulemaking. One case of overruling a backfit order on an aging plant does not set a precedent that will prevent the NRC from issuing future backfit orders to compel old plants, operating beyond their original design lifetimes, to correct any errors or otherwise improve safety, when appropriately justified. Backfits are performed on a case-by-case basis with an established process. No changes were made in the LR GEIS, final rule, or guidance as a result of this comment.*

Comment: 21. The NRC's license renewal rules rely heavily on inspections for aging management. But inspection in some parts of the plant can be difficult. An example of this is that a 2002 inspection of the Davis Besse RPV failed to detect a hole with a surface area of 20-30 square inches. Boric acid had eaten through the carbon steel RPV head to the thin internal liner of stainless steel. The corrosion process had been going on for more than six years. It had not been found in two earlier inspections, in 1998 and 2000. (**24-6-26** [Curran, Diane])

Response: *The NRC disagrees with this comment. The Davis-Besse event is outside the scope of the NRC's license renewal environmental review conducted under 10 CFR Part 51 as well as this LR GEIS and rulemaking. This Part 51 rulemaking does not pertain to license renewal safety review activities in-service inspection requirements imposed by 10 CFR 50.55a, nor the NRC Reactor Oversight Process to inspect, measure, and assess the safety and security performance of operating commercial nuclear power plants, such as the 2002 inspection of the Davis-Besse reactor pressure vessel. Therefore, to the extent that this comment challenges the NRC's safety regulations or oversight of Davis-Besse, it is outside the scope of this LR GEIS and rulemaking. To the extent that this comment challenges the evaluation of postulated accidents, it does not contain a clear link to the analyses in Appendix E. Nevertheless, the NRC acknowledges that the Davis-Besse nuclear plant boric acid event in 2002 was a significant incident in the history of nuclear power regulation in the United States. Several regulatory actions were taken by NRC in response to this incident. Some of the key regulatory actions taken included bulletins and orders:*

- *NRC Bulletin 2001-01: Before the actual incident in 2002, the NRC issued Bulletin 2001-01 in August 2001 (NRC 2001b). This bulletin alerted nuclear plant operators to potential safety concerns related to boric acid corrosion and emphasized the importance of monitoring and managing boric acid deposits.*
- *NRC Bulletin 2002-01: After the Davis-Besse incident, the NRC issued Bulletin 2002-01 in March 2002 (NRC 2002c). This letter requested that all nuclear plant licensees provide information about their reactor vessel head inspections, boric acid control programs, and corrective actions taken in response to the Davis-Besse event.*

Order EA-03-009: The NRC issued Order EA-03-009 in February 2003 (NRC 2003), which outlined additional requirements for Davis-Besse, including plant improvements, safety enhancements, and ongoing regulatory oversight.

These regulatory actions were taken to address the immediate safety concerns at the Davis-Besse nuclear plant and to prevent similar issues from occurring at other nuclear power plants. They emphasized the importance of maintaining the integrity of reactor vessel heads and the

need for robust inspection and maintenance programs. No changes were made in the LR GEIS, final rule, or guidance as a result of this comment.

A.2.13.26 Comments Regarding LR GEIS Appendix E, General – Climate Change

Comment: C. The Draft GEIS Fails to Take into Account New and Significant Information Affecting Accident Risk.

1. Climate change
The GEIS is deficient because it does not consider the effects of climate change on accident risk. This is a new and fast-developing issue that was not addressed in the 1996 GEIS or the 2013 Revised GEIS. As explained by Mr. Mitman at pages 9-10, climate change affects risk in two ways. First, it increases the likelihood or initiating event frequency of events. For example, increased storm frequency can lead to higher initiating event frequency for losses of offsite power (LOOPs). Second, climate change can increase the probability of failure of design features or mitigation equipment. A 2020 severe windstorm at the Duane Arnold plant (ML21139A091) illustrates this phenomenon. While the storm may or may not be directly attributable to climate change, it is a reasonable example of the type of severe weather effects that climate change can cause today and will cause in the future. In that case, a severe windstorm caused a loss of offsite power (LOOP). As a result of the LOOP, debris accumulated at the suction of the service water systems, which are necessary to cool the emergency diesel generators (EDGs) and the emergency core cooling system (ECCS) heat exchangers. The NRC's risk analysis of the event showed an increase in the failure probabilities of the service water system, the EDGs and the ECCS due to this climate-related external event. Consideration of these risks in an EIS would provide important information regarding climate-related accident risk as well as identification of mitigation measures to address those risks.

A third way that climate change affects risk analysis, which is unique to flooding risk, is the "cliff edge" effect. With most hazards if the severity is increased slightly, the stress on the system is increased somewhat proportionately. However, with many flood-related issues, a small increase in the hazard can cause a dramatic and often overwhelming impact on a structure. For example, a small increase in wave height could raise the flood height sufficiently to overtop a floodwall inundating the equipment the floodwall is designed to protect. Risk analyses for climate change-related flooding must look carefully at this cliff-edge phenomenon.

Finally, the National Academies under sponsorship of the National Oceanic and Atmospheric Administration (NOAA) has started a project to modernize the probable maximum precipitation (PMP) methodology (https://www.nationalacademies.org/our-work/modernizing-probable-maximum-precipitation-estimation#sectionSponsors). This project will consider approaches for estimating PMP in a changing climate, with the goal of recommending an updated approach, appropriate for decision-maker needs. PMP is a significant input into the design of critical infrastructure such as dam and reactor safety analysis directly and indirectly through its impact on probable maximum flood (PMF). The NRC is well aware of this effort as they have already participated in at least one of the initial project workshops. PMP and PMF also impact reactor safety directly via their impact on local intense precipitation (LIP). The Draft GEIS is silent on this and is thus deficient. As this process is likely to take several years, if the GEIS cannot wait for resolution, then any plant issued a SLR prior to its resolution should be required to revisit the issue once the update is completed. (**24-1-6** [Curran, Diane])

Comment: 3. Failure to address significant and relevant factors affecting accident risk, such as climate change, long-term aging effects, multi-unit accidents, and accident risks during shutdown (**24-3-3** [Curran, Diane])

Comment: (3) Failure to Address Significant and Relevant Factors Affecting Accident Risk

Climate Change
Various sections of the Draft GEIS address climate change --*see* Section 4.5 Water Resources, Section 4.12 Greenhouse Gas Emissions and Climate Change, Section 4.13 Cumulative Effects of the Proposed Action and Section 4.14 Impacts Common to All Alternatives. However, the Draft GEIS does not address climate changes impacts on accident risks in Section 4.9.1.2 or Appendix E. This omission constitutes a significant deficiency in the Draft EIS because climate change demonstrably affects the frequency and intensity of external events and therefore has the potential to significantly increase accident risks. Moreover, the frequency and intensity of climate change effects are increasing over time. Given that the NRC is proposing to rely on the Draft GEIS for decisions that could affect reactor safety decades from now, the Draft GEIS must address these changing effects over the entire licensed lifetime of reactors, which may end 4 decades from now.

As discussed above, the Draft GEIS is already inadequate as a general matter for making broad generalizations about external event CDF based on extrapolations from internal event CDF values and limited actual plant-specific values for external event CDF. Appendix E looks explicitly at external events focusing exclusively on internal fires and seismic issues. It ignores other external events such as flooding, external fires (e.g., forest and wildfires), tornadoes, etc. Climate change has already started to increase the frequency and intensity of these events. See, for example, "Climate change is probably increasing the intensity of tropical cyclones," March 31, 2021 NOAA, https://www.climate.gov/news-features/understanding-climate/climate-change-probably-increasing-intensity-tropical-cyclones; "Climate Change Indicators: Weather and Climate," EPA, https://www.epa.gov/climate-indicators/weather-climate; "Global Warming and Hurricanes," NOAA Geophysical Fluid Dynamics Laboratory, April 11, 2023, https://www.gfdl.noaa.gov/global-warming-and-hurricanes/.

The NRC is well-aware of the issues of climate change and its impact on nuclear plant safety. After the Fukushima meltdowns, the NRC Office of Research initiated a research program to develop tools to assist in probabilistic and deterministic assessments of external hazards including seismic, high winds and flooding with a consideration of climate change. See "NRC Probabilistic Flood Hazard Assessment Research Program Overview,", February 22 - 25, 2021 (ML21064A418) and Potential Impacts of Accelerated Climate Change," PNNL-24868, May 2016 (ML16208A282)). In addition, climate change has been a topic of discussion at the NRC's Regulatory Information Conference (RIC) in recent years. See Climate Change Impact on the Safety of Nuclear Installations," March 8-10, 2022 (ML22140A312)) & "Observations on Extreme Weather and Impacts on Nuclear Power Plants, EPRI ML22140A320, 2022). (**24-3-9** [Curran, Diane])

Comment: Accident risk evaluations for climate change must be site-specific

The effects of climate change on accident risk are and will continue to be site-specific and not subject to generalization. For example, the three reactors at the Oconee plant --for which the NRC is now considering an application for subsequent license renewal --lie downstream of two large dams. The design of the dams includes consideration of the maximum probable flood

induced by the maximum probable precipitation (i.e., storm). Climate change has the potential to significantly increase the amount of precipitation falling on watersheds above the dams. Will the dams be able to pass these higher intensity storms and the resulting floods? See the attached declaration "NRC Relicensing Crisis at Oconee Nuclear Station: Stop Duke from Sending Safety Over the Jocassee Dam" for a thorough analysis.

Another example is the Turkey Point plant, located in a low-lying coastal area of South Florida. With climate change the already-occurring, sea level change will continue and possibly accelerate during the SLR period. Likewise, hurricane intensity, i.e., wind speed, rain fall and storm surge, will intensify.

As discussed elsewhere in my report, the Duane Arnold plant in Iowa was prematurely and permanently shuttered after being hit with a Derecho with wind speeds exceeding 100 mph. Climate change has been implicated in the severity of this extreme weather event ("Hints of a derecho-climate change link, ten years after 2012 storm," Washington Post, June 29, 2022, https://www.washingtonpost.com/climate-environment/2022/06/29/derecho-climate-change-severe-storm/)

Therefore, in order to provide a reasonably thorough and complete analysis of accident risks during the license renewal term, the Draft GEIS must address the continuing and growing contribution of climate change to accident risks at nuclear plants. And this evaluation must be conducted on a site-specific basis. (**24-3-10** [Curran, Diane])

Comment: Effects of climate change considerations on Probabilistic Analysis

Climate change affects risk in two ways. First, it increases the likelihood or initiating event frequency of events. For example, increased storm frequency can lead to higher initiating event frequency for losses of offsite power (LOOPs). Second, climate change can increase the probability of failure of design features or mitigation equipment. A 2020 severe windstorm at the Duane Arnold plant (ML21139A091) illustrates this phenomenon. While the storm may or may not be directly attributable to climate change, it is a reasonable example of the type of severe weather effects that climate change can cause today and will cause in the future. In that case, a severe windstorm caused a loss of offsite power (LOOP). As a result of the LOOP, debris accumulated at the suction of the service water systems, which are necessary to cool the emergency diesel generators (EDGs) and the emergency core cooling system (ECCS) heat exchangers. The NRC's risk analysis of the event showed an increase in the failure probabilities of the service water system, the EDGs and the ECCS due to this climate-related external event. Consideration of these risks in an EIS would provide important information regarding climate-related accident risk as well as identification of mitigation measures to address those risks.

A third way that climate change affects risk analysis, which is unique to flooding risk, is the "cliff edge" effect. With most hazards if the severity is increased slightly, the stress on the system is increased somewhat proportionately. However, with many flood-related issues, a small increase in the hazard can cause a dramatic and often overwhelming impact on a structure. For example, a small increase in wave height could raise the flood height sufficiently to overtop a floodwall inundating the equipment the floodwall is designed to protect. Risk analyses for climate change-related flooding must look carefully at this cliff-edge phenomenon.

Finally, the National Academies under sponsorship of the National Oceanic and Atmospheric Administration (NOAA) has started a project to modernize the probable maximum precipitation (PMP) methodology (https://www.nationalacademies.org/our-work/modernizing-probable-

maximum-precipitation-estimation#sectionSponsors). This project will consider approaches for estimating PMP in a changing climate, with the goal of recommending an updated approach, appropriate for decision-maker needs. PMP is a significant input into the design of critical infrastructure such as dam and reactor safety analysis directly and indirectly through its impact on probable maximum flood (PMF). The NRC is well aware of this effort as they have already participated in at least one of the initial project workshops.

PMP and PMF also impact reactor safety directly via their impact on local intense precipitation (LIP). The Draft GEIS is silent on this and is thus deficient. As this process is likely to take several years, if the GEIS cannot wait for resolution, then any plant issued a SLR prior to its resolution should be required to revisit the issue once the update is completed. (**24-3-11** [Curran, Diane])

Comment: 15., E-5, 8-13, Assertion that "[t]he environmental impacts of design-basis accidents and severe accidents are assessed in Sections 5.3.2 and 5.3.3 of the 1996 LR GEIS, respectively. As stated in Section 5.3.2, the environmental impact of design-basis accidents was assessed in the individual plant-specific EISs at the time of the initial LR application review. Because licensees are required to maintain the plant within acceptable design and performance criteria consistent with the current licensing basis, regardless of initial LR or SLR term, these impacts are not expected to change."

Both design basis accidents and severe accidents include external events. Examples include: external fires, tornadoes, floods, hurricanes. These types of events are directly related to local weather conditions. Thirty years have passed since issuance of the 1996 GEIS, and additional decades since issuance of original EISs for U.S. reactors. During that time, climate change has significantly degraded worldwide weather conditions and thus local weather conditions. As climate change continues, weather events will increase in both their intensity and frequency. Thus, it is reasonable to expect significant challenges to the safe operation of nuclear reactors. But the NRC has not taken into consideration these changes in intensity and frequency of weather events in their environmental analysis of accident impacts. This is a significant omission. (**24-4-11** [Curran, Diane])

Response: *The NRC disagrees in part and agrees in part with the comments regarding addressing climate change in Appendix E. The NRC is required, under the NEPA, to evaluate the impacts of proposed Federal actions, such as the renewal of an operating license, on human health and the environment. The NRC complies with NEPA through its regulations in 10 CFR Part 51. The NRC agrees that climate change should be considered in this LR GEIS, as appropriate. For example, climate change and its possible environmental effects are considered throughout the LR GEIS, such as in Section 4.5.1.1 under the issues of "Surface Water Use Conflicts (Plants with Once-Through Cooling Systems)" and "Surface Water Use Conflicts (Plants with Cooling Ponds or Cooling Towers Using Makeup Water from a River)." In addition, Section 4.12.2 of the LR GEIS addresses the environmental impacts of climate change on environmental resources. The latter is a Category 2 issue that must be addressed in every plant-specific license renewal application.*

The NRC disagrees that the impacts of future climate change and mitigation should be considered for postulated accidents. The impacts of future changing natural phenomena on nuclear power plant postulated accidents are outside the scope of this LR GEIS and rulemaking. For Appendix E of this LR GEIS, the scope of the rule is regarding probability-weighted consequences of atmospheric releases, fallout onto open bodies of water, releases to groundwater, and societal and economic impacts from severe accidents and mitigation. As

presented in Appendix E, existing and updated information show continued large margins to the 95 percent UCB from the 1996 LR GEIS and support the conclusion that the impact of severe accidents is SMALL. The information considered by the NRC staff reflected updated information about site-specific external events and hazards. The large margin can account for a variety of uncertainties, including imperfectly quantified factors in the risk analyses.

The implications of long-term climate change on plant operations and adjustments or preparations by licensees to a new or changing environment are outside the scope of the NRC's license renewal environmental review, which documents the potential environmental impacts of continued reactor operations; however, adaptation of nuclear power plants to climate change is addressed through the NRC's existing regulations. 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. Furthermore, nuclear power plants are required to operate within technical specifications in accordance with their NRC-issued operating license, which includes specifications for coping with natural phenomena hazards. Any change in technical specifications would require the NRC to conduct a review before allowing licensees to make operational changes because of changing environmental conditions.

Additionally, the NRC continually evaluates nuclear power plant operating conditions and physical infrastructure through its reactor oversight program to ensure ongoing safe operations. Moreover, NRC regulations require the NRC staff to assess the need for an update of the LR GEIS on a 10-year cycle; therefore, the NRC staff disagrees that the staff would rely on this analysis decades from now even if it were to become outdated by new climate change information. 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 at existing nuclear power plants. If climate change happens more quickly or changes more substantially than what is currently forecasted, the NRC will evaluate the new information to determine whether any safety-related changes are needed at existing nuclear power plants. However, this is a separate and distinct process from the NRC's license renewal environmental review that is conducted in accordance with NEPA. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.

A.2.13.27 Comments Regarding LR GEIS Appendix E, General - Integrated Site Severe Accident Risk

Comment: 2.NRC studies that assess the radiological consequences of SFP accidents, such as NUREG-1738 and SMSAB-99-02, project off-site "early fatalities" or "prompt fatalities" out to 100 miles. Despite the potentially deadly off-site consequences of a SFP accident, the NRC has failed to adequately assess the on-site (ground zero) consequences which would obviously be much worse. The on-site radiological consequences could prevent mitigative actions and lead to multiple concurrent reactor-SFP accidents. (**33-1-5** [Magnuson, Brian])

Comment: 2.NRC studies that assess the radiological consequences of SFP accidents, such as NUREG-1738 and SMSAB-99-02, project off-site "early fatalities" or "prompt fatalities" out to 100 miles. Despite the potentially deadly off-site consequences of a SFP accident, the NRC has failed to adequately assess the on-site (ground zero) consequences which would obviously be much worse. The on-site radiological consequences could prevent mitigative actions and lead to multiple concurrent reactor-SFP accidents. (**33-1-12** [Magnuson, Brian])

Response: *The NRC disagrees with these comments regarding integrated site severe accident risk. The composite of the SFP accident risk assessments discussed in Section E.3.7 of Appendix E of the LR GEIS provides a strong basis for the NRC conclusion that the risk from accidents at SFPs is low and bounded by the probability-weighted consequences reported in the 1996 LR GEIS. The risk assessment results from NUREG-2161 (NRC 2014b), referred to as the SFP Study, which is also discussed in Section E.3.7 of Appendix E of the LR GEIS, specifically show that the probability-weighted consequences or risk of both mitigated and unmitigated (or unsuccessful mitigation) SFP accidents is significantly below the NRC safety goals.*

Furthermore, the NRC specifically considers onsite accident consequences in the assessment of SAMAs. As cited several times in Appendix E of the LR GEIS, NEI 05-01 (NEI 2005) is the NRC-endorsed guidance for evaluating SAMAs. This guidance specifies consideration of both onsite and offsite economic and exposure costs in the assessment of SAMAs. In addition, since many of the SAMA analyses were completed, the industry responded to post-Fukushima requirements, such as reliable spent fuel pool monitoring, that would be expected to further mitigate onsite consequences during a postulated accident.

The NRC has made changes in Section E.4 of this final LR GEIS to clarify that if new and significant information arises out of the NRC Full-Scope Site Level 3 PRA study, then that information will need to be considered in license renewal applications.

A.2.13.28 Comments Regarding LR GEIS Appendix E, General-Multi-Unit Severe Accident Risk

Comment: 1. The accidents at Fukushima demonstrated that multiple concurrent reactor-SFP accidents are credible. Despite this demonstration and contrary to Fukushima Near Term Task Force recommendations (SECY11-093), the NRC has not yet evaluated the consequences of multiple concurrent reactor-SFP accidents— which would have the most impact on the environment. (**33-1-4** [Magnuson, Brian])

Comment: 1. The accidents at Fukushima demonstrated that multiple concurrent reactor-SFP accidents are credible. Despite this demonstration and contrary to Fukushima Near Term Task Force recommendations (SECY-11-093), the NRC has not yet evaluated the consequences of multiple concurrent reactor-SFP accidents—which would have the most impact on the environment. (**33-1-11** [Magnuson, Brian])

Response: *The NRC disagrees with these comments. None of the NTTF recommendations in SECY-11-0093 (NRC 2011) specify evaluation of consequences of multi-unit or multiple concurrent reactor-SFP events in severe accident risk assessments. Rather, the NTTF recommendations with regard to multi-unit events are to strengthen emergency preparedness at nuclear power plants to be capable of responding to prolonged station blackout and multi-unit events and to enhance accident mitigation capability. With specific regard to emergency preparedness, the recommendation included a proposal for licensees to add guidance to their emergency plans that documents how to perform a multi-unit dose assessment (including release from SFPs) using the licensee's site-specific dose assessment software and approach. The NRC has developed the Radiological Assessment System for Consequence Analysis for radiological emergencies (RASCAL) code for performing dose assessments during radiological emergencies (see https://ramp.nrc-gateway.gov/codes/rascal). Training on this code has been updated to include how to assess doses from multi-unit accidents (see, for example, http://www.nationalrep.org/2018Presentations/Session1_RASCAL%20Training_Kowalczik.pdf).*

Section E.2 of Appendix E of the LR GEIS provides a summary of the NRC actions taken to address the NTTF recommendations, and Section E.3.7 provides a summary of actions taken that directly reduce SFP severe accident risk. The NRC conclusion after consideration of the lessons learned from the Fukushima accident and implementation of the NTTF recommendations is that the probability-weighted consequences of severe accidents reported in the 1996 LR GEIS remain bounding.

Furthermore, SAMA analyses completed to date, which were considered in Appendix E, have addressed multi-unit risk. Specifically, SAMA analyses address multi-unit risk by either assuring that the benefits and implementation costs of SAMAs are on a per-site basis (for example, by multiplying the maximum benefit of a SAMA for a single unit by the number of units at the site to fully account for its potential benefit), or if SAMA benefits and costs are on a per unit basis, the impact associated with implementation of the SAMA is reflected in the estimated implementation costs (for example, the estimated cost of a SAMA is divided by the number of units to account for economies-of-scale in its implementation at each unit). Also, SAMAs that can mitigate risk at all units on the site (e.g., installation of an additional backup power supply) are identified and evaluated. The NRC has revised Section E.4 of this LR GEIS to clarify this treatment of multi-unit risk in SAMA analyses.

A.2.13.29 Comments Regarding the Location of Prairie Island Nuclear Generating Plant

Comment: The proposed rule would reclassify severe accidents (currently Category 2) to Category 1 (or generic issues) and that severe accident mitigation alternatives ("SAMA") "do not warrant further plant specific analyses because the demonstrated reductions in populations dose risk and continued severe accident regulatory improvements substantially reduce the likelihood of finding cost-effective significant plant improvements" (page 13,355). With less than 700 yards between PIIC Tribal homes, our government center, and businesses, we do not agree that severe accidents should be reclassified as a Category 1 issue. Because a severe accident at the PINGP has great potential to negatively impact PIIC and our economic driver, Treasure Island Resort & Casino, the NRC has a Trust obligation to ensure that people, lands, and resources of the tribe are protected. (**14-2** [Johnson, Johnny])

Response: *The NRC acknowledges the comment and concern. The NRC disagrees with the comment that the issue of "Severe accidents" should not be recategorized as a Category 1 issue. The 1996 LR GEIS (and the 2013 LR GEIS) resolved the impacts portion of the severe accident issue generically, leaving only the mitigation component of the issue to be resolved on a plant-specific basis for facilities that had not already considered SAMAs. The probability-weighted consequences, which account for both the likelihood and consequences of postulated severe accidents and include the 95 percent UCB for predicted early and latent fatalities and dose estimates, are unchanged from the 1996 LR GEIS in this revised LR GEIS. The NRC has determined that the severe accident risk results estimated in the 1996 LR GEIS remain bounding after consideration of the additional information presented in Appendix E of this revised LR GEIS. Additionally, the NRC has confirmed the agency's existing NEPA policy to not require a SAMA analysis for plants that have previously been the subject of such an analysis. The vast majority, if not all, LR applicants expected to reference this LR GEIS have already considered severe accident mitigation and, therefore, would not need to do so again.*

During preparation of plant-specific supplements to the LR GEIS, the NRC staff considers changes in nuclear power plant operating parameters as well as new and potentially significant information provided by the applicant or identified through public comments, or resulting from the NRC's due diligence in reviewing relevant information. The NRC staff reviews data in part

for information that could provide a seriously different picture of the impacts of license renewal with regard to this issue and trigger further plant-specific reviews.

The NRC also acknowledges that the Federal government has a Trust Relationship and Trust Responsibility to Indian Tribes in the agency's Tribal Policy Statement (82 FR 2402), published in 2017. Under the Federal Trust Doctrine, the United States—and the individual agencies of the Federal government—owe a fiduciary duty to Indian Tribes. The nature of that duty depends on the underlying substantive laws (i.e., treaties, statutes, agreements) creating that duty. The NRC exercises its Trust Responsibility under its authorizing statutes, including the Atomic Energy Act of 1954, the Energy Reorganization Act of 1974, the Nuclear Waste Policy Act of 1982, the Low-Level Radioactive Waste Policy Act of 1985, and the Uranium Mill Tailings Radiation Control Act of 1978, as amended.

As an independent regulatory agency that does not hold in trust Tribal lands or assets or provide services to federally recognized Tribes, the NRC fulfills its Trust Responsibility through implementation of the principles of the Tribal Policy Statement, by providing protections under its implementing regulations, and through recognition of additional obligations consistent with other applicable treaties and statutory authorities (see Principle 1, NRC Tribal Policy Statement).

Concerning the location of the Prairie Island Indian Community relative to the Prairie Island plant, this concern is outside the scope of the LR GEIS and this rulemaking. Issues related to siting were resolved during initial licensing and are generally not revisited during license renewal. No changes were made in the LR GEIS, final rule, or guidance as a result of this comment.

A.2.13.30 Comments Regarding LR GEIS Appendix E, General - Section 4.9.1.2 and Appendix E Accidents

Comment: -Each nuclear power plant has site-specific conditions that affect the likelihood and nature of a radiological disaster, such as: a) Geology and seismicity, b) Hydrology, c) Severe weather events and climatic conditions, and D) Security risks and vulnerabilities (**20-20** [Judson, Timothy])

Comment: I am opposed to the proposed rule package that reclassifies the current Category 2, Severe Accidents, as a Category 1—Generic Issue. I am also opposed to classifying Spent Fuel Accidents as a Category 1— Generic Issue. (**33-1-2** [Magnuson, Brian])

Comment: I am opposed to the proposed rule package that reclassifies the current Category 2, Severe Accidents, as a Category 1—Generic Issue. I am also opposed to classifying Spent Fuel Accidents as a Category 1—Generic Issue. (**33-1-9** [Magnuson, Brian])

Comment: Each nuclear power plant has site-specific conditions that affect the likelihood and nature of a radiological disaster, such as: a) Geology and seismicity, b) Hydrology, c) Severe weather events and climatic conditions, and D) Security risks and vulnerabilities (**44-16** [Lee, Gary])

Response: *The NRC disagrees with these comments. Section 4.9.1.2 and Appendix E of the LR GEIS discuss the technical basis for concluding that design-basis and severe accidents are Category 1 issues. NRC's update of the LR GEIS with respect to these issues included a review of changes in applicable laws and regulations, new data in its possession, collective experience,*

and lessons learned and knowledge gained from conducting environmental reviews for initial LR since issuance of the 1996 LR GEIS. The new data included information regarding site-specific conditions. Considering this updated information and that severe reactor accidents remain unlikely, this LR GEIS concludes that the environmental impacts of a severe accident are SMALL because they remain bounded by the probability-weighted consequences reported in the 1996 LR GEIS (i.e., 95 percent UCB for predicted early and latent fatalities and dose). No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.

A.2.13.31 Comments Regarding Consideration of Gender and Age

Comment: And then I have another more general question. What is the criteria for -- well, this is a question that comes from Mary Olson's group, which is gender impact statements.
And I'm wondering, what is your generalized concept of the human being? And who are you including when you think about an accident?

I mean, the accident could occur near a maternity hospital, where there are young babies --all babies are young -- or near a mental hospital for men who are older and less-susceptible.
So, I have an objection to the idea that severe accidents could be put back in Category 1. That doesn't seem the least bit logical to me. (**8-4-2** [Boudart, Jan])

Response: *The NRC disagrees with this comment. In this LR GEIS, the NRC determined that the severe accident risk results estimated in the 1996 LR GEIS remain bounding after consideration of the additional information presented in Appendix E. As discussed in Section E.3.8 of Appendix E of this LR GEIS, the accident consequences estimated in the 1996 LR GEIS were developed using risk coefficients recommended by the ICRP in ICRP Publication 60 (ICRP 1991), which are consistent with the risk factors estimated in the Biological Effects of Ionizing Radiation V report (National Research Council 1990) by the National Research Council Committee on the Biological Effects of Ionizing Radiation. ICRP Publication 60 explains that the risk coefficient used for the public is representative of a population composed of men and women and for a wide range of ages. ICRP Publication 60 further explains that "although there are differences between the sexes and between populations of different age-specific mortality rates, these are not so large as to necessitate the use by the Commission of different nominal probability coefficients." As discussed in Section E.3.8 of Appendix E in this revised LR GEIS, the latest information about risk coefficients provided in the Biological Effects of Ionizing Radiation VII report (National Research Council 2006), indicates that while the risk coefficients are about 20 percent higher than those used in the 1996 LR GEIS, they continue to be bounded by the risk results estimated in the 1996 LR GEIS. No changes were made in the LR GEIS, final rule, or guidance as a result of this comment.*

A.2.13.32 Comments Regarding Changes in Population

Comment: And I'm looking at Slide 18, where severe accidents are changed from Category 2 to Category 1. And I want to clarify that Category 1 issues are generic and Category 2 issues are specific. Am I right about that?

That makes me stir, because how can you evaluate a severe nuclear accident without including the demographics of the area around the nuclear power plant?

There have been some nuclear power plants where the population around the plant has increased many, many times since the plant was established. And different demographics include different ages of people and different family groups, different family sizes.

And so, I have that question that every nuclear power plant is going to have a different demographic profile that needs to be included in an evaluation of a severe accident. There are some where people could be evacuated, and some where people could not be evacuated, because there's too many people to be evacuated. So, that alone means that you can't transfer severe accidents from Category 2 to Category 1. (**8-4-1** [Boudart, Jan])

Comment: 52., E-81, 20-22, Assertion that "[t]he **national mean population growth** for the 20-year period representing the average SLR years (2040 to 2060) is approximately 20 percent based on U.S. Census Bureau projections 21 (USCB 2021)." (emphasis added).

Here the analysis uses the national mean population growth. This would significantly underestimate the population growth around many US nuclear power plants, which are economically growing and presumably growing in population faster than the national average. (**24-6-10** [Curran, Diane])

Response: *The NRC agrees in part and disagrees in part with the comments. The NRC agrees with the one comment to the extent that Category 1 issues are those that do not require additional plant-specific review and Category 2 issues require additional plant-specific review.*

The NRC also agrees with the comment that population growth around a nuclear power plant may be faster than the national average considered in Section E.3.9.2 of Appendix E of this LR GEIS.

The NRC disagrees with the comments to the extent that one comment asserts that the "Severe accidents" issue cannot be a Category 1 issue because of plant-specific population demographics and increases in the population located near nuclear power plants over time, and the second comment states that Section E.3.9.2 of the draft LR GEIS only considers the national mean population growth. Section E.3.9.2 of Appendix E of this revised LR GEIS evaluates population growth projections for the license renewal time period both nationally and for seven nuclear power plant sites for which an SLR application has been submitted to the NRC. Based on this information, the NRC concluded that the information from the population projections does not affect the SMALL finding for severe accidents in this LR GEIS revision, that risk is being effectively addressed and reduced by the various NRC orders and other initiatives, and that, therefore, population increases are not expected to challenge the 1996 LR GEIS 95 percent UCB risk metrics during any SLR time period. Furthermore, mechanisms are in place to conduct a full plant-specific review if new and significant information, such as unexpected changes in site-specific population increases, warrants. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.

A.2.13.33 Comments Regarding Guidance-New and Significant Information with Respect to SAMA

Comment: The proposed revision to Reg Guide 4.2 Supplement 1 page 71 should be changed as follows: If a SAMA or SAMDA review has previously been completed, an applicant need not provide an assessment of new and significant information with respect to a prior SAMA or SAMDA analysis. Instead, like all Category 1 issues, a New and Significant Information Assessment would be performed for the probability-weighted consequences of atmospheric releases, fallout onto open bodies of water, releases to groundwater, and societal and economic impacts from severe accidents in accordance with the guidance of Section C-1 and Chapter 5 of Reg Guide 4.2 Supplement 1. See attached file for further details. (**12-1** [Gallagher, Michael])

Comment: In Draft NUREG–1437, Revision 2 Appendix E the NRC staff documented a comprehensive and rigorous analysis of the Environmental Impact of Postulated Accidents and concluded (page E-90):

“Given the discussion in this appendix, the staff concludes that the reduction in environmental impacts from the use of new information (since the 1996 LR GEIS analysis) outweighs any increases resulting from this same information. As a result, the findings in the 1996 LR GEIS remain valid. Therefore, design-basis accidents is a Category 1 issue, and the probability-weighted consequences of severe accidents are SMALL for all plants. In the 2013 LR GEIS, severe accidents was a Category 2 issue to the extent that only the alternatives to mitigate severe accidents must be considered for all plants that have not previously considered such alternatives. This GEIS update provides the technical basis for classifying severe accidents as a Category 1 issue because SAMA analyses are not likely to be required at the vast majority, if not all, of the facilities that would reference this LR GEIS. In addition, it was reasonable that in license renewal applications, the impacts from reactor accidents at full power, including internal and external events, were considered when assessing SAMAs in license renewal. The impacts of all new information in this update do not contribute sufficiently to the environmental impacts to warrant further SAMA analysis because the likelihood of finding cost-effective significant plant improvements is small. Alternatives to mitigate severe accidents still 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.”

However, the standard should not be "finding cost-effective significant plant improvements", but rather should be consistent with the NRC's rulings that new and significant information is that which "presents a seriously different picture' of the environmental impacts...compared to the previously issued final environmental impact statement," (NextEra Energy Seabrook, LLC (Seabrook Station, Unit 1), CLI-16-03, 83 NRC 52, 55 (2016)). It is hard to imagine after all the plant risk reduction efforts described in Appendix E, that any cost-effective SAMA would "present 'a seriously different picture' of the environmental impacts...compared to the previously issued final environmental impact statement. In all the license renewals and subsequent license renewals completed to date, there has not been any SAMA identified that is cost effective and presents a seriously different picture of the environmental impacts.

Therefore, the guidance is not appropriate in the proposed revision to Reg Guide 4.2 Supplement 1 which states on page 71:

If a SAMA review has previously been completed, an applicant must provide an assessment of new and significant information with respect to a prior SAMA analysis. Guidance is provided in NEI 17-04, Revision 1, *Model SLR New and Significant Assessment Approach for SAMA," dated August 2019 (Ref. 68). NEI 17-04 is endorsed in this RG for plant-specific environmental reviews.

Based on the information in GEIS Rev 2 Appendix E, the NRC staff should make it clear in accordance with 10 CFR 51.53(c)(3)(ii)(L), that for LR and SLR applicants where the staff had previously considered severe accident mitigation alternatives for the applicant's plant, in an environmental impact statement or related supplement or in an environmental assessment, that an updated SAMA is not required. In addition, the NRC staff should take "a check the box approach" that a SAMA has been completed and not require, demand, or expect a New & Significant analysis such as guidance in NEI 17-04 (NEI 2019). If a previous SAMA had been performed, then that is all that is needed. This is acceptable based on the overwhelming amount of information contained in Appendix E.

This approach also supports the NRC Principle of Good Regulation for Efficiency which states in part:

Regulatory activities should be consistent with the degree of risk reduction they achieve. Where several effective alternatives are available, the option which minimizes the use of resources should be adopted.

The cost of preparing a SAMA analysis for a license renewal application is typically about 1/3 of the entire cost to prepare an Environmental report. The NEI 17-04 New & Significant analysis cost is also significant, it is about 1/2 the cost of a SAMA.

A New and Significant Information Assessment would still be performed by the applicant on the Severe Accident Category 1 issue. Mitigation measures appropriate to the New and Significant Information would be identified by the applicant rather than blindly performing a SAMA which would probably not mitigate the New and Significant information that was identified by the applicant. This will satisfy the NEPA requirements.

Therefore, the proposed revision to Reg Guide 4.2 Supplement 1 page 71 should be changed as follows:
If a SAMA or SAMDA review has previously been completed, an applicant need not provide an assessment of new and significant information with respect to a prior SAMA or SAMDA analysis. ~~Guidance is provided in NEI 17-04, Revision 1, "Model SLR New and Significant Assessment Approach for SAMA," dated August 2019 (Ref. 68). NEI 17-04 is endorsed in this RG for plant-specific environmental reviews.~~ Instead, like all Category 1 issues, a New and Significant Information Assessment would be performed for the probability-weighted consequences of atmospheric releases, fallout onto open bodies of water, releases to groundwater, and societal and economic impacts from severe accidents in accordance with the guidance of Section C-1 and Chapter 5 of Reg Guide 4.2 Supplement 1.
(**12-2** [Gallagher, Michael])

Response: *The NRC agrees in part and disagrees in part with the comments. The NRC agrees that most license renewal applicants expected to reference this LR GEIS have already completed a SAMA analysis and therefore need not undertake a second analysis per NRC's regulations. The totality of the studies and regulatory actions discussed in Section E.4 of Appendix E of this LR GEIS confirm the robust basis for the Commission's decision to not require applicants to perform a SAMA analysis in an initial LR or SLR application if the NRC has previously completed a SAMA analysis for that nuclear plant in a NEPA document. The NRC clarified the staff position in Section E.5 of Appendix E and Section 4.9.1.2.1 of this revised LR GEIS.*

The NRC disagrees with the comments to change the text in Regulatory Guide 4.2, Supplement 1, Revision 2 (NRC 2024a) so "that an applicant need not provide an assessment of new and significant information with respect to a prior SAMA or SAMDA analysis." This proposed change is contrary to the NRC determination in dismissing adjudicatory challenges to the Limerick license renewal. See Exelon Generation Company, LLC (Limerick Generation Station, Units 1 and 2), CLI-13-07, 78 NRC 199 (Exelon 2013). During the course of that proceeding, the Commission recognized that NRC license renewal regulations "…on the one hand exempt Exelon and similarly situated license renewal applicants from including a SAMA analysis in their environmental reports, but on the other hand require an applicant to identify 'any new and significant information of which it is aware'." The Commission further recognized the NRC's continuing duty to take a hard look at new and significant information for each major

federal action to be taken. In its conclusions, the Commission directed the NRC staff to review the significance of any new SAMA-related information, not just information related to the impacts of severe accidents, in its review of Exelon's license renewal application for Limerick. In response to the comments, the NRC clarified the staff position in Chapter 5 of Regulatory Guide 4.2, Supplement 1, Revision 2. The NRC also revised Section E.4 of Appendix E of this LR GEIS to better explain the reason an assessment of new and significant SAMA-related information is required.

A.2.14 Waste Management: Radioactive Waste Including Spent Nuclear Fuel

Comment: There also is insufficient safe storage for the nuclear waste. (**2-4** [Bilz, Reed])

Comment: But the fact of the matter is, for all these going on eight decades, we've been producing a highly dangerous waste and not getting to the point of where we're dealing with it. You know, first rule of thumb in getting out of hole is stop digging and figure out where you're headed. First rule of thumb in avoiding a train wreck is stop the train. (**9-3-2** [Burnham, Lon])

Comment: Also, the lack of viable solutions for long-term storage of nuclear waste, leaves out the topic of protection for the people who live near one of the off-site storage depots or transport routes. (**28-2** [Ramsay, Rebecca])

Response: *The NRC disagrees with these comments. The environmental effects of long-term storage of spent fuel onsite have been assessed by the NRC as set forth in NUREG-2157, "Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel" (NRC 2014c) and codified under 10 CFR 51.23. The NRC has determined that the expected increase in the volume of spent nuclear fuel from an additional 20 years of operation—either during initial LR or SLR—can be safely accommodated onsite during the license renewal term through dry or pool storage at all plants. For the period after the licensed life for reactor operations, the impacts of onsite and away-from-reactor storage (offsite) of spent nuclear fuel during the continued storage period are discussed in NUREG-2157, which addresses impacts of three storage timeframes: short-term, long-term, and indefinite storage. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.*

Comment: Furthermore, applying the proposed rule and LR GEIS to more than one SLR term does not create an inconsistency between the LR GEIS and the Continued Storage GEIS.[10] The latter documents the NRC's generic determinations regarding the technical feasibility and environmental impacts of safely storing spent fuel on or off the site beyond a plant's licensed life for operations and before its disposal in a permanent repository.[11] Thus, for purposes of its analysis, the NRC defined "licensed life for reactor operations" as the original licensed life of 40 years and up to two 20-year license extensions for each reactor.[12] In finding that the onsite storage of spent fuel during the license renewal term is a Category 1 issue with an impact of SMALL in the 2013 LR GEIS (and again in the draft revised LR GEIS), the NRC incorporated this same assumption. i.e., up to two 20-year extensions.[13]

[10] NUREG-2157, Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel
- Final Report, Vols. 1 & 2 (Sept. 2014), https://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr2157/v1/index.html (Continued Storage GEIS).

[11] Specifically, the NRC evaluated the potential environmental impacts of continued storage of used nuclear fuel for three timeframes - short-term storage, long-term storage, and indefinite storage See Continued Storage GEIS, Vol. 1 at 1-12 to 1-15.
[12] Id. at 1-17; Revised LR GEIS, Vol. 1 at 1-12, 4-153.
[13] Revised LR GEIS, Vol. 1 at 1-12, 4-153.

This assumption does not preclude expansion of the LR GEIS analysis to include additional SLR terms. In fact, the draft revised LR GEIS notes that the current and potential environmental impacts of spent fuel storage at the current reactor sites "have been studied extensively, are well understood, and the environmental impacts were found to be SMALL," and that the NRC's review of information from SEISs completed since development of the 2013 LR GEIS has "identified no new information or situations that would result in different impacts for this issue for either an initial LR or SLR term."[14] In our view, there is sufficient information and analysis available now for the NRC staff to extend its Category 1 impact finding for onsite storage of spent nuclear fuel to additional SLR terms.
[14] Id. at 4-154. (**19-1-5** [Uhle, Jennifer])

Response: *The NRC acknowledges the comment. The Category 1 impact finding for onsite storage of spent nuclear fuel is supported by the NRC's analysis presented Section 4.11.1.2 of the LR GEIS. Additionally, Section 4.11.1.2 of the LR GEIS states, "[A]s defined in NUREG-2157 and clarified in the Continued Storage Final Rule (79 FR 56238, page 56263), the licensed life for operation of a reactor assumes an original licensed life of 40 years and up to two 20-year license extensions for each reactor, for a total of up to 80 years of operation." The licensed life for an operating reactor as defined and analyzed in NUREG-2157 is not in conflict with the analysis of onsite storage of spent nuclear fuel for an initial LR or SLR term in the LR GEIS. No changes were made in the LR GEIS, final rule, or guidance as a result of this comment.*

Comment: (xvi) Waste Management
(69 Onsite storage of spent nuclear fuel. - 1. Site specific risks to storage (2). Storm surge at coastal sites such as Turkey Point, and estuarine sites as well, pose unique risks to onsite storage of spent fuel. Hurricanes have been intensifying and increasing surge risks.
(**7-15** [Stoddard, Philip])

Comment: Specifically, I notice in B-1 it's identified that there are severe accidents and REO is reviewed for reactors, but not for high-level radioactive waste. And I find that kind of strange, simply because they'll be on the same site in most cases.

But you also changed severe accidents from a Category 2 to a Category 1, which means not site-specific, to more generic.

In the case of radioactive waste, especially here in Illinois, that doesn't make a lot of sense to us. An example would be the Zion Nuclear Facility, which of course is decommissioned, has a thousand tons of high-level radioactive waste, 400 yards from the shore of Lake Michigan, and a thousand flights a day from O'Hare Field going overhead.
To us, that at least represents a potential for one of those unpredictable -- I think that's how it's defined -- severe accidents and REOs, yet there's no mention of that in Table B-1, in terms of the waste.

So, really think that needs to be examined in some detail. I just use Zion as an example, but you could go to any of the other 92 reactors and come with their own unique scenarios, which, again, makes a thing for us that that's really a Category 2 issue. So, that was one observation. (**8-1-1** [Kraft, David])

Comment: a. Onsite Land Use
The Draft GEIS does not explain if cleanup obligations are within the scope of this review. If cleanup is a part of onsite land use, then this must be a Category 2 issue. The cleanup of a spill, leaks, radioactive waste burials, and cumulative radiological and chemical contamination are necessarily site-specific. The very nature of such contamination is that it occurs unexpectedly or unintentionally and therefore cannot be generic. (**32-4-2** [Reiser, Caroline])

Response: *The NRC disagrees with these comments. NRC regulations in 10 CFR Part 20 and in 10 CFR Part 50 limit the amount of radioactive material, from all sources at a nuclear power plant, released into the environment to levels that are as low as is reasonably achievable (ALARA) along with associated radiation dose limits. The regulations are designed to protect the public and the environment. Under these regulations, a licensee is required to act regarding radioactive contamination that occurs unexpectedly or unintentionally. Additionally, the NRC has concluded that the issues of "Low-level waste storage and disposal," "Mixed-waste storage and disposal," "Nonradioactive waste storage and disposal," and "Onsite storage of spent nuclear fuel" are properly designated as Category 1 issues, because the environmental impacts were found to be the same or similar at all plant sites based on previous license renewal environmental reviews. Specific to decommissioned nuclear power plant sites where spent fuel remains, the impacts of onsite storage of spent nuclear fuel during the continued storage period are discussed in NUREG-2157 and are as stated in § 51.23(b). These findings are supported by the NRC's analysis presented in Section 4.11 of the LR GEIS. Further information about waste management and pollution prevention is presented in Section 3.11 of the LR GEIS, and environmental impacts from postulated accidents at spent fuel pools can be found in Appendix E.3.7 of the LR GEIS. The NRC has stated its methods and criteria for environmental issue identification, categorization, and definitions in Section 1.5 of this LR GEIS as well as in the footnotes to Table B–1 in Appendix B to Subpart A of 10 CFR Part 51, as revised pursuant to this final rule.*

However, a designation of an issue as a Category 1 issue does not mean that potential impacts are not considered. During preparation of plant-specific supplements to the LR GEIS, the NRC staff considers changes in nuclear power plant operating parameters and new and potentially significant information provided by the applicant or identified through public comments, or resulting from the NRC's due diligence in reviewing relevant information. Data are reviewed in part for information that could change the conclusion in the LR GEIS with regard to an issue. Thus, even though an issue is a Category 1 issue, mechanisms are in place to conduct a full plant-specific review if new and significant information warrants such a review. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.

A.2.15 Waste Management: Nonradiological Waste

Comment: 1. Solid and Hazardous Wastes and Hazardous Materials. According to the GEIS (page 3-137), under normal operations and maintenance activities, nuclear power plants generate both radioactive and nonradioactive waste, including hazardous and nonhazardous wastes. Waste minimization and pollution prevention are part of operations at all nuclear power plants.

1(a) Agency Jurisdiction. On behalf of the Virginia Waste Management Board, the DEQ Division of Land Protection and Revitalization is responsible for carrying out the mandates of the Virginia Waste Management Act (Virginia Code §10.1-1400 et seq.), as well as meeting Virginia's federal obligations under the Resource Conservation and Recovery Act and the Comprehensive Environmental Response Compensation Liability Act (CERCLA), commonly known as Superfund. The DEQ Division of Land Protection and Revitalization (DLPR) also administers those laws and regulations on behalf of the State Water Control Board governing Petroleum Storage Tanks (Virginia Code §62.1 44.34:8 et seq.), including Aboveground Storage Tanks (9VAC25-91 et seq.) and Underground Storage Tanks (9VAC25-580 et seq. and 9VAC25-580-370 et seq.), also known as 'Virginia Tank Regulations', and § 62.1-44.34:14 et seq. which covers oil spills.

Virginia:

x Virginia Waste Management Act, Virginia Code § 10.1-1400 et seq.
x Virginia Solid Waste Management Regulations, 9 VAC 20-81
x (9 VAC 20-81-620 applies to asbestos-containing materials)
x Virginia Hazardous Waste Management Regulations, 9 VAC 20-60
x (9 VAC 20-60-261 applies to lead-based paints)
x Virginia Regulations for the Transportation of Hazardous Materials, 9 VAC 20110.

Federal:
x Resource Conservation and Recovery Act (RCRA), 42 U.S. Code sections 6901 et seq.
x U.S. Department of Transportation Rules for Transportation of Hazardous Materials, 49 Code of Federal Regulations, Part 107
x Applicable rules contained in Title 40, Code of Federal Regulations.

1(b) Recommendations. The DEQ DLPR has a number of general recommendations for license renewal activities.

1(b)(i) Environmental Databases. The DEQ DLPR staff recommends a search (at least 200-ft radius) of any land-based project areas using the following solid and hazardous waste databases to identify waste sites (including petroleum releases) in proximity to project areas:

x Environmental Protection Agency (EPA) Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) Database: Superfund Information Systems Information on hazardous waste sites, potentially hazardous waste sites and remedial activities across the nation, including sites that are on the National Priorities List (NPL) or being considered for the NPL: www.epa.gov/superfund/sites/cursites/index.htm
x DEQ Online Database: Virginia Environmental Geographic Information Systems Information on Permitted Solid Waste Management Facilities, Impaired Waters, Petroleum Releases, Registered Petroleum Facilities, Permitted Discharge (Virginia Pollution Discharge Elimination System Permits) Facilities, Resource Conservation and Recovery Act (RCRA) Sites, Water Monitoring Stations, National Wetlands Inventory: www.deq.virginia.gov/ConnectWithDEQ/VEGIS.aspx

1(b)(ii) Pollution Prevention Recommendation. DEQ recommends that power plants implement pollution prevention principles, including the reduction, reuse, and recycling of all solid wastes generated. All generation of hazardous wastes should be minimized and handled appropriately.

1(c) Requirements. Below are waste-related requirements that would apply to any future construction or operation/maintenance activities at facilities during the renewed license term.

1(c)(i) Waste Management. Any soil or groundwater that is suspected of contamination or wastes that are generated during construction-related activities must be tested and disposed of in accordance with applicable federal, state, and local laws and regulations. All construction waste, including excess soil, must be characterized in accordance with the Virginia Hazardous Waste Management Regulations prior to disposal at an appropriate facility. It is the generator's responsibility to determine if solid waste meets the criteria of a hazardous waste and is subsequently managed appropriately.

1(c)(ii) Petroleum Releases. If evidence of a petroleum release is discovered during implementation of this project, it must be reported to DEQ, as authorized by Virginia Code § 62.1-44.34.8 through 9 and 9 VAC 25-580-10 et seq.

1(c)(iii) Asbestos-Containing Materials and Lead-Based Paint. All structures being demolished/renovated must be checked for asbestos-containing materials (ACM) and lead-based paint (LBP) prior to demolition. If ACM or LBP are found, in addition to federal waste-related regulations, state regulations 9 VAC 20-80-620 for ACM and 9 VAC 20-60-261 for LBP must be followed. (**11-1** [Rayfield, Bettina])

Comment: 5. Pollution Prevention. DEQ advocates that principles of pollution prevention and sustainability be used in all construction projects as well as in facility operations. Effective siting, planning, and on-site BMPs will help to ensure that environmental impacts are minimized. However, pollution prevention and sustainability techniques also include decisions related to construction materials, design, and operational procedures that will facilitate the reduction of wastes at the source.

5(a) Recommendations. We have several pollution prevention recommendations that may be helpful for general operations at facilities:

- Consider development of an effective Environmental Management System (EMS). An effective EMS will ensure that the proposed facility is committed to complying with environmental regulations, reducing risk, minimizing environmental impacts, setting environmental goals, and achieving improvements in its environmental performance. DEQ offers EMS development assistance and recognizes facilities with effective Environmental Management Systems through its Virginia Environmental Excellence Program (VEEP). VEEP provides recognition, annual permit fee discounts, and the possibility for alternative compliance methods.
- Consider environmental attributes when purchasing materials. For example, the extent of recycled material content, toxicity level, and amount of packaging should be considered and can be specified in purchasing contracts.
- Consider contractors' commitment to the environment (such as an EMS) when choosing contractors. Specifications regarding raw materials and construction practices can be included in contract documents and requests for proposals.
- Choose sustainable materials and practices for infrastructure construction and design, including choosing materials that contain recycled materials. (**11-7** [Rayfield, Bettina])

Comment: 1. Solid and Hazardous Wastes. All solid waste, hazardous waste, and hazardous materials must be managed in accordance with all applicable federal, state, and local

environmental regulations. Contact the appropriate DEQ Regional Office (Contact Us | Virginia DEQ) for information on the location and availability of suitable waste management facilities in the project area or if free product, discolored soils, or other evidence of contaminated soils are encountered.

1(a) Petroleum Releases. If evidence of a petroleum release is discovered during construction, it must be reported to the DEQ Regional Office.

1(b) Asbestos-Containing Material. It is the responsibility of the owner or operator of a demolition activity to thoroughly inspect the affected part of the facility prior to demolition for the presence of asbestos, including Category I and Category II nonfriable asbestos-containing material. Upon classification as friable or non-friable, all asbestos-containing material shall be disposed of in accordance with the Virginia Solid Waste Management Regulations (9VAC 20-80-640) and transported in accordance with the Virginia regulations governing Transportation of Hazardous Materials (9VAC 20-110-10 et seq.). Contact DEQ (Carlos Martinez, 804-350-9962) for additional information.

1(c) Lead-Based Paint. This project must comply with the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) regulations and with the Virginia Lead-Based Paint Activities Rules and Regulations. For additional information regarding these requirements, contact the Department of Professional and Occupational Regulation (804-367-8500). (**11-8** [Rayfield, Bettina])

Response: *The NRC acknowledges the information provided and agrees that each nuclear power plant licensee must conduct its operations in accordance with all applicable Federal, State, and local permits and regulations. Waste management and pollution prevention are designated as Category 1 issues, as discussed in Sections 3.11 and 4.11 of this LR GEIS. These sections provide background information about wastes generated at nuclear power plants as well as the waste management requirements associated with the generated wastes. Management of hazardous waste generation, treatment, transportation, and disposal are regulated by the EPA or by States under agreement with the EPA per the regulations promulgated under the Resource Conservation and Recovery Act (RCRA) (Public Law 94-580 [42 U.S.C. § 6901 et seq.]) As discussed in Section 3.11.1 of the LR GEIS and 10 CFR 20.1406, 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 101-508 [42 U.S.C. § 13101 et seq.]) and RCRA (Public Law 94-580 [42 U.S.C. § 6901 et seq.]). Section 3.11.5 of the LR GEIS discusses pollution prevention and waste minimization. Appendix F of this LR GEIS provides a summary of potentially relevant Federal and State laws, regulations, and other requirements that may affect the renewal and continued operation of NRC-licensed nuclear power plants.*

With regard to the suggestion that a search of environmental databases be conducted as part of the NRC's license renewal environmental review process, the NRC agrees with the suggestion. Section 3.11 of Regulatory Guide 4.2, Supplement 1, Revision 2 (NRC 2024a) states, in part, that license renewal applicants should include the following in their environmental report: (1) descriptions, names, and locations of facilities currently used and likely to be used in the future for offsite processing and disposal of wastes; (2) information about current disposal activities including the size and location of disposal sites as well as the plans for ultimate treatment and/or restoration of retired disposal sites; (3) identification of radiation sources stored onsite as solid waste (e.g., contaminated equipment, low-level radioactive waste storage, storage of used steam generators); (4) description of all sources, types, quantities, and

composition of solid, hazardous, radioactive, and mixed wastes expected from the proposed action; and (5) anticipated disposal plans for all wastes (i.e., transfer to an offsite waste disposal facility, treatment facility, or storage onsite). In addition, all nuclear power plant licensees undertake an annual census of activities within a specified radius of the plant site to determine whether any changes have occurred in the location of residential populations as well as in nearby and adjoining land uses. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.

A.2.16 Greenhouse Gas Emissions and Climate Change

Comment: B. Climate Change Impacts on Environmental Resources (Category 2 Issue)

The NRC also has identified a new Category 2 issue related to climate change titled "Climate change impacts on environmental resources." The NRC's specific finding, as reflected in the draft revised LR GEIS and revised Table B-1, is as follows:

Climate change can have additive effects on environmental resource conditions that may also be directly impacted by continued operations and refurbishment during the license renewal 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 license renewal term are location-specific and cannot be evaluated generically.[32]

[32] Revised LR GEIS, Vol. 1 at 2-14; Proposed Rule, 88 Fed. Reg. at 13,356.

The NRC also proposes to amend 10 CFR 51.53(c)(3)(ii) to add new paragraph (Q), which states:

Applicants shall include an assessment of the effects of any observed and projected changes in climate on environmental resource areas that are affected by license renewal, as well as any mitigation measures implemented at the applicant's plant to address climate change impacts.[33]

[33] Proposed Rule, 88 Fed. Reg. at 13,346, 13,351.

As explained below, NEI has concerns with adding climate change as a distinct Category 2 issue. We also have concerns regarding the mitigation-related provision in proposed 10 CFR 51.53(c)(3)(ii)(Q), which, contrary to controlling judicial and NRC precedent discussed below, could be wrongly construed to mean that NEPA and Part 51 require applicants to implement identified mitigation measures. Therefore, we recommend that the NRC not treat the "additive effects" of climate change on environmental resource conditions as a separate Category 2 issue in lieu of its current approach of analyzing such effects as cumulative impacts, and that it delete proposed section 51.53(c)(3)(ii)(Q) in its entirety. (**19-1-10** [Uhle, Jennifer])

Comment: 2. <u>Consistent with NRC Practice, Climate Change Impacts on Environmental Resources Are More Appropriately Considered as a Cumulative Effect Under NEPA</u>

There also is no need to create a new Category 2 issue and finding concerning climate change impacts on environmental resources. NEPA, as construed by the CEQ and the federal courts,[48] as well as the NRC's current regulations and guidance, already provide a framework for analyzing the cumulative effects of a proposed action - including climate change impacts on environmental resource areas that may be incrementally affected by license renewal. With

regard to license renewal, 10 CFR 51.53(c)(3)(ii)(O) requires applicants to "provide information about other past, present, and reasonably foreseeable future actions occurring in the vicinity of the nuclear plant that may result in a cumulative effect."[49] Table B-1 identifies "Cumulative impacts" as a Category 2 issue, and provides the following description:
Cumulative impacts of continued operations and refurbishment associated with license renewal must be considered on a plant-specific basis. Impacts would depend on r**egional resource characteristics**, the **resource-specific impacts** of license renewal, and the **cumulative significance of other factors affecting the resource.** (Emphasis added)

[48] See, e.g., NRDC v. Hodel, 865 F.2d 288, 297-98 (D.C. Cir. 1988) (stating that "NEPA, as interpreted by the courts, and CEQ regulations both require agencies to consider the cumulative impacts of proposed actions"); Hanly v. Kleindienst, 471 F.2d 823, 830-831 (2d Cir. 1972), cert. denied, 412 U.S. 908 (1973) (interpreting the term "significantly" in Section 102(2)(A) of NEPA to include "adverse environmental effects of the action itself, including the cumulative harm that results from its contribution to existing adverse conditions or uses in the affected area").
[49] Although Part 51 does not define "cumulative effects", the NRC has adopted the CEQ definition thereof in the revised LR GEIS and other agency guidance documents - i.e., "effects on the environment that result from the incremental effects of the action when added to the effects of other past, present, and reasonably foreseeable actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions," and which "can result from individually minor but collectively significant actions taking place over a period of time." Revised LR GEIS, Vol. 1 at 4-167.

When this description is juxtaposed with the NRC's description of the proposed new Category 2 issue, "Climate change impacts on environmental resources," the similarities are readily apparent:

Climate change can have **additive effects on environmental resource conditions** that may also be directly impacted by continued operations and refurbishment during the license renewal 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 license renewal term are location-specific and cannot be evaluated generically.[50]

[50] Proposed Rule, 88 Fed. Reg. at 13,356 (emphasis added).

The revised LR GEIS further underscores these similar (and duplicative) requirements in noting that "[i]n order for there to be a cumulative effect, the proposed action (license renewal) must have an incremental new, additive, or increased physical effect or impact on the resource or environmental condition beyond what is already occurring."[51] Additionally, citing 1997 CEQ guidance, the revised LR GEIS states that "[t]he incremental effects of the proposed action (license renewal) when added to the effects from past, present, and reasonably foreseeable future actions and other actions (including trends such as **global climate change**) result in the overall cumulative effect."[52]

[51] Revised LR GEIS, Vol. 1 at 4-176. In fact, on page 4-165, the revised LR GEIS simply substitutes "climate change impact" for "cumulative effect" in the following sentence: "In order for there to be a climate change impact on an environmental resource, the proposed action (license renewal) must have an incremental new, additive, or increased physical effect or impact on the resource or environmental condition beyond what is already occurring."

[52] Revised LR GEIS, Vol. 1 at 4-167 (emphasis added).

In a similar vein, current NRC regulations require ERs to analyze "alternatives available for reducing or avoiding adverse environmental effects" (i.e., mitigation measures).[53] The specific regulation applicable to license renewal applications is 10 CFR 51.53(c)(3)(iii), which requires the ER to "contain a consideration of alternatives for reducing adverse impacts, as required by § 51.45(c), for all Category 2 license renewal issues in appendix B to subpart A of [Part 51]." Thus, there is no need for a duplicative requirement in proposed 10 CFR 51.53(c)(3)(ii)(Q) to consider mitigation measures for climate change impacts. Moreover, current NRC guidance for the preparation of ERs already directs applicants to consider potential mitigation measures for issues such as drought, consumptive surface water use, and groundwater withdrawals, among others that may be affected by climate change.[54]

[53] 10 CFR 51.45(c).
[54] See Regulatory Guide 4.2, Supplement 1, Revision 1 at 27-28.

In summary, under its current Part 51 regulations, the NRC already has a framework for considering "additive" climate change impacts on environmental resources that may be affected by license renewal on a site-specific basis. Indeed, as the proposed rule explicitly notes: "In site-specific initial LR and SLR SEISs prepared since development of the 2013 LR GEIS, the NRC considered climate change impacts for those resources that could be incrementally affected by license renewal **as part of the cumulative impact analysis**."[55] Thus, there is no need for the proposed new Category 2 issue or section 51.53(c)(3)(ii)(Q) to adequately consider the additive or incremental effects of climate change or mitigation measures for purposes of the NRC's license renewal NEPA evaluation.

[55] Proposed Rule, 88 Fed. Reg. at 13,345 (emphasis added). (**19-1-12** [Uhle, Jennifer])

Comment: 5. Section 88FR13329, Page 13351, Comment/Recommendation: As elaborated in the cover letter preceding this table, NEI recommends eliminating climate change as a separate Category 2 issue, and instead addressing the issue of climate change as part of the cumulative effects analysis. NEI recommends deleting proposed section 51.53(c)(3)(ii)(Q) in its entirety as well as the Table B-1 issue "Climate change impacts on environmental resources" and its corresponding category and finding. To the extent NRC draft guidance on this issue could be helpful for applicants to understand expectations for addressing climate change as part of the cumulative effects analysis, that information still considered relevant could be relocated to the cumulative effects sections within the respective guidance documents accordingly.
(**19-2-5** [Uhle, Jennifer])

Comment: Alternatively, NextEra urges the NRC to choose not to create a new Category 2 issue for climate change impacts on environmental resources and instead ensure that evaluation of the issue of climate change and climate analysis is continued in the same manner as NRC has addressed it in its recent NEPA documents. The NRC's current framework already ensures that material climate change impacts are addressed. The NRC's 2013 GEIS included a section on "GHG Emissions and Climate Change," which summarized potential cumulative impacts of GHG emissions and global climate change, while also committing to evaluate with each SEIS a plant-specific analysis of any cumulative impacts of climate change over the course of the license renewal term (NUREG 1437, Rev. 1 at 1-30). By separating climate change as a distinct Category 2 issue, the proposed rule and draft GEIS would create confusion between the impacts of license renewal and cumulative impacts. For this reason, NextEra believes the current manner in which NRC NEPA documents have reviewed both the climate

impacts of the continued operation of an existing nuclear plant, as well as the cumulative impacts of climate change does not need to be changed. (**22-5** [Strand, Dianne])

Response: *The NRC agrees in part and disagrees in part with these comments. The NRC disagrees that the new Category 2 issue, "Climate change impacts on environmental resources," and accompanying Section 51.53(c)(3)(ii)(Q) are unnecessary and does not find them to be duplicative of the NRC's cumulative effects analysis. However, with respect to mitigation measures, the NRC agrees that part of the proposed requirement in 10 CFR 51.53(c)(3)(ii)(Q) is duplicative.*

Climate change is a subject of national and international interest and has been and continues to be a topic of broad public interest with respect to reactor license renewal. The implications of climate change and the high level of public interest have made this topic one that the NRC believes requires a "hard look" as required under NEPA. For the new Category 2 issue, "Climate change impacts on environmental resources," the NRC has concluded that the impacts of climate change on environmental resources that are affected by continued nuclear power plant operations and refurbishment during the license renewal term are location-specific, thus requiring a plant-specific review.

The NRC's consideration of climate change impacts is separate and distinct from the analysis of cumulative effects. The NRC has appropriately limited the boundaries of its inquiry of climate change impacts and the scope of the new Category 2 issue to matters germane to the NRC's proposed action. As further discussed in Section 4.12.2 of this revised LR GEIS, the Category 2 climate change impacts issue considers those reasonably foreseeable effects on environmental resource conditions that may also be directly affected by continued operation and refurbishment of nuclear power plants during the license renewal term. The NRC must consider the impact and implications from projected climate change parameters on environmental resource baseline conditions. Similar to cumulative impacts, climate change impacts can occur across all resource areas that could be affected by the proposed action, including the effects of continued reactor nuclear plant operations during the license renewal term and any refurbishment activities at a nuclear power plant.

In contrast, as defined by the Council on Environmental Quality (CEQ), cumulative effects are the impacts on the environment that result from incremental effects of the action when added to the effects of other past, present, and reasonably foreseeable actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions (40 CFR 1508.1). Analyzing the cumulative effects requires that the environmental baseline and thresholds of environmental change be established. As discussed in the LR GEIS, the affected environment is the environment currently existing around the operating commercial nuclear power plant. Establishing the Category 2 issue, "Climate change impacts on environmental resources" will assess the potential future baseline conditions (affected environment) as a result of climate change. Prior to developing the cumulative effects analysis and evaluating the effects on individual resources, the baseline conditions with respect to climate change trends will need to be established for resource areas on which the proposed action will have an incremental impact. Therefore, the NRC has determined that establishing "Climate change impacts on environmental resources" as a separate Category 2 issue is appropriate and will facilitate a more focused and effective cumulative effects analysis. The NRC has made associated clarifying changes in Section 4.12 in Regulatory Guide 4.2, Supplement 1, Revision 2 (NRC 2024a), and Section 4.12.5 in NUREG-1555, Supplement 1, Revision 2 (NRC 2024b).

With respect to mitigation measures, the NRC staff agrees with the comments that the NRC's regulations at 10 CFR 51.53(c)(3)(iii) already require that environmental reports submitted by license renewal applicants address mitigation. Therefore, the NRC has revised 10 CFR 51.53(c)(3)(ii)(Q) in this final rule to eliminate this duplicative requirement specific to mitigation measures for climate change impacts. The NRC also made conforming changes to Section 4.12 in Regulatory Guide 4.2, Supplement 1, Revision 2 (NRC 2024a) and Section 4.12.5 in NUREG-1555, Supplement 1, Revision 2 (NRC 2024b).

Comment: With reference to consideration of climate change impacts on a site-specific basis, the Breakthrough Institute is supportive of that new consideration within a limit. The applicant for the renewal should be able to consider that and, without significant analysis, note whether the potential for impact exists or not before doing a very in-depth study. (**4-2-2** [Stein, Adam])

Comment: Consideration of climate change impacts on a site-specific basis may be useful for moving forward because we do expect to see impacts due to climate change on a site-by-site basis. However, those considerations should be able to be rejected through high-level analysis if there seems to be no consideration for that impact or that type of impact at a particular site without doing extensive analysis. But it would be certainly warranted for some particular plants. (**4-2-3** [Stein, Adam])

Comment: One other piece that we also are supportive of, recently, there was a RIC Technical Session that was chaired by Commissioner Crowell, and it was on the transformation and modernization of the environmental review process. And on one of those slides, it was pretty succinctly stated that environmental reviews should be looking at the impact of operating the plants on the environment, and not the other way around. We think that that is a very distinct clarification; that the staff should continue to point all additional climate change aspects to the correct process when it comes to the potential impacts of climate change on the plant and safety itself. So, we think that those processes exist outside the environmental review process and those lines should be clearly delineated. (**4-3-3** [Titus, Brett])

Comment: You know, our concern is that I'm sure the agency is aware that the National Academy of Sciences is currently going through a process to develop a study on the maximum --let's see --the probable maximum precipitation, which is connected to flooding and a number of issues relative to safe operation of nuclear power into the projected climate change period for these license renewals.

And the issue being that the agency is still in the process of developing its probable maximum flood. So, you can't really develop a probable maximum flood methodology if you don't really, even have workable models for probable maximum precipitation. And this is what the NAS is currently striving to put forward. So, it seems like, you know, the rush of the agency and the industry to push this process out is putting the cart before the horse in any kind of meaningful understanding and mitigation of climate impacts on the projected operation in these extension periods. (**4-4-1** [Gunter, Paul])

Comment: Nuclear energy has a critical role to play in reducing greenhouse gas emissions, but in event of error could play a dramatic role in environmental crisis.
(**5-2** [Anonymous, Anonymous])

Comment: And I guess this may be a comment as well, but I'm glad that the Commission is starting to look at climate change and the climate crisis, and doing analyses about that. But it would be important to put in the documents, what models are you using to come up with your

assessments? They're changing every ten years, or whenever the IPCC comes out with a new analysis. And clearly, we agree it would be site-specific, which is why you have it as a Category 2.

But herein comes the problem. Much of the analysis that I've seen on the table relies on past performance, past behaviors. And that's good. That's how we do learn things. We observe the past.

But I have to point out the past does not always predict the future. And the purpose of the license extensions into the future has to extrapolate that understanding 20, 40 years out. Which is pretty tough. Nobody has a crystal ball. But it puts a whole new dynamic to how this process gets analyzed, and specifically on the climate issue, where it's a real crapshoot right now. So, I see that as a serious category that has to really be examined, not just from what we know, but what we're extrapolating. I mean, whenever you see the IPCC graphs, they're always giving you ranges of three different or four different possibilities.

Have you done the same for the reactors? Probably not. And I think that needs to be examined, if you're really going to make this meaningful. (**8-1-3** [Kraft, David])

Comment: #2 It is good to see a requirement to include greenhouse gas emissions. However, in a world with a changing climate, potential impacts of climate on the nuclear reactors should be considered as well. For example, will ongoing and predicted future droughts hamper the availability of enough cooling water? Will the water be cool enough to do the job? Reactors have been shutdown for this reason in the past, and droughts are increasing in some regions. (**18-4** [Hadden, Karen])

Comment: (74) Climate Change Impacts on Environmental Resources

The undersigned believe that the Nuclear Regulatory Commission has taken a significant, if delayed, step in including this category. We agree that this issue merits review as a "2" for site-specific analysis.

Specific to Turkey Point and its one-of-a-kind cooling canal system, Florida Power and Light must understand how a changing climate will impact the operation of the CCS. The NRC must investigate whether the recovery well system for the hypersaline plume remediation efforts is storm-hardened enough to withstand stronger, wetter storms, and whether the recovery wells will function if inundated by sea level rise and storm surge.

We believe that in any re-licensing procedure, the Nuclear Regulatory Commission must evaluate whether Florida Power and Light is preparing and fortifying the plant for sea level rise, and what impacts the fortification will have. For instance, will roads into the plant be elevated? Will the cooling canal system be protected? What impacts will construction and operation of any new features have on habitat? What impacts will construction and operation of any new features have on local surface and subsurface hydrology, and will alterations in hydrology caused by construction affect the hypersalinity plume remediation?

The NRC must also consider updated information on how the subsequent license renewal will affect crocodiles and their critical habitat as climate change causes atmospheric and oceanic temperatures to rise, presenting added stressors on the species.

When considered along with an environmental baseline that will be significantly affected by climate change, the effects of Turkey Point's subsequent renewed license will likely have increasingly significant impacts to the American crocodile over the coming decades. Although sea level rise occurs over time, it intensifies the effects of discrete events such as spring tides and storm surges, causing habitat damage, migration, elimination, and conversion into other habitat types. Increasingly intense storms and higher storm surge will pose additional threats to the crocodile's coastal habitat. For example, eutrophication and seagrass loss in the CCS is likely to become more frequent or intense as temperatures rise and more intense storms increase turbidity. Sea level rise may further compromise Turkey Point's open CCS or necessitate resiliency responses such as coastal hardening that adversely modify the crocodile's critical habitat or subject it to coastal squeeze. In general, climate change will make the crocodile more vulnerable to existing negative effects, including those originating from Turkey Point's operations under the subsequent renewed license. The NRC must consider these environmental impacts - regardless of whether the NRC designates the issues as Category 1 or 2. Climate change impacts are new and significant information that the NRC must consider for all environmental issues. (**31-19** [Silverstein, Rachel])

Comment: G. Climate Change

One glaring example of a fatal flaw in the proposed Revision 2 to NUREG-1437 is the lack of discussion on how changing climate impacts affect the local environment near each plant and how this would affect the impact over the expected future life of the plant upon license renewal.

For example, the discussions on surface water impacts in the proposed Revision 2 to NUREG-1437 simply do not mention any impact of changing climate on source/receiving waters such as rivers or lakes in particular. Nor do they discuss climate-induced changes in the quality of the waters and changes in the aquatic biota that may be present in the water.

Not considering the inevitable and already observable climate impacts that will be occurring concurrently with the terms of the future renewed licensing period over many additional decades, is therefore a fatal omission. Relying on the 1996 and 2013 GEISs, as has been done in the proposed Revision 2 to NUREG-1437, misses incorporating climate impacts into specific environmental analysis. This is especially critical for surface water impacts because changing climatic conditions change the nature and characteristics of the intake/receiving waters. In the case of rivers, the flow rates of rivers varies more between flood and drought conditions and even seasonally. For other types of receiving waters such as estuaries, the biological composition of aquatic organisms is affected by a changing climate. For yet other environments such as lakes and impoundments, evaporation changes affects the capacities of these water bodies and also their vertical temperature distributions and resultant stability.

As an example of NRC's improper omission of climate impacts, I reference a recent, December 2022 GAO Report entitled "Tennessee Valley Authority - Additional Steps Are Needed to Better Manage Climate-Related Risks."[15] I provide this example because it is a recognition of the obvious and adverse climate impacts on nuclear plant operations that the proposed Revision 2 to NUREG-1437 fails to include. Specifically for Tennessee Valley Authority, this report notes that:

[15] AO-23-105375. December 2022. Available at https://www.gao.gov/products/gao-23-105375 "The Tennessee Valley Authority (TVA) faces several climate-related risks to its operations. Increasing temperatures and other climate-related risks are expected to affect TVA's ability to generate and transmit electricity, according to reports reviewed and stakeholders interviewed by

GAO. For example, in 2007, 2010, and 2011, TVA had to reduce power generation at its Browns Ferry Nuclear Plant because river temperatures were too high to receive discharge water from the plant without raising ecological risks. Climate-related effects, such as heavy precipitation and flooding, could also create added costs to TVA's operations-- such as for infrastructure investments--that could affect TVA's ability to keep electricity rates low. For example, in 2010, a TVA substation was submerged in over 5 feet of water when 15 inches of rain fell in 2 days. TVA relocated the substation to higher ground, at a cost of about $9 million."[16]

[16] In fact, the proposed Revision 2 at p. 3-42 recognized the reduced generation at Browns Ferry and other plants due to high temperatures - yet this did not dissuade the NRC from concluding that a Category 1 generic analysis is sufficient, nonetheless.
It goes on to say that:

"TVA has taken several steps to manage climate-related risks. For example, TVA identified risks, such as flooding and drought, in its 2021 Climate Action Adaptation and Resiliency Plan and implemented several resilience measures, such as relocating certain infrastructure. However, TVA has not conducted an inventory of assets and operations vulnerable to climate change or developed a resilience plan that identifies and prioritizes resilience measures to address specific risks. According to the Department of Energy's (DOE) Guide for Climate Change Resilience Planning, conducting an inventory of assets and operations vulnerable to climate change can help utilities more accurately identify relevant hazards and the potential severity of disruptions to operations or damage to related infrastructure. This, in turn, would better position TVA to plan and implement appropriate actions to address climate change vulnerabilities as they become more acute, and as new and better information becomes available. In addition, developing a resilience plan that includes a portfolio of resilience measures could help TVA identify available options and determine whether mitigating certain risks is worth the investment. Doing so would help TVA better fulfill its mission of providing reliable and affordable power to its customers."

The NRC is remiss and wrong to stick to its Category 1 grouping of all surface water impacts in the face of the site-specific climate-related impacts to source and receiving waters.
(**32-16-1** [Reiser, Caroline])

Comment: <u>Subsection xvii (74)- Climate Change Impacts on Environmental Resources:</u> This proposed rule is lacking in only requiring evaluation of impacts of climate change on environmental resources that are affected by the continued nuclear power plant operation and refurbishments during the license renewal term (initial LR or SLR). The proposed rule should be modified/ expanded to require thorough evaluation of impacts of climate change on the continued safe nuclear power plant operation and refurbishments itself during the license renewal term (LR or SLR). The evaluation of the impact of sea level rise on safety and performance of nuclear power plants located directly along a coast, such as the Turkey Point Power Plant in Miami-Dade County which is located just above mean sea level and immediately adjacent to Biscayne Bay and the Atlantic Ocean, is a critical issue which deserves the minimum Category 2, and probably a Category 3 classification.

Two recent studies by climate scientists, Jianjun Yin, and Sonke Dangendorf have concluded that a quickly warming Gulf of Mexico is driving a faster than expected rise in sea levels along the Gulf and across the east coast of Florida that is "unprecedented in at least 120 years". These studies were reported in the Washington Post and also used in the **UN Intergovernmental Panel on Climate Change recent report. (IPCC) In July, the Southeast Florida Regional Climate Change Compact projected that by 2040, seas would rise**

between 10 to 17 inches over 2000 levels, based on predictions from NOAA and the Intergovernmental Panel on Climate Change, the United Nations body that has studied the issue since the 1980s.

Exhibit 3, **Seas Have Drastically Risen Along the Southern U.S. coast in Past Decade**, The Washington Post, April 10, 2023.
Exhibit 4 **Unified Sea Level Rise Projection for Southeast Florida prepared by the Florida Regional Climate Change Compact's Sea Level Rise Ad Hoc Work Group, pp 9- 23.**
Other significant elements of climate change that can and do impact the performance of nuclear power plant reactors and support systems such as the cooling canal system, are increasing average annual ambient temperature and decreasing average annual rainfall which can adversely affect the capacity and thermal efficiency of the reactor(s) water cooling system if ponds or canals on / adjacent to the nuclear plant site are utilized. The inability of the weather/ climate dependent cooling ponds or canals to reliably return water to the nuclear reactors which is cooled to the design influent temperature can cause a reduction in the electrical power generating capacity of the nuclear power plant.

For example, in 2014, the cooling canals at the FPL Turkey Point Power Plant, drought conditions and extremely high ambient temperatures coupled with poor operation & maintenance practices of the CCS, reactor intake water temperatures reached 104 degrees F, This exceeded the design limit by 8 degrees F and the Applicant had to apply for and was granted an increase from the NRC which was unprecedented and the highest input temperatures of any nuclear plant in the nation. This resulted in the NRC requiring FLPL to temporarily ramp down the operating capacity of the 2 nuclear reactors and obtain an emergency permit to withdraw millions of gallons of the L31E canal water (freshwater) to cool down the CCS and the reactors.

NRC must require the applicant to address in the site -specific environmental report for a nuclear power plant located on US Atlantic, Pacific and Gulf Coast that proposes to continue to use ponds and canals as the cooling water system based upon the actual predicted level of sea level rise, projected storm surge and King Tides and not the historic levels which Applicant used in its EIS years more than 5 years ago in support of its application, during the license renewal period and determine whether these factors will adversely impact the operational integrity and the thermal efficiency of said canals or ponds. This is assuming greater importance on the SLR for 20 years from 2032 which will extend the life of the reactors to 80 years of operation and exceeds design specifications for nuclear reactors. The seffect of climate change will be even more intense. If so, the applicant must demonstrate how the adverse impact can be prevented by a proven refurbishment to the pond or canal system or by complete replacement with new industry-standard cooling towers constructed well above sea level rise and hurricane storm surge. If replacement is the only viable option, then the renewal permit should stipulate immediate termination of water use from the canals and ponds and, if on-site, immediate decommissioning of the canals or ponds after the cooling towers are completed, tested, and put online. (**37-4** [Rippingille, Bonnie])

Comment: One of the issues intervenors expressed with the existing LR GEIS is that climate change was not completely considered. However, the NEPA environmental review is about the facility's impacts on the environment, not the environment's impact on the facility. Further, the existing or future impacts of climate change on a local level are difficult to determine and include significant uncertainty as to the extent of impact and cause. If impacts due to climate change do exist at a nuclear power site, it is further uncertain to what extent the operation of the power plant may impose new or additional environmental impacts. The extensive uncertainty in an

assessment could result in a substantial regulatory burden that, in the most likely case, would not be able to scientifically demonstrate impacts. As such, the consideration of climate change is relevant on a plant-level, case-by-case basis, but will be "no-impact' for most sites. A simple process using reasonable assumptions is necessary to determine if impact is zero or minimal and then be excluded from a detailed analysis. (**38-2** [LLoveras, Leigh Anne])

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Response: *The NRC acknowledges the comments that are generally in support of the NRC's addition of new environmental issues including "Greenhouse gas impacts on climate change" and "Climate change impacts on environmental resources." However, the NRC disagrees with the comments recommending changes to the scope of the Category 2 issue, "Climate change impacts on environmental resources."*

As discussed in Section 4.12.2 of this revised LR GEIS, which provides the technical basis for the Category 2 issue, "Climate change impacts on environmental resources," the NRC has concluded that the impacts of climate change on environmental resources that are affected by continued nuclear power plant operations and refurbishment during the license renewal term are location-specific. The effects of climate change can vary regionally, and climate change information at the regional and local scale is necessary to assess the trends and impacts on the human environment for a specific site location. Section 3.12.2 and Section G.12.1 in Appendix G of the LR GEIS provide a discussion of observed changes in climate for U.S. geographic regions, with a focus on regions in which operating nuclear power plants are located. As part of the NRC's analysis for this Category 2 issue, the NRC considered consensus information from the U.S. Global Change Research Program (USGCRP). The USGCRP integrates the best available information and current state of knowledge regarding climate change trends and effects and provides consensus-based estimates across 13 Federal member agencies.

Given the site-specific and regional variables at play with respect to climate change, a plant-specific evaluation of potential climate change impacts is required. In plant-specific environmental reviews, the NRC staff will consider and evaluate climate change impacts in proportion to their significance and the magnitude of the impacts anticipated. The NRC will use the latest, best available information from the USGCRP and/or data from member agencies. Plant-specific supplements to the LR GEIS will discuss the climate models as well as greenhouse gas (GHG) emission scenarios considered when discussing climate projections. The NRC's plant-specific environmental reviews will also consider and document potential impacts on water resources as some comments request.

The scope of the new Category 2 issue focuses on the impacts of climate change on environmental resources that are also affected by continued nuclear power plant operations and any refurbishment during the LR term, not the climate change impacts on safe operation of

nuclear power plants. The effects of climate change on structures, systems, and components are outside the scope of the NRC's license renewal environmental review and this LR GEIS and rulemaking. The NRC's environmental review documents the potential effects from 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, including maximum probable precipitation, as set forth in 10 CFR Part 100, "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 specifications in accordance with the NRC operating license, including coping with natural phenomena hazards. The NRC conducts safety reviews prior to allowing licensees to make operational changes due to changing environmental conditions.

Additionally, the NRC evaluates nuclear power plant operating conditions and physical infrastructure to ensure 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 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 license renewal environmental review that it conducts in accordance with NEPA and the NRC's regulations for implementing NEPA in 10 CFR Part 51.

Regarding the comments specific to Turkey Point, the cited site-specific environmental issues and concerns will be addressed, as appropriate, by the NRC in plant-specific license renewal environmental reviews. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.

Comment: We are constantly looking for future problems. And we see it in a number of areas. Because basically we're seeing it, we mentioned the Paluxy River drying out. That river has never dried out. It's gone low, but it's never completely dried out. And that's how we found the dinosaur tracks in this area because the river was completely dry. So that's something that could easily be missed in your research. (**9-6-3** [Gosslee, Susybelle])

Comment: You live in a different environment, and you don't realize the winds we have. It may make a difference here. (**9-6-5** [Gosslee, Susybelle])

Comment: You don't realize of how we go through periods of droughts. It's not all just old cowboy stories, okay? (**9-6-6** [Gosslee, Susybelle])

Response: *The NRC acknowledges the comments and concerns related to observed climate change impacts in north-central Texas. The comments were not specific to the LR GEIS or this rulemaking. However, Section 3.12.2 and Section G.12.1 in Appendix G of this LR GEIS describe observed changes in climate, including those in the Southern Great Plains (which includes Texas). In the LR GEIS, the NRC has concluded that impacts of climate change on environmental resources are location-specific and cannot be evaluated generically. This is a new Category 2 issue. Therefore, each plant-specific supplement to the LR GEIS will consider the climate change impacts on environmental resources that could be affected by the proposed action.*

Specifically, Vistra Operations Company LLC submitted an initial license renewal application for Comanche Peak to the NRC in October 2022 (Luminant 2022), and the NRC accepted the application for docketing on November 28, 2002. On December 13, 2022, the NRC published a notice of intent to conduct a scoping process and to prepare a plant-specific supplemental environmental impact statement (SEIS) to the 2013 LR GEIS (87 FR 76219, 88 FR 10940). In preparing the draft SEIS, the NRC staff considered scoping comments received from the public and relevant Category 1 (generic) and plant-specific (Category 2) environmental issues listed in the 2013 LR GEIS. The draft SEIS was issued for public comment in November 2023. The final SEIS is scheduled to be issued in the spring of 2024. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.

Comment: The NRC must take a hard look at climate change, and it can only do this if it does not wall off from site-specific review Category 1 issues. (**32-5-6** [Reiser, Caroline])

Response: *The NRC agrees with the comment to the extent that the NRC should take a "hard look" at climate change. The NRC has concluded that impacts of climate change on environmental resources are location-specific and cannot be evaluated generically. Therefore, the NRC has added "Climate change impacts on environmental resources" as a new Category 2 issue in the LR GEIS and final rule. With respect to the consideration of climate change in other contexts, the designation of an issue as a Category 1 issue does not preclude the NRC from considering the climate change impacts on that environmental resource, provided that the information is new and significant. As discussed in Section 4.12.2 of this LR GEIS, climate change impacts can occur across all resource areas that could be affected by the proposed action. In order for there to be a climate change impact on an environmental resource, the proposed action (license renewal) must have an incremental new, additive, or increased physical effect or impact on the resource or environmental condition. Changes in nuclear power plant operating parameters, as well as new and significant information provided by the applicant, identified through public comments, or resulting from NRC's due diligence in reviewing relevant information are considered during preparation of plant-specific supplements to the LR GEIS. Data are reviewed in part for information that could change the conclusion in the LR GEIS with regard to an issue. No changes were made in the LR GEIS, final rule, or guidance as a result of this comment.*

Comment: The draft GEIS, published on March 3,2023, indicates that "At the time of publication of this LR GEIS, CEQ had not published updated guidance on the consideration of the effects of GHG emissions and climate change when evaluating proposed Federal Actions" (Section 4.12, p.4-161 lines 39-40). However, on January 9, 2023, CEQ published interim guidance to assist federal agencies in assessing and disclosing climate change impacts during environmental reviews.[1] This interim guidance is effective immediately, and CEQ recommends that agencies use this interim guidance for all new proposed actions. CEQ developed this guidance in response to Executive Order 13990, Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis.

NRC did not address several aspects of the draft GEIS consistent with the CEQ guidance, such as disclosure of reasonably foreseeable upstream and downstream emissions, comparison of the emissions to total global or domestic emissions and representing them as a small fraction of these totals, and consideration of GHG emissions in the comparison of alternatives.

*EPA recommends that NRC update the language regarding the published CEQ interim guidance and follow the interim guidance for the final GEIS and all upcoming proposed actions to ensure robust consideration of potential climate impacts, mitigation, and adaptation issues.

[1] https://www.federalregister.gov/documents/2023/01/09/2023-00158/national-environmental-policy-act guidance-on-consideration-of-greenhouse-gas-emissions-and-climate (**15-1** [Tomiak, Robert])

Comment: *Consistent with CEQ's position expressed in the January 6, 2023, CEQ interim GHG guidance referenced above, and October 7, 2021, notice of proposed NEPA rulemaking, the final GEIS should estimate and disclose the alternatives' potential upstream GHG emissions. The analysis should be broken out by GHG type. Section 3.12.2 has a very limited discussion of indirect emissions that focuses on workers vehicle emissions but does not include estimates of upstream and downstream emissions, such as those from the fuel cycle. Indirect emissions should include emissions from, and effects associated with, the processing, refining and end-use of the fuel. Section 4.14 indicates GHG emissions from the nuclear fuel life cycle are discussed in 4.12. However, this section does not appear to disclose representative fuel life cycle GHG emissions. EPA recommends that NRC provide an estimate of the fuel cycle GHG emissions using an appropriate model, such as the Department of Energy's GREET fuel life-cycle model or other appropriate emission factors. (**15-2** [Tomiak, Robert])

Comment: *EPA recommends that the Comparison of Alternatives, Section 2.4, including Table 2.4-5 (pp.10-110) include comparison of GHG emissions. (**15-4** [Tomiak, Robert])

Comment: * The draft GEIS identifies the disclosure of climate change impacts and adaptation as a Category 2 environmental issue that will be address in each SEIS for reauthorizations. Whereas the disclosure of GHG emissions is determined to be a Category 1 issue that NRC does not intend to address in each reauthorization SEIS unless something substantial has changed. EPA concurs with the Category 2 designation for climate change impacts and adaptation, given case and location specific impacts and adaptation needs for each reauthorization. However, EPA suggests that additional and more robust disclosure of reasonably expected GHG emissions, especially those for upstream fuel cycle emissions, is necessary in the final GEIS for GHG emissions to be considered Category 1. (**15-5** [Tomiak, Robert])

Response: *The NRC agrees in part and disagrees in part with these comments. With respect to the comments that the LR GEIS should include fuel-cycle GHG emissions, Section 3.12.1 of the LR GEIS has been revised to include a discussion of GHG emissions from the nuclear lifecycle, which includes the uranium fuel cycle and plant construction, operation, and decommissioning.*

Regarding the suggestion that a comparison of GHG emissions from replacement power alternatives be included in Section 2.4 and Table 2.4-5 of the LR GEIS, Table D.4-3 in Appendix D of this LR GEIS already provides a comparison of carbon dioxide emission factors for representative fossil fuel-fired facilities (e.g., natural gas combined cycle, supercritical pulverized coal, integrated gasification combined cycle). Additionally, plant-specific supplements to the LR GEIS will quantify and compare GHG emissions from the proposed action (license renewal) and the alternatives considered.

Nonetheless, the NRC agrees, as indicated in the 2023 CEQ guidance, that GHG emissions and climate change effects are legitimate topics to consider in agency NEPA reviews. The NRC disagrees that the LR GEIS should fully incorporate the CEQ's January 9, 2023 (88 FR 1196) interim guidance for estimating GHG emissions and climate change effects and that the NRC should designate it for future use in the NRC's plant-specific environmental reviews. Section 4.12 of the LR GEIS has been updated to include a discussion of the fact that on January 9, 2023, CEQ issued interim guidance, "National Environmental Policy Guidance on

Consideration of Greenhouse Gas Emissions and Climate Change." While the LR GEIS acknowledges the 2023 CEQ guidance, the NRC also recognizes that this guidance is not a rule or regulation and therefore compliance with it is not required. CEQ's guidance itself includes language explaining that it does not impose legally binding requirements, as explained in the associated Federal Register notice,

> *This guidance is not a rule or regulation, and the recommendations it contains may not apply to a particular situation based upon the individual facts and circumstances. This guidance does not change or substitute for any law, regulation, or other legally binding requirement, and is not legally enforceable.*

The NRC may determine that it is appropriate to implement portions of the recommendations in CEQs guidance on a nuclear plant-specific basis, and will therefore do so in plant-specific supplements to this LR GEIS. Additionally, the NRC has designated "Climate change impacts on environmental resources" as a new, Category 2 issue in Section 4.12.2 of this LR GEIS and final rule. Because the effects of climate change can vary regionally and climate change information at the regional and local scale is necessary to assess the impacts on environmental resources, climate change impacts will be evaluated in future plant-specific supplements to the LR GEIS, or similar analysis. In conducting this plant-specific analysis for proposed nuclear power plant licensing actions, the NRC will apply staff guidance for conducting license renewal environmental reviews contained in NUREG-1555, Supplement 1, Revision 2 (NRC 2024b) and will consider other appropriate guidance regarding GHGs and climate change effects.

Comment: However, the deployment of nuclear power and other sources of carbon-free energy production has not scaled to the level required to support national and international climate goals. Delays in our nation's permitting processes to expand energy transmission infrastructure and build a clean grid for our future have allowed fossil fuels to continue to dominate energy markets. Aside from exacerbating the climate crisis through the continued emission of greenhouse gasses, energy derived from fossil fuels has a demonstrably negative impact on air quality and contributes to many health problems and premature deaths. Sadly, these effects are felt disproportionately in underserved and low-income communities.

Understanding the benefits that nuclear power provides and the public health risks of carbon-intensive energy use, we ask that in its new environmental assessment rulemaking, the NRC moves expeditiously to establish an environmental protection framework that adapts to a changing climate. (**16-2** [Luse, Jeff])

Comment: III. Greenhouse Gas Emissions and Climate Change

A significant proposed change to the LR GEIS and Table B-1 is the NRC's addition of new Category 1 and 2 issues related to greenhouse gas (GHG) emissions and climate change. We provide specific comments on both of these issues below. However, we first underscore our agreement with the NRC that environmental reviews for license renewal are appropriately focused on the potential impacts of continued operation of the plant on the environment, and not vice versa.[22] As the revised LR GEIS makes clear, earthquakes, storms, floods, droughts, and other natural hazards, even if exacerbated by climate change, are outside the scope of the NRC staff's environmental and safety reviews for license renewal. The safety review is narrowly focused on aging management of systems, structures, and components within the scope of license renewal, as defined in 10 CFR 54.4. The potential impacts of changing environmental conditions on plant operation is a current licensing basis (CLB) matter.[23] Accordingly, if new information about changing environmental conditions (e.g., rising sea levels) becomes available,

the NRC evaluates the new information as part of its ongoing regulatory oversight activities. Such evaluations are thus outside the scope of the LR GEIS and proposed rule.[24]

[22] See Revised LR GEIS, Vol. 1 at 4-21.
[23] See 10 CFR 54.3(a) (defining "current licensing basis"); Fla. Power & Light Co. (Turkey Point Nuclear Generating Plant, Units 3 and 4), CLI-01-17, 54 NRC 3, 9 (2001) ("The CLB represents an evolving set of requirements and commitments for a specific plant that are modified as necessary over the life of a plant to ensure continuation of an adequate level of safety," and "is effectively addressed and maintained by ongoing agency oversight, review, and enforcement.") (internal quotation marks and citation omitted).
[24] Turkey Point, CLI-01-17, 54 NRC at 7 (quoting Nuclear Power Plant License Renewal; Final Rule, 56 Fed. Reg. 64,943, 64,946 (Dec.13,1991)) (''License renewal reviews are not intended to 'duplicate the Commission's ongoing review of operating reactors.'"). (**19-1-8** [Uhle, Jennifer])

Comment: A. Greenhouse Gas Impacts on Climate Change (Category 1 Issue)
In the draft revised LR GEIS, the NRC concludes that the impact of GHG emissions on climate change from continued plant operation during the license renewal term and any refurbishment activities would be SMALL for all nuclear plants, making this a Category 1 issue.[25] The technical basis for this conclusion is presented in Sections 3.12.1, 4.12.1, and D.1 of the LR GEIS. In short, the NRC determined that the GHG emissions from nuclear power plants are "very minor, because such plants do not normally combust fossil fuels to generate electricity."[26] In reaching this conclusion, the NRC considered, among other sources of information, direct and indirect GHG emissions from operations at nuclear power plants presented in initial LR and SLR SEISs.[27] Notably, the revised LR GEIS also acknowledges the role that nuclear plants play in **avoiding** additional GHG emissions.[28]

[25] See Proposed Rule, 88 Fed. Reg. at 13,345, 13,356; Revised LR GEIS, Vol. 1 at 2-14 (Table 2.1-1).
[26] Revised LR GEIS, Vol. 1 at 2-14, 3-148, 4-162.
[27] See id. at 3-145 to 3-150, 4-162 to 4-163.
[28] See id. at 4-162 (noting that in the Peach Bottom SLR SEIS and Surry SLR SEIS, the NRC concluded that continued operation would result in at least between 4 and 5 million tons/year of CO2eq emission avoidance when compared to replacement energy alternatives).

NEI agrees that the impact of GHG emissions on climate change from continued plant operation during any license renewal term and any refurbishment activities would be SMALL for all nuclear power plants. However, we believe nuclear energy's vital role in avoiding GHG emissions and other positive environmental attributes warrant greater emphasis in the revised LR GEIS. Nuclear energy already provides approximately half of the carbon-free electricity in the United States. In doing so, it avoids over 500 million metric tons of carbon dioxide, 265 thousand short tons of sulfur dioxide, and 238 thousand short tons of nitrogen oxide emissions every year.[29] Nuclear power has the highest average capacity factor and one of the lowest overall life-cycle impacts of any electric generation source.[30] Additionally, due to its high energy density, nuclear power has a much smaller geographic footprint than other clean energy generation sources.[31] As a result, nuclear power also minimizes land use and ecological impacts. Consistent with NEPA's public disclosure goal, we believe these environmentally beneficial aspects of nuclear power should be fully disclosed in the LR GEIS.

[29] NEI, "Annual Greenhouse Gas Emissions Avoided by the U.S. Nuclear Power Plants." https://www.nei.org/resources/statistics/old/emissions-avoided-by-us-nuclear-industry (updated Aug. 2022).

[30] See, e.g., IAEA. Nuclear Power and Sustainable Development, at 5, 38, 50-51 (2016), http://www-pub.iaea.org/MTCD/Publications/PDF/Pub1754web-26894285.pdf ("Life cycle emissions from the nuclear power chain are comparable with the best renewable energy chains and several orders of magnitude lower than fossil fuel chains."); Nakagawa, N.; Kosai, S.; Yamasue, E. Life cycle resource use of nuclear power generation considering total material requirement. J. CLEAN. PROD. 2022, 363:132530, https://www.sciencedirect.com/science/article/pii/S095965262202131X ("The [total material requirement] of nuclear power generation is significantly lower than that of thermal power generation and is similar to that of renewables. On the basis of the low greenhouse gas emissions associated with nuclear power generation, like renewables, it can be considered favorable not only from the global warming perspective but also from a resource use perspective.").

[31] Nuclear power has the smallest overall environmental footprint of any energy source, using roughly 50 to 500 times less space for energy production than wind and solar. See LucidCatalyst, Beautiful Nuclear, at 54 (June 2022), https://www.lucidcatalyst.com/beautifulnucleardrivingdeepdecarbonisation. (**19-1-9** [Uhle, Jennifer])

Comment: b. NEPA Requires Consideration of the Best Information Reasonably Available Agencies have broad discretion to keep their NEPA inquiries within appropriate and manageable bounds.[71] NEPA requires an agency to conduct its environmental review "with the best information available today."[72] It does not require an agency to "wait until inchoate information matures into something that later might affect [it] review,"[73] or to "undertake studies to obtain information that is not already available."[74] NEPA also allows agencies to select their own methodology as long as that methodology is reasonable.[75] Agencies are not required "to use technologies and methodologies that are still 'emerging' and under development, or to study phenomena 'for which there are not yet standard methods of measurement or analysis.'"[76] The Commission has thus emphasized that an EIS is not a "'research document,' reflecting the frontiers of scientific methodology, studies and data."[77] Instead, it should be "analytic, concise, and no longer than necessary to comply with NEPA."[78]

[71] Metro. Edison, 460 U.S. at 776.
[72] Luminant Generation Co., LLC (Comanche Peak Nuclear Power Plant, Units 3 and 4), CLI-12-7, 75 NRC 379, 391-92 (2012) (citations omitted).
[73] Id. (citations omitted).
[74] Fla. Power & Light Co. (Turkey Point Nuclear Generating Units 3 and 4), CLI-16-18, 84 NRC 167, 173 (2016).
[75] Entergy Nuclear Generation Co. (Pilgrim Nuclear Power Station), CLI-10-11, 71 NRC 287, 316 (2010)
[76] Id. at 315 (quoting Twn. of Winthrop v. FAA, 535 F.3d 1, 11-13 (1st Cir. 2008)).
[77] Id.
[78] *40 CFR 1502.2(c); see also Private Fuel Storage, CLI-02-25, 56 NRC* at 348 n.25.

In recent LR and SLR SEISs, the NRC has adhered to these guiding principles and should continue to do so in future SEISs prepared under the final rule and revised LR GEIS. For example, in the SEIS for Surry Units 1 and 2 SLR, the NRC staff "considered the best available climate change studies performed by the [U.S. Global Change Research Program] and partner agencies as part of the staff's assessment of potential changes in climate indicators during the Surry subsequent license renewal terms."[79] The staff summarized relevant information and data from these studies and acknowledged the uncertainties and limitations associated with those

studies. In Section 4.16 (Cumulative Impacts) of the SEIS for Surry SLR, the staff provided concise assessments of climate change impacts for those resource areas that could be incrementally impacted by the proposed action.

[79] NUREG-1437, Supplement 6, Second Renewal, Final Report at 4-130.
(**19-1-15** [Uhle, Jennifer])

Comment: c. NEPA Does Not Require an Agency to Resolve All Scientific Uncertainties NEPA does not require an agency to resolve all uncertainties or disagreements among scientists as to methodology, or even to use the best scientific methodology.[80] An agency's analysis made "in the face of unavailable information" is "grounded in the 'rule of reason.'"[81] In cases involving such uncertainties, an agency satisfies NEPA when it considers and discloses the uncertainties and, as discussed above, evaluates the impact based on the best information available.[82]
[80] See Izaak Walton League of Am. v. Marsh, 655 F.2d 346, 377 (D.C. Cir. 1981); The Lands Council v. McNair, 537 F.3d 981, 1003 (9th Cir. 2008) (an EIS need not be based on the "best scientific methodology available").
[81] 51 Fed. Reg. 15,618, 15,621 (April 25, 1986); see also Jicarilla Apache Tribe of Indians v. Morton, 471 F.2d. 1275, 1280 (9th Cir. 1973) ("If we were to impose a requirement that an impact statement can never be prepared until all relevant environmental effects were known, it is doubtful that any project could ever be initiated."; Village of False Pass v. Watt, 565 F. Supp. 1123, 1149 (D. Alaska 1983) ("[T]he unavailability of information should not be permitted to halt all government action.").
[82] See Baltimore Gas & Elec. Co. v. NRDC, 462 U.S. 87, 88, 98-100, 101-02 (1983) (finding that the NRC complied with NEPA's requirements of consideration and disclosure where it summarized major uncertainties and found the evidence tentative but favorable). Cf. Mayo Found. v. Surface Transp. Bd., 472 F.3d 545, 555-56 (8th Cir. 2006) (finding final EIS adequate where the agency had modeled potential national air pollution impacts but could not estimate local impacts with any degree of confidence).

These principles are especially germane here given the NRC's express recognition in the revised LR GEIS that "GHG emission scenarios, their supporting assumptions, and the projections of possible climate change effects entail substantial uncertainty."[83] This NRC staff observation is consistent with those of the scientific and academic communities. As one recent technical paper explains:

Uncertainty over climate-change-related impacts - and this includes land management and use - refers to **limited knowledge about the intensity of a precise local impact within a global dynamic**. Undoubtedly, our understanding of climate change and the underlying dynamic continues to increase. **Even so, some uncertainties remain regarding the links between cause and impact within a specific geographic setting.** This uncertainty in turn generates serious challenges when identifying the appropriate adaptation strategies for risk and impact reduction within a specific geographic setting, even when climate-change related impacts pose a global risk for communities and societies.[84]

[83] Revised LR GEIS, Vol. 1 at 4-165.
[84] Filho, W. et al., "Assessing Uncertainties in Climate Change Adaptation and Land Management." *Land* 2022, 11, 2226. https://doi.org/10.3390/land11122226 (emphasis added).

In another paper discussing judicial treatment of scientific uncertainty within the context of climate change litigation, the authors summarized the issue as follows:
Among the environmental problems characterized by significant and persistent uncertainty is

climate change. Certain aspects of climate change science are beyond dispute among the vast majority of reputable climate scientists. These include the existence of a warming planet and the acknowledgment that human activity - [GHG] emissions and deforestation in particular - is a contributing factor. ... **Nevertheless, considerable uncertainty surrounds other aspects of climate change. Scientists are unable to predict the magnitude of the physical effects of climate change or exactly how those effects will differ by location with any assurance.** Partly, these uncertainties are due to the yet-to-be-determined nature of the human response to warnings about climate risks - will GHG emissions continue unabated, for example, or be curtailed? In addition, scientists engaged in assessing the future of climate change and its effects rely on global climate models that generate simulations of future climate scenarios.[85]
[85] Kim, D., Glicksman, R., & Groth-Tuft, K. Judicial Review of Scientific Uncertainty in Climate Change Lawsuits: Deferential and Nondeferential Evaluation of Agency Factual and Policy Determinations. 6 HARV. ENV'T L. REV. 367 (2022). https://harvardelr.com/wp-content/uploads/sites/12/2022/07/HELRVol.-46.2-Judicial-Review-of-Scientific-Uncertainty.pdf (emphasis added); see also Shepherd, T. et al. Storylines: An Alternative Approach to Representing Uncertainty in Physical Aspects of Climate Change, 151 CLIMATIC CHANGE 555, 557 (2018) (noting that "it is not known how to correct model biases in simulating climate changes (as opposed to simulations of the present climate state)" and that "[e]stimates of uncertainties at the regional scale can quickly accumulate to a point where this knowledge hinders rather than supports scenario-led climate adaptation decision-making").

These and other studies make clear that there are multiple sources of uncertainty in the climate models used to predict future climate change that warrant disclosure in a NEPA analysis.[86]

[86] See, e.g., Morrison, F., Manson, C. & Wickersham, M. Climate Change Science and the Daubert Standard, 44 WM. & MARY ENV'T L. & POL'Y REV. 391, 410 (2020) (identifying the three main sources of uncertainty in the climate models used to predict future climate change as: (1) natural internal variability which is intrinsic to the climate system; (2) uncertainty concerning past, present and future forcing on the climate system by anthropogenic forcing agents; and (3) uncertainty related to the response of the climate system to the specified forcing agents). (**19-1-16** [Uhle, Jennifer])

Comment: 5. Summary and Recommendations

NEI agrees that the GHG-related impacts of continued nuclear plant operation on climate change can be analyzed generically, are small in magnitude, and are appropriately treated as a Category 1 issue. However, we do not believe climate change impacts on environmental resources should be treated as a separate Category 2 issue. Rather than representing a direct or indirect effect of license renewal, climate change represents a potential (and often uncertain) change to the affected environment that occurs irrespective of license renewal. As such, it is more logically considered as a cumulative impact or simply as part of the discussion of the affected environment used in evaluating the impacts of license renewal, as the NRC has done in SLR SEISs issued to date.

Regardless, any NRC analysis of the "additive" or "incremental" effects of climate change and license renewal should adhere to NEPA's rule of reason and the principles described above. This will help ensure that the NRC's NEPA analysis focuses "on those consequences of greatest concern to the public and of greatest relevance to the agency's decision,"[96] rather than temporally or geographically remote effects that defy meaningful analysis due to a lack of reliable scientific data. As noted above, estimating or projecting how climate change will affect

environmental resources on a regional or local scale many years from now involves major uncertainties. The NRC should explicitly acknowledge these uncertainties in the revised LR GEIS and in its implementing guidance.

96 Methow Valley, 490 U.S. at 356.

NRC guidance must clearly identify the scope of this issue and appropriate methods for conducting and documenting climate change evaluations to "enable applicants to predictably meet NRC staff needs and for the NRC staff to meet its obligations under NEPA." This includes identifying what specific sources of information the NRC views as the best currently available for analyzing climate change impacts, and how applicants should use and present that information (including, for example, level of detail, disclosure of uncertainties, and use of qualitative analysis). The NRC also should clarify that applicants are not expected to perform new studies or climate modeling exercises, and that any potentially relevant mitigation measures - which are not compelled by NEPA - are likely to fall within the jurisdiction of other agencies. In short, clear guidance and acceptance criteria are needed to avoid analysis of worst-case scenarios or highly speculative effects, as well as potential conflicts with the requirements and determinations of other federal and state agencies that have jurisdiction over the environmental resources in question. (**19-1-18** [Uhle, Jennifer])

Comment: 8. Section/Page 3.12 Climate Change 36, Comment/Recommendation: Description of regional changes from climate assessment reports lists two in this section but does not bound the review to just these two reports. (**19-2-15** [Uhle, Jennifer])

Comment: 1. Section/Page 4.12.3 4-71, Comment/Recommendation: The statement: "Studies and monitoring programs: Briefly summarize any studies or monitoring programs that provide site-specific data and can assist with understanding GHG emission sources and climate change impacts, including trends in key climate impacts, " is very broad. Clarity regarding the scale or regional area of interest should be provided. Additionally, clarify the examples that follow are to be treated on an "as applicable" basis, as some data may not be collected routinely and/or is not relevant to every plant. (**19-2-21** [Uhle, Jennifer])

Comment: 2. Section/Page 4.12.8 4-72, Comment/Recommendation: The statement: "Changes in climate parameters should be quantified including changes in, but not limited to, ambient temperature, precipitation, surface water temperature and levels, length of growing season, and flooding, as appropriate." This listing needs to be bounded to changes that are materially relevant to the project/action -i.e., license renewal. For example, the growing season is not relevant to the project. (**19-2-22** [Uhle, Jennifer])

Comment: 3. Section/Page 4.12.8 4-73, Comment/Recommendation: For the statements: "Describes and quantifies climate change projections. When discussing changes in climate parameters, identify the future GHG emission projections and scenarios selected." In addition to the projections and scenarios selected, identifying the model(s) selected -single model, set of models, ensemble of models -is just as important. Also, if data are downscaled, the downscaling technique applied should be specified. (**19-2-23** [Uhle, Jennifer])

Response: *The NRC agrees in part and disagrees in part with these comments. The NRC also acknowledges the comments that are generally supportive of the NRC's consideration of greenhouse gas (GHG) emissions and climate change in this LR GEIS and associated rulemaking. The NRC generally agrees with the comments that suggest that clarity is needed in*

the NRC's guidance to applicants and staff with regard to the treatment of GHGs and climate change impacts as presented in this LR GEIS and rulemaking.

Regarding the question on Section 3.12 of draft Regulatory Guide 4.2, Supplement 1, Revision 2, the description of the observed regional changes in key climate change indicators in an applicant's environmental report is not limited to climate assessment reports from the U.S. Global Change Research Program or Intergovernmental Panel on Climate Change. The NRC has identified these as possible, authoritative examples of climate assessment reports that can be used by license renewal applicants. No changes were made in Regulatory Guide 4.2, Supplement 1, Revision 2 (NRC 2024a) as a result of this comment.

The NRC agrees with the recommendation that Section 4.12.3 of NUREG-1555, Supplement 1, Revision 2 (NRC 2024b) should be revised to provide an area of interest to be considered. The NRC has added a geographic scope under "studies and monitoring programs." Regarding the list of climate change indicators, the list provides examples, and the NRC recognizes that not all may apply to every nuclear power plant site. The NRC has revised the list to include "and/or."

The NRC also agrees with the recommendation that Section 4.12 of NUREG-1555, Supplement 1, Revision 2 should be revised to limit the list of climate change parameters that should be considered. The NRC has revised the statement cited in the comment to clarify that climate change parameters can include those that are listed.

The NRC also agrees with the recommendation that the statement concerning climate change projections in Section 4.12 of NUREG-1555 Supplement 1, Revision 2 should also reference the climate models used. The NRC has made clarifying changes to the statement in Section 4.12.5 of final NUREG-1555, Supplement 1, Revision 2.

The NRC agrees with the comments to the extent that uncertainty remains with respect to climate change impacts. However, the NRC believes that it has appropriately limited the boundaries of its inquiry of climate change impacts and the scope of the new Category 2 issue to matters germane to the NRC's proposed action. The NRC will consider climate change impacts in proportion to their significance and to the magnitude of the impacts anticipated. The NRC staff will further use the best available climate change information and consensus reports (e.g., U.S. Global Climate Change Research Program) and will quantify climate change impacts to the extent possible. These considerations govern all environmental impact analyses performed by the NRC. While uncertainty exists with respect to climate change projections, the mere presence of uncertainty does not exempt the NRC from considering and disclosing potential climate change impacts. The NRC recognizes that it has an obligation under NEPA to disclose uncertainties and any incompleteness in available data for all environmental impact analyses it performs. For clarity, the NRC has revised Section 4.12.5 of NUREG-1555, Supplement 1, Revision 2 (NRC 2024b) to ensure that climate change impact analyses prepared by NRC staff appropriately focus on and discuss reasonably foreseeable climate change impacts and that they be evaluated in proportion to their significance.

The NRC disagrees with the suggestions that the NRC should emphasize in the LR GEIS other positive environmental attributes or benefits associated with nuclear power. The NRC does not promote any particular form of energy generation, including nuclear power. The purpose of this LR GEIS and associated rulemaking is to identify and evaluate the environmental issues that could result in the same or similar impact (i.e., generic issues) on the environment at all nuclear power plants or a specific subset of plants and determine which issues could result in different levels of impact during the license renewal term, thus requiring nuclear power plant-specific

environmental analyses for impact determination. The LR GEIS also discusses a range of reasonable alternatives to the proposed action (initial LR or SLR), which would be analyzed in detail in plant-specific supplements to the LR GEIS. With regard to the latter, Table D.4-3 in Section D.4.11 of this LR GEIS provides a comparison of carbon dioxide emission factors for representative fossil fuels (e.g., natural gas combined cycle, supercritical pulverized coal, integrated gasification combined cycle).

Regarding the specific suggestion that the LR GEIS should emphasize the smaller environmental footprint of nuclear power when compared to other energy sources, the NRC will quantify and compare GHG emissions from the proposed action (license renewal) and the alternatives considered in plant-specific supplements to this LR GEIS. Section 3.12.1 of the LR GEIS has been revised to include a discussion of GHG emissions from the nuclear lifecycle, which includes the uranium fuel cycle and plant construction, operation, and decommissioning. Additional discussion regarding nuclear power carbon footprint is not necessary to support the Category 1 issue, "Greenhouse gas impacts on climate change."

Comment: -Climate change is occurring rapidly and challenging reactor safety systems in unexpected ways. (**20-22** [Judson, Timothy])

Comment: First, make a plan of how the review process, the research, and report will be made and presented to the public. Gather all the information needed to make a responsible well-informed and productive decision by using multiple third-party, up-to-date resources, research, and studies. Lack of information leads to ineffective decisions and possibly dangerous and costly decisions. Full investigation with analysis, critical thinking, and deep investigation with staff listening and hearing the public's comments with an open mind to arrive at the best solutions. The public knows their own community's weather, earthquakes, lakes and waterways, droughts, floods, wind, temperatures, and all other environmental aspects which could affect the nuclear reactor. Investigate how the changes in the climate will affect the reactor during the next twenty to forty years on a Category 2 site-specific basis. (**21-4** [Gosslee, Susybelle])

Comment: -Storm pattern changes are occurring rapidly and will continue challenging reactor safety systems in unexpected ways. (**45-22** [Hutar, J Jeremy])

Comment: Climate change is occurring rapidly and challenging reactor safety systems in unexpected ways. (**46-10** [Kirby, Laurence])

Response: *The NRC agrees with the comments to the extent that they suggest that the NRC needs to consider and use site-specific information regarding changing environmental conditions and trends that can be associated with climate change. The effects of climate change can vary regionally, and climate change information at the regional and local scale is necessary to assess the trends and impacts on the human environment. Therefore, the NRC has added "Climate change impacts on environmental resources" as a new Category 2 issue in the LR GEIS and final rule, as described in Section 4.12.2 of this revised LR GEIS. Section 3.12.2, as further detailed in Appendix G, Section G.12.1, of this LR GEIS discusses observed changes in climate, spanning seven distinct regions of the United States, the Northeast, Southeast, Midwest, including the Southern Great Plains (which includes Texas). As part of the NRC's analysis for this Category 2 issue, the NRC considered consensus information from the U.S. Global Change Research Program (USGCRP). The USGCRP integrates the best available information and current state of knowledge regarding climate change trends and effects and provides consensus-based estimates across 13 Federal member agencies.*

As a Category 2 issue, the climate change impacts on environmental resources that could be affected by the proposed action will be considered by the NRC in each plant-specific supplement to the LR GEIS. The NRC will use the latest, best available information from the USGCRP and/or data from member agencies. To initiate the environmental review for each plant-specific license renewal environmental review, the NRC will conduct a scoping process in part to solicit information from the public about issues and concerns, as well as site-specific information, that should be considered by the NRC during the environmental review.

The NRC disagrees with the comments to the extent that they suggest that the NRC should consider the impacts of climate change on safe operations of nuclear power plants. The scope of the new Category 2 issue focuses on the impacts of climate change on environmental resources that are also affected by continued nuclear power plant operations and any refurbishment during the LR term, not the climate change impacts on safe operation of nuclear power plants. The effects of climate change on plant structures, systems, and components are outside the scope of the NRC staff's license renewal environmental review and this LR GEIS and rulemaking. The NRC's environmental review documents the potential effects from continued nuclear power plant operation on the environment. However, 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 specifications in accordance with the NRC operating license, including coping with natural phenomena hazards. The NRC conducts safety reviews prior to allowing licensees to make operational changes due to changing environmental conditions. Additionally, the NRC evaluates nuclear power plant operating conditions and physical infrastructure to ensure 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 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's license renewal environmental review that it conducts in accordance with NEPA and the NRC's regulations for implementing NEPA in 10 CFR Part 51. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.

Comment: 4. Any Analysis of Climate Change Impacts on Environmental Resources Must Be Informed and Bounded by the NEPA "Rule of Reason"

Whether the NRC requires consideration of climate change impacts on environmental resources and related mitigation measures as a separate Category 2 issue or as a cumulative effect, it should make clear in the statement of considerations for the final rule and in its implementing guidance that such analysis is informed and bounded by NEPA's "rule of reason."[64] We summarize the key principles below. These principles are especially relevant here given the substantial complexities and uncertainties inherent in assessing climate change effects, especially on a regional or local scale, and the evolving state of the art in climate change science and modeling.

[64] See New York v. Kleppe, 429 U.S. 1307, 1311 (1976); see also Pub. Citizen, 541 U.S. at 767-69 (2004) (rule of reason is inherent in NEPA and its implementing regulations); NextEra Energy Point Beach LLC (Point Beach Nuclear Plant, Units 1 and 2), LBP-21-__, 91 NRC 1, __ (2021).

a. NEPA Requires Consideration of Only "Reasonably Foreseeable" Effects

"NEPA requirements are 'tempered by a practical rule of reason.'"[65] In this regard, NEPA only requires that the EIS address those environmental impacts that are "reasonably foreseeable."[66] An agency "need not address 'all theoretical possibilities,' but rather only those that have some 'reasonable possibility' of occurring."[67] Nor does it need to analyze events that would be considered "worst case" scenarios or "remote and highly speculative."[68] NEPA, moreover, "does not call for certainty or precision, but an estimate of anticipated (not unduly speculative) impacts."[69] Under this standard, "an EIS is required to furnish only such information as appears to be reasonably necessary under the circumstances for evaluation of the project rather than to be so all-encompassing in scope that the task of preparing it would become either fruitless or well nigh impossible."[70] Thus, if the potential effects of climate change on an environmental resource cannot be reasonably estimated with any degree of confidence, the NRC need not consider them in a license renewal SEIS.

[65] Entergy Nuclear Operations, Inc. (Indian Point, Units 2 and 3), CLI-16-7, 83 NRC 293, 326 (2016) (quoting Entergy Nuclear Generation Co. (Pilgrim Nuclear Power Station), CLI-10-22, 72 NRC 202, 208 (2010)); see also Potomac Alliance v. NRC, 682 F.2d 1030, 1035 (D.C. Cir. 1982).

[66] Potomac Alliance, 682 F.2d at 1035; Pa'ina Hawaii, LLC (Materials License Application), CLI-10-18, 72 NRC 56, 89 (2010).

[67] Crow Butte Res., Inc. (Marsland Expansion Area), LBP-19-2, 89 NRC 18, 40 (2019) (quoting Long Island Lighting Co. (Shoreham Nuclear Power Station, Unit), ALAB-156, 6 AEC 831, 836 (1973)).

[68] Holtec Int'l (HI-STORE Consol. Interim Storage Facility), LBP-19-4, 89 NRC 353, 375 (2019) (quoting Private Fuel Storage, L.L.C. (Indep. Spent Fuel Storage Installation), CLI-02-25, 56 NRC 340, 352 (2002); Limerick Ecology Action, Inc. v. NRC, 869 F.2d 719, 754-55 (3d Cir. 1989)).

[69] La. Energy Servs. (Nat'l Enrichment Facility), CLI-05-20, 62 NRC 523, 536 (2005).

[70] New York v. Kleppe, 429 U.S. 1307, 1311 (1976) (quoting NRDC v. Callaway, 524 F.2d 79, 88 (2d Cir. 1975)). (**19-1-14** [Uhle, Jennifer])

Response: *The NRC agrees with the comment to the extent that the NRC's climate change impact analyses should and must be governed by NEPA's "rule of reason," use the best information reasonably available, recognize relevant scientific uncertainties, and be limited to reasonably foreseeable impacts or effects. For the new Category 2 issue, "Climate change impacts on environmental resources," the issue only applies to the environmental resources directly affected by continued operations and refurbishment during the license renewal term. Thus, the NRC staff's focus will be on action-relevant and reasonably foreseeable environmental effects. For clarity, the NRC has revised Section 4.12.5 of NUREG-1555, Supplement 1, Revision 2 (NRC 2024b) to reiterate that climate change impact analyses prepared by the NRC staff appropriately focus on and discuss reasonably foreseeable climate change impacts and that they be evaluated in proportion to their significance. No other changes were made in the LR GEIS or final rule as a result of this comment.*

Comment: 3. Treating Climate Change Impacts on Environmental Resources as a Separate Category 2 Issue May Result in Conflicts with Other NRC Part 51 Regulations

The proposed provisions in question also could create conflicts with (1) the limitation in 10 CFR 51.53(c)(3)(ii)(B) on evaluating impacts of entrainment, impingement, and thermal discharges on fish and shellfish, and (2) the NRC's generic resolution of certain Category 1 issues in the LR GEIS and Table B-1. Pursuant to 10 CFR 51.53(c)(3)(ii)(B), which applies to plants with once through cooling or cooling ponds, no assessment of the impact of thermal discharges is required if an applicant provides a Clean Water Act Section 316(a) variance. Similarly, no

assessment of entrainment or impingement is required if the applicant provides a Section 316(b) determination. This limitation implements Section 511(c)(2) of the Clean Water Act, which provides that:

Nothing in [NEPA] shall be deemed to "(A) authorize any Federal agency authorized to license or permit the conduct of any activity which may result in the discharge of a pollutant into the navigable waters to **review any effluent limitation or other requirement established pursuant to this Act** . . . or (B) authorize any such agency to impose, as a condition precedent to the issuance of any license or permit, any effluent limitation other than any such limitation established pursuant to this Act.[56]

[56] 33 U.S.C. § 1371(c)(2) (emphasis added).

This statutory provision bars the NRC from second-guessing a National Pollutant Discharge Elimination System (NPDES) permitting agency's analysis or approval of the impacts associated with once-through cooling or requiring any analysis of cooling towers or other mitigating alternatives. As the Commission has clearly held, "the [NPDES] permitting agency 'determines what cooling system a nuclear power facility may use and NRC factors the impacts resulting from use of that system into the NEPA cost-benefit analysis.'"[57] "[T]he NRC has no statutory authority to review limitations or other requirements established by the [NPDES permitting agency] under the Clean Water Act and must accept at face value its determination that . . . once-through cooling system . . . is sufficiently protective of the environment."[58] "Under this statutory scheme, the NRC's decision whether to renew . . . licenses does not require an environmental analysis of cooling towers as an alternative."[59] Requiring an assessment of climate change as a separate Category 2 issue, as well as mitigation measures implemented at the applicant's plant to address climate change impacts, might incorrectly suggest that thermal impacts from once through cooling must be analyzed, regardless of an NPDES agency's 316(a) determination. The Commission should avoid any such suggestion, as it would violate Section 511(c)(2) of the Clean Water Act.

[57] NextEra Energy Point Beach LLC (Point Beach Nuclear Plant, Units 1 and 2), CLI-22-05, 95 NRC __ (Mar. 23, 2022) (slip op. at 9) (citing Entergy Nuclear Vt. Yankee, LLC, and Entergy Nuclear Operations, Inc. (Vt. Yankee Nuclear Power Station), CLI-07-16, 65 NRC 371, 389 (2007) (quoting Pub. Serv. Co. of N.H. (Seabrook Station, Units 1 and 2), CLI-78-1, 7 NRC 1, 26-27 (1978))).

[58] Id. (citing Vt. Yankee, CLI-07-16, 65 NRC at 376-77, 385-89).

[59] Id.

In the same vein, requiring climate change and related mitigation measures to be analyzed as a separate Category 2 issue could create a conflict with Category 1 findings on impacts that might hypothetically be affected by climate change. For example, while the draft revised LR GEIS concludes that surface water use conflicts would be SMALL for all plants with once through cooling systems (a Category 1 finding),[60] treating climate change as a Category 2 issue might be construed as requiring further analysis of the consumptive water use of a plant using once through cooling. This would undercut the Category 1 finding, eliminating the benefit of the GEIS's generic analysis, and would be particularly inappropriate because the generic analysis considers climate change.[61] In addition, for all Category 1 issues, NRC has determined that "additional plant-specific mitigation measures are not likely to be sufficiently beneficial to warrant implementation."[62] To eliminate the potential conflict and preserve the efficacy of Category 1 findings, any consideration of climate change impacts on Category 1 issues should be limited to the existing processes for identifying new and significant information. Absent new and significant information, Category 1 issues do not require additional analysis in a plant-specific

environmental review, and are not subject to challenge in individual licensing adjudications without a waiver.[63]
[60] Revised LR GEIS, Vol. 1 at 4-30.
[61] See id. at 4-29 to 4-30.
[62] Proposed Rule, 88 Fed. Reg. at 13,357 (footnote 2 of Table B-1).
[63] See Entergy Nuclear Vt. Yankee, LLC, and Entergy Nuclear Operations, Inc. (Vt. Yankee Nuclear Power Station), CLI-07-3, 65 NRC 13, 19-21 (2007); Massachusetts v. United States, 522 F.3d 115, 127 (1st Cir. 2008) (noting that "generic Category 1 issues cannot be litigated in individual licensing adjudications without a waiver"). (**19-1-13** [Uhle, Jennifer])

Comment: NextEra is concerned, however, with the NRC's creation of a new Category 2 issue, "Climate change impacts on environmental resources." Historically, the NRC's LR GEIS has evaluated "Category 1" issues, which can be addressed generically across the industry, need not be addressed by an applicants' Environmental Reports, and are not subject to challenge in hearings because they have been adopted by rule. By contrast, the NRC has also evaluated "Category 2" issues, which cannot be addressed generically, and so must be addressed in site specific Environmental Reports. The proposed climate change issue is a new concept, a cross-cutting Category 2 issue that potentially reaches every other issue, whether Category 1 or Category 2. Moreover, this issue is not itself an impact of the proposed action of license renewal but is more appropriately considered a cumulative impact. NextEra is concerned that this proposal is inconsistent with the NRC's successful existing license renewal process and may have unintended consequences. (**22-3** [Strand, Dianne])

Comment: Specifically, NextEra is concerned about the interaction between this new Category 2 issue and existing Category 1 issues. The proposed rule states that this issue encompasses the "impacts of climate change on environmental resources that are affected by continued nuclear power plant operations." In other words, this new Category 2 issue could be read to require a site-specific review of climate change coupled with the environmental impacts of license renewal is required for every environmental issue, regardless of whether that issue is currently a Category 1 or Category 2 issue.

NextEra believes, however, that this interpretation was not the NRC's intent because such an interpretation would upend the NRC's long-established environmental framework and the proposed rule continues to utilize the distinction between Category 1 and Category 2 issues.

As a result, NextEra requests that the NRC clarify this proposal and affirm that that the existence of this new Category 2 issue in the proposed rule does not change the standards for analyzing or challenging generic Category 1 issues. (**22-4** [Strand, Dianne])

Response: *The NRC acknowledges the concerns regarding the new Category 2 issue, "Climate change impacts on environmental resources." Climate change is a subject of national and international interest and has been and continues to be a topic of broad public interest with respect to reactor license renewal. The implications of climate change and the high level of public interest have made this topic one that the NRC believes requires a "hard look" as required by NEPA. Further, the CEQ in its January 9, 2023, interim guidance, "National Environmental Policy Act Guidance on Consideration of Greenhouse Gas Emissions and Climate Change," (88 FR 1196), encourages agencies in their NEPA reviews to quantify proposed actions' GHG emissions and disclose relevant climate change impacts. The NRC has concluded that 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. Therefore, for the new Category 2 issue, the impacts*

of climate change on environmental resources that are affected by continued nuclear power plant operations and refurbishment during the license renewal term are location-specific, thus requiring a plant-specific review.

The NRC disagrees with the comment that treating climate change impacts as a Category 2 issue could conflict with other provisions of 10 CFR Part 51, including the treatment of Category 1 issues in Appendix B to Subpart A of 10 CFR Part 51. The NRC's climate change impacts analysis will focus on reasonably foreseeable climate change impacts and predicted (future) trends on the baseline affected environment (i.e., the effects of climate change on environmental resource areas). Impact levels (i.e., SMALL, MODERATE, LARGE) are not assigned to this Category 2 issue because the analysis will define the future environmental baseline (i.e., future affected environment). In contrast, Category 1 issues focus on discrete aspects of nuclear power plant operations and refurbishment during the license renewal term and their environmental impacts.

To apply for license renewal, an applicant must submit an environmental report that contains any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware, in accordance with 10 CFR 51.53(c)(3)(iv). This rulemaking does not change this requirement. If there is no new and significant information for a Category 1 issue, the applicant can rely on that Category 1 generic finding and analyses in the LR GEIS. Issues that are resolved generically (Category 1) are not reevaluated in the plant-specific supplement to the LR GEIS, unless new and significant information is identified that would lead the NRC staff to reevaluate the LR GEIS's conclusions. Similar to how the Category 2 issue, "Cumulative effects," does not override Category 1 issues or their findings, the Category 2 issue, "Climate change impacts on environmental resources," does not override Category 1 issues, or impose any additional requirements.

The NRC also disagrees with comments that express concern that requiring the consideration of mitigation as part of the new Category 2 issue may result in the NRC imposing conditions or measures that are outside NRC's regulatory authority. As noted by some comments, for some resource areas (e.g., water and aquatic resources), the contributions of ongoing actions are regulated and monitored through a permitting process (e.g., National Pollutant Discharge Elimination Systems [NPDES]) under State-delegated or Federal authority. However, as required by NEPA and NRC's regulations (see 10 CFR 51.71(d)), the NRC is obligated to perform its own assessment of the impacts of the proposed action. The NRC recognizes, however, that in carrying out its NEPA responsibilities, it has no authority to impose effluent limitations or monitoring requirements contrary to those imposed by the U.S. Environmental Protection Agency or the delegated permitting authority pursuant to the Clean Water Act.

In response to these and other comments, the NRC has revised 10 CFR 51.53(c)(3)(ii)(Q) in this final rule to eliminate the duplicative requirement specific to mitigation measures for climate change impacts. Inclusion of this consideration in 10 CFR 51.53(c)(3(ii)(Q) is duplicative because the NRC's regulations set forth in 10 CFR 51.53(c)(3)(iii) already require that environmental reports submitted by license renewal applicants address mitigation for all Category 2 license renewal issues.

Comment: Moreover, every year we experience an ever more rapidly changing environment due to the climate crisis.[17] The Draft GEIS acknowledges that the climate is changing[18] on the one hand, and on the other continues to claim that environmental impacts are understood, predictable, and gradual.

[17] See e.g. Christopher Flavelle and Jeremy C.F. Lin, Bloomberg, U.S. Nuclear Plants Weren't Built for Climate Change (Apr. 18, 2019).
[18] See e.g. Draft GEIS at 4-166.

The NRC cannot rely on what has happened for the last 50 years of operating nuclear reactors as a basis for how aging reactors and the global-warming-altered environment will interact over the next several decades. Claiming it can is arbitrary and capricious. (**32-2-5** [Reiser, Caroline])

Response: *The NRC disagrees with the comment. The NRC believes that the statement in Section 1.1 of the LR GEIS, "Changes in the environment around the nuclear plant plants are gradual and predictable," remains accurate given what is known about ongoing and potential future climate change effects. This statement, originating in the 1996 LR GEIS, is referring to the incremental impacts and changes associated with continued nuclear power plant operations and any refurbishment activities during the license renewal term. In other words, certain environmental impacts during the license renewal term, alongside environmental changes, are gradual and predictable, such that many of the aspects and impacts associated with license renewal can be evaluated generically (i.e., Category 1 issues) for the purposes of projecting environmental impacts during the license renewal term. The subject statement is not referring specifically to the impacts of climate change on the environment.*

In contrast, as discussed in Section 4.12.2 of the LR GEIS, the NRC has concluded that the impacts of climate change on environmental resources that are affected by continued nuclear power plant operations and refurbishment during the license renewal term are location-specific. The effects of climate change can vary regionally, and climate change information at the regional and local scale is necessary to assess the trends and impacts on the human environment for a specific site environment. Therefore, the NRC has added "Climate change impacts on environmental resources" as a new Category 2 issue. In plant-specific supplements to the LR GEIS, the NRC will consider the impacts of climate change on environmental resources that are affected by continued nuclear power plant operations and any refurbishment during the license renewal term. Furthermore, as part of a plant-specific environmental review, the NRC staff will determine whether there is any new and significant information that was not considered in the LR GEIS for Category 1 issues. Thus, even though an issue is designated as a Category 1 issue, mechanisms are in place to conduct a full plant-specific review if new and significant information is identified. No changes were made in the LR GEIS, final rule, or guidance as a result of this comment.

Comment: <u>4. The NRC Must Take a Hard Look at Climate Change and Environmental Justice Impacts for all issues, regardless of Category.</u>

The NRC correctly concludes that climate change and environmental justice require site specific analysis and therefore are Category 2 issues. However, the NRC fails to address how it will take a hard look at climate change and environmental justice related to Category 1 issues. Climate change and environmental justice do not exist in a vacuum but rather are a vital lens through which to consider the interaction of the nuclear power plant, the environment, and the issue. Critically, they demonstrate the imperative under NEPA to avoid walling off environmental issues from site-specific review.

a. Climate Change
In explaining what an analysis of climate change effects should focus on, the CEQ states:

The analysis also should consider how climate change can make a resource, ecosystem, human community, or structure more vulnerable to many types of effects and lessen its resilience to other environmental effects. This increase in vulnerability can exacerbate the environmental effects of potential actions, including environmental justice impacts. For example, a proposed action or its alternatives may require water from a stream that has diminishing quantities of available water because of decreased snow pack in the mountains, or add heat to a water body that is already warming due to increasing atmospheric temperatures. Such considerations are squarely within the scope of NEPA and can inform decisions on siting, whether to proceed with and how to design potential actions and reasonable alternatives, and to eliminate or mitigate effects exacerbated by climate change. They also can inform possible adaptation measures to address the effects of climate change, ultimately enabling the selection of smarter, more resilient actions.[66]
[66] 88 Fed. Reg. at 1,208.

The NRC seems to agree, as the Draft GEIS acknowledges that "[c]hanges in climate have broader implications for environmental resources (e.g., water resources, air quality, and ecosystems),"[67] and that "[c]limate change may impact the affected environment in a way that alters the environmental resources that are impacted by the proposed action (license renewal). Similar to cumulative impacts, climate change impacts can occur across all resource areas that could be affected by the proposed action, including the effects of continued reactor operations during the license renewal term and any refurbishment activities at a nuclear power plant."[68]

[67] Draft GEIS at 4-162.
[68] Draft GEIS at 4-165.

But the Draft GEIS does not put this in practice. It simply lists the reasonably foreseeable changes in the environment due to climate change[69]--it does not analyze the broader implications of those changes on specific environmental impacts. Other than in the specific section discussing climate change, the Draft GEIS mentions how climate change interacts with other issues only four times:

- Section 4.5.1.1.8 Surface Water Use Conflicts (Plants with Once-Through Cooling Systems), where the Draft GEIS discusses both the reasonably foreseeable changes in climate and how those changes may interact with the issue of surface water use conflicts.[70] This new and significant information, through which the Draft GEIS acknowledges major site-specific changes and that "conflict might arise," should have led the NRC to conclude that it must be considered site-specifically.
- Section 4.5.1.1.9 Surface Water Use Conflicts (Plants with Cooling Ponds or Cooling Towers Using Makeup Water from a River), which is a Category 2 issue.
- Section 4.9.1.1.3's subsection on Microbiological Hazards to the Public, which is a Category 2 issue.[71]
- 4.11.1.3 Offsite Radiological Impacts of Spent Nuclear Fuel and High-Level Waste Disposal, explaining that DOE will need to consider the effects of climate change.[72]

[69] We note also that Section 3.12.2 of the Draft GEIS on Observed Changes in Climate leave out significant and relevant climatic changes, including: extreme cold events, increased number and intensity of storms like hurricanes and derechos (see NRC Information Notice 2021-03: Operating Experience Related to the Duane Arnold Energy Center Derecho Event on August 10, 2020 (Aug. 11, 2021) (ADAMS Accession NO. ML21139A091) https://www.nrc.gov/docs/ML2113/ML21139A091.pdf), increased fire risks, the word "drought,"

how sea level rise combines with storm surge, the changing location of tornadoes. See Draft GEIS at 3-150 - 3-155.
[70] Draft GEIS at 4-29 - 4-30.
[71] Draft GEIS at 4-142.
[72] Draft GEIS at 4-155.

The Draft GEIS then misleadingly claims that "[i]n plant-specific initial LR and SLR SEISs prepared since development of the 2013 LR GEIS, the NRC has considered climate change impacts for those resources that could be incrementally affected by the proposed action as part of the cumulative impacts analysis."[73] The Draft GEIS mentions six plants in its discussion of Climate Change Impacts. Some of the SEISs explain the reasonably foreseeable changes in temperature and precipitation trends and, to some extent "the potential cumulative, or overlapping, impacts from climate change on environmental resources where there are incremental impacts of the proposed action."[74] However, none of the SEIS analyze climate change impacts on all impacts, including land use, human health, accidents, or decommissioning.[75]
[73] Draft GEIS at 4-164.
[74] See e.g. Generic Environmental Impact Statement for License Renewal of Nuclear Plants Supplement 7, Second Renewal Regarding Subsequent License Renewal for North Anna Power Station Units 1 and 2 (Aug. 2021) https://www.nrc.gov/docs/ML2122/M4L21228A084.pdf.
[75] Including:
Generic Environmental Impact Statement for License Renewal of Nuclear Plants Supplement 7, Second Renewal Regarding Subsequent License Renewal for North Anna Power Station Units 1 and 2 (Aug. 2021) https://www.nrc.gov/docs/ML2122/ML21228A084.pdf (North Anna SEIS).
Generic Environmental Impact Statement for License Renewal of Nuclear Plants Supplement 6, Second Renewal Regarding Subsequent License Renewal for Surry Power Station Units 1 and 2 (Apr. 2020) https://www.nrc.gov/docs/ML2007/ML20071D538.pdf (Surry SEIS).
Generic Environmental Impact Statement for License Renewal of Nuclear Plants Supplement 59 Regarding Waterford Steam Electric Station, Unit 3 (Nov. 2018) https://www.nrc.gov/docs/ML1832/ML18323A103.pdf (Waterford SEIS).
Generic Environmental Impact Statement for License Renewal of Nuclear Plants Supplement 56 Regarding Fermi 2 Nuclear Power Plant (Aug. 2016) https://www.nrc.gov/docs/ML1625/ML16259A103.pdf.
Generic Environmental Impact Statement for License Renewal of Nuclear Plants Supplement 23 Second Renewal Regarding Subsequent License Renewal for Point Beach Nuclear Plant Units 1 and 2 (Nov. 2021) https://www.nrc.gov/docs/ML2130/ML21306A226.pdf.
(**32-5-4** [Reiser, Caroline])

Response: *The NRC agrees in part and disagrees in part with this comment. The NRC agrees with this comment to the extent that the issues, "Climate change impacts on environmental resources" and "Impacts on minority populations, low-income populations, and Indian Tribes" should be Category 2 issues, as discussed in Sections 4.12.2 and 4.10.1.1, respectively, of this revised LR GEIS.*

The NRC disagrees that the rule and the LR GEIS fail to take a "hard look" at the potential environmental impacts associated with climate change and environmental justice as they relate to Category 1 issues.

In the LR GEIS, the NRC has concluded that impacts of climate change on environmental resources are location-specific and cannot be evaluated generically. This is a new Category 2 issue. The designation of an issue as a Category 1 issue does not preclude the NRC from

considering the climate change impacts on that environmental resource. However, the new Category 2 issue, "Climate change impacts on environmental resources" is focused on the effects on environmental resource conditions that may also be directly affected by continued operations and refurbishment during the license renewal term. In other words, no climate change impact analysis will be performed for resource areas where the proposed action is unlikely to have impacts on that resource. The NRC is aware that the potential effects of climate change could occur across all environmental resources irrespective of license renewal, but the Category 2 impact analysis is confined to those resources and associated environmental conditions that the proposed action affects, and which would be considered in proportion to their significance.

Potential disproportionately high and adverse human health or environmental effects of climate change on minority and low-income populations resulting from continued nuclear power plant operation during the license term are addressed in each plant-specific supplement to the LR GEIS. In the environmental justice review, the NRC (1) identifies the location of minority and low-income populations that may be affected by the continued operation of the nuclear power plant during the license renewal term, (2) determines whether there would be any potential human health or environmental effects on these populations or on special pathway receptors (groups or individuals with unique consumption practices and interactions with the environment), and (3) determines whether any of the effects may be disproportionately high and adverse. Disproportionately high and adverse human health effects occur when the risk or rate of exposure to an environmental hazard for a minority or low-income population is significant and exceeds the risk or exposure rate for the general population or for another appropriate comparison group. Disproportionately high environmental effects occur when impacts or risks of impacts on the natural or physical environment in a minority or low-income community are significant and appreciably exceed the environmental impacts on the larger community. Such effects may include biological, cultural, economic, or social impacts and other related environmental issues, including new and significant information related to all Category 1 issues. Therefore, the NRC's nuclear plant-specific analysis takes a hard look at climate change impacts on environmental justice populations to determine whether human health and environmental effects would be disproportionately high and adverse. No changes were made in the LR GEIS, final rule, or guidance as a result of this comment.

Comment: <u>Subsection xvii (73)- Greenhouse Emissions and Climate Change:</u>

We agree with the comments filed by the U.S Department of Environmental Protection's comments filed in these proceedings and that this new category should be added but not as a Category 1 issue; it should be added as a Category 2 issue. The draft GEIS has assigned Category 2 to climate change impacts and adaptions and should also assign Category 2 to Greenhouse upstream and downstream emissions. Although the NRC evaluation of nuclear power plants' operations concludes that GHG emissions are inherently low and impact on climate change would be "SMALL", there is strong evidence that GHG emissions coming from transmission facilities conveying electrical power from the nuclear power plant is "MODERATE to LARGE". Therefore, this issue during environmental review should justify a Category 2 classification and we attach the following as further support. (See EXHIBIT US Emissions of the World's Most Potent Greenhouse Gas are 56 percent higher Than EPA Estimates, a New Study Shows. Inside Climate News, January 31, 2023. (**37-6** [Rippingille, Bonnie])

Response: *The NRC disagrees with this comment. The NRC has concluded that the issue of "Greenhouse gas impacts on climate change" is properly designated as a Category 1 issue with an impact level of SMALL. The NRC has stated its methods and criteria for environmental issue*

identification, categorization, and definitions in Section 1.5 of this LR GEIS as well as in the footnotes to Table B-1 in Appendix B to Subpart A of 10 CFR Part 51, as revised pursuant to this final rule.

Section 3.12.1 of the LR GEIS discusses sources of GHG emissions from nuclear power plants, including sulfur hexafluoride used in electric power transmission and distribution applications (substations, circuit breakers, and other switchgear). Furthermore, the GHG discussion in the LR GEIS also considered direct and indirect emissions from nuclear power plant operations, including upstream and downstream activities such as employee commuting. Table 3.12-2 in the LR GEIS presents direct and indirect GHG emissions from representative operating nuclear power plants, and the discussion acknowledges that the observed range and distribution of direct and indirect GHG emissions from site to site are a result of different sources and contributors. However, the NRC's analysis presented in Section 4.12.1 of the LR GEIS shows that the quantified GHG emissions from nuclear power plant operations, when compared to annual State-level GHG emissions, or annual county-level GHG emissions, or replacement power alternatives, are orders of magnitude lower across all nuclear power plant sites presented in Table 3.12-2.

Therefore, a generic, a Category 1 designation is appropriate for the issue, because the environmental impacts were found to be the same or similar at all nuclear plant sites based on previous license renewal environmental reviews, the impacts of GHG emissions on climate change from continued operations and refurbishment during the initial LR and SLR terms and any refurbishment activities would be SMALL, and plant-specific mitigation measures are not warranted. No changes were made in the LR GEIS, final rule, or guidance as a result of this comment.

Comment: 1. Climate Change is Not a Direct or Indirect Effect Caused by License Renewal

NEI does not support the designation of climate change impacts on environmental resources as a distinct Category 2 issue for several reasons. First, climate change is not a direct or indirect environmental effect caused by license renewal.[34] GHG emissions are of "primary concern" for climate change.[35] As the draft LR GEIS concludes (generically for all plants), GHG emissions from continued nuclear plant operation are "very minor" because such plants do not combust fossil fuel to generate electricity.[36] Consequently, renewing a nuclear plant's operating license does not contribute in any significant manner to climate change. Indeed, as discussed above, nuclear power plants contribute significantly to reducing air pollution - including GHG emissions - by avoiding the need for more greenhouse-gas intensive generation sources. Notably, in CLI-09-21, the Commission stated that "[w]e expect the Staff to include consideration of carbon dioxide and other greenhouse gas emissions in its environmental reviews for major licensing actions under the [NEPA]."[37] It further noted that "[t]he Staff's analysis for reactor applications should encompass emissions from the uranium fuel cycle as well as from construction and operation of the facility to be licensed."[38] Thus, as relevant to license renewal, the Commission's focus was on GHG emissions associated with continued plant operation, not on postulated "additive effects" of license renewal and climate change.

[34] As defined in Council on Environmental Quality (CEQ) regulations, "effects or impacts" are "changes to the human environment **from the proposed action** or alternatives that are reasonably foreseeable." "Direct effects" are "**caused by the action** and occur at the same time and place." "Indirect effects" are "**caused by the action** and are later in time or farther removed in distance, but are still reasonably foreseeable. 40 CFR 1508.1(g)(1)-(2) (emphasis added). The term "reasonably foreseeable" means "sufficiently likely to occur such that a person of

ordinary prudence would take it into account in reaching a decision." 40 CFR 1508.1(aa). The NRC uses these same definitions. *See* 10 CFR 51.14(b).
[35] Revised LR GEIS, Vol. 1 at 3-146.
[36] Id. at 2-14, 4-162.
[37] Duke Energy Carolinas, LLC (William States Lee III Nuclear Station, Units 1 and 2), CLI-09-21, 70 NRC 927, 931 (2009).
[38] Id.
Under controlling case law, the NRC does not appear to have a legal duty to consider the impacts of climate change on environmental resources as a direct or indirect effect of license renewal. The U.S. Supreme Court has clearly stated the test for whether a postulated "effect" triggers review under NEPA. In *Metropolitan Edison Company v. People Against Nuclear Energy*,39 and again in *Department of Transportation v. Public Citizen*,[40] the Court held that a particular environmental "effect" requires evaluation under NEPA only if there exists "'a reasonably close causal relationship' between the environmental effect and the alleged cause" thereof - i.e., the agency action under consideration.[41] The Court held that "where an agency has no ability to prevent a certain effect due to its limited statutory authority over the relevant actions, the agency cannot be considered a legally relevant cause of the effect." In applying the *Public Citizen* test, the D.C. Circuit has held that "[a]n agency has no obligation to gather or consider environmental information if it has no statutory authority to act on that information."[42]

[39] 460 U.S. 766 (1983).
[40] 541 U.S. 752 (2004)
[41] Pub. Citizen, 541 U.S. at 767 (quoting Metro. Edison, 460 U.S. at 774).
[42] Sierra Club v. FERC, 867 F.3d 1357, 1372 (D.C. Cir. 2017).

The NRC's statutory duties and authorities flow from the AEA, in which "Congress granted [the NRC] authority merely to regulate radiological and related environmental concerns."[43] As a procedural statute, NEPA does not expand the NRC's statutory mandate or authorities.[44] Instead, it requires the NRC to analyze those potential impacts that have a reasonably close causal connection to changes to the physical environment resulting from its proposed licensing actions. The "changes in climate parameters and trends" discussed in the revised LR GEIS - e.g., changes in air and water temperature, precipitation amounts, flood and storm frequencies, sea level - are not changes to the physical environment caused by license renewal.

[43] Hydro Res., Inc. (Albuquerque, NM), CLI-98-16, 48 NRC 119, 121 (1998) (emphasis added).
[44] See, e.g., Robertson v. Methow Valley Citizens Council, 490 U.S. 332, 350 (1989). ("[I]t is now well settled that NEPA itself does not mandate particular results, but simply prescribes the necessary process.").

Rather than representing a direct or indirect effect of license renewal, climate change represents a potential (albeit uncertain) change to the affected environment that occurs irrespective of license renewal.[45] As such, climate change should not be treated as a separate Category 2 issue. As discussed below, it is more logically considered as a cumulative impact, or simply as part of the discussion of the affected environment used in evaluating the impacts of license renewal, insofar as climate change effects on the "environmental baseline"[46] conditions described in Chapter 3 of an applicant's ER and the NRC's SEIS may be reasonably discerned based on reliable data.[47]

[45] Revised LR GEIS, Vol. 1 at 4-164.
[46] The "environmental baseline" is the site environmental conditions as they exist or are

estimated to exist in the absence of the proposed action and against which potential environmental impacts of license renewal are evaluated. Revised LR GEIS, Vol. 1 at 3-1, 8-3.
[47] See, e.g., Revised LR GEIS, Vol. 1 at 3-153 (noting that plant-specific environmental reviews of initial LR and SLR applications considered localized observed changes in sea level rise). (**19-1-11** [Uhle, Jennifer])

Response: *The NRC disagrees with this comment. Climate change is a subject of national and international interest and has been and continues to be a topic of broad public interest with respect to reactor license renewal. The implications of climate change and the high level of public interest have made this topic one that the NRC believes requires a "hard look" as required by NEPA. For the new Category 2 issue, "Climate change impacts on environmental resources," the NRC has concluded that the impacts of climate change on environmental resources that are affected by continued nuclear power plant operations and refurbishment during the license renewal term are location-specific, thus requiring a plant-specific review. The LR GEIS appropriately considers both the direct (caused by the action and occur at the same time and place) and indirect (caused by the action and are later in time or farther removed in distance but are still reasonably foreseeable) effects (impacts) of the proposed action (license renewal). The effects on or changes in the human environment caused by GHG emissions associated with continued nuclear power plant operations and refurbishment manifest as climate change. Therefore, climate change has a measurable impact on the affected environment. The NRC has concluded that GHG impacts on climate change from continued operations and refurbishment associated with license renewal are expected to be SMALL. This is a new Category 1 issue, "Greenhouse gas impact on climate change."*

As discussed in Section 3.12.1 and 4.12.1 of this LR GEIS, Earth's climate responds to changes in concentrations of GHGs in the atmosphere. Increasing concentrations of GHGs in the atmosphere generally increase the Earth's surface temperature. Climate models indicate that over the next few decades, temperature increases will continue due to current GHG emission concentrations in the atmosphere. Over the longer term, the magnitude of temperature increases and climate change-related effects will depend on future global GHG emissions. The NRC recognizes that climate change impacts are not attributable to any single action and, while license renewal accounts for a relatively small addition to global GHG concentrations, GHG emissions associated with license renewal still make a contribution to climate change, both directly and indirectly. Therefore, the NRC has concluded that it is appropriate that the impacts of climate change on environmental resources should be a Category 2 issue because the effects of climate change can vary regionally, and climate change information at the regional and local scale is necessary to assess environmental trends and the impacts on the human environment for a specific location. No changes were made in the LR GEIS, final rule, or guidance as a result of this comment.

A.2.17 Cumulative Effects

Comment: The closest the Draft GEIS comes to acknowledging potential cumulation of impacts or a change in stress over time is that it acknowledges that for ecological resources, "due to the ever-changing nature of ecological communities, the magnitude of impact that these stressors exhibit on ecological resources may change."[27] But the Draft GEIS fails to take the next step and discuss the difference of a stressor for original operating time (total of 40 years), LR (total of 60 years) and SLR (total of 80 years). Twenty additional years of operation could be the difference between populations and ecosystems substantially recovering after decommissioning and permanent alterations or long-term shifts.[28]

[27] Draft GEIS at 4-53.
[28] See. e.g. C S Holling, Resilience and Stability of Ecological Systems (1973) (introduced the word "resilience"-the amount of stress an ecosystem could stand without changing); David J. Rapport, Walter G. Whitford, How Ecosystems Respond to Stress: Common properties of arid and aquatic systems (Mar. 1999) https://academic.oup.com/bioscience/article/49/3/193/242486; National Academies of Sciences, Engineering, and Medicine, An Ecosystem Services Approach to Assessing the Impacts of the Deepwater Horizon Oil Spill in the Gulf of Mexico (2013) https://nap.nationalacademies.org/read/18387/chapter/5; Juan C Rocha, Ecosystems are showing symptoms of resilience loss (2022) https://iopscience.iop.org/article/10.1088/1748-9326/ac73a8/pdf. (**32-3-3** [Reiser, Caroline])

Response: *The NRC acknowledges the comment. As discussed in Section 4.13 of this LR GEIS, the NRC has determined that cumulative effects (impacts) is a Category 2 issue requiring a plant-specific review, the results of which would be documented in a plant-specific supplement to this LR GEIS. The scope of the NRC's cumulative effects analysis follows the guidance for Federal agencies set forth by the President's Council on Environmental Quality (CEQ). Cumulative effects, as defined by the CEQ, encompass the effects on the environment that result from the incremental effects of the action when added to the effects of other past, present, and reasonably foreseeable actions, regardless of what agency (Federal or non-Federal) or person undertakes such other actions. No changes were made in the LR GEIS, final rule, or guidance as a result of this comment.*

A.2.18 Uranium Fuel Cycle

Comment: *Section 4.14 indicates that conservative impacts from the fuel cycle are disclosed in Table 4.14-1, which the draft GEIS indicates is required by 10 CFR 51.51 40 (pp.440-445). Because this table is based on data from the 1970s, NRC believes the values are conservative. EPA suggests that in addition to the required table, the final GEIS should including updated data in this section based on the best available science, including GHG emissions. The table is also difficult to understand, as many of the entries and columns lack units, which are also not included in the footnotes. (**15-3** [Tomiak, Robert])

Response: *The NRC agrees in part with the comment. Table S-3 of 10 CFR 51.51(b) (reproduced as Table 4.14-1 in this LR GEIS) does not provide an estimate of GHG emissions associated with the uranium fuel cycle; it only addresses pollutants that were of concern when the table was promulgated in the 1980s. However, Table S-3 states that 323,000 megawatt-hours (MWh) is the assumed annual electric energy use for the reference 1,000 megawatt(s) electric (Mwe) nuclear power plant and that this 323,000 MWh of annual electric energy is assumed to be generated by a 45 MWe coal-fired power plant burning 118,000 metric tonnes (MT) of coal. Table S-3 also assumes that approximately 135,000,000 standard cubic feet (scf) of natural gas is required per year to generate process heat for certain portions of the uranium fuel cycle. The NRC staff estimates that burning 118,000 MT of coal and 135,000,000 scf of natural gas per year results in approximately 253,000 MT of carbon dioxide equivalent (CO_2e) being emitted into the atmosphere per year because of the uranium fuel cycle (Harvey 2013). Electricity generation from coal is now approximately 19.5 percent and approximately 38.8 percent from natural gas. Given that U.S. GHG emissions totaled 6,340 million MT CO_2e in 2021 (see Section 3.12.1 in this LR GEIS), the uranium fuel cycle contribution is a very small fraction of the total U.S. GHG emissions. The NRC made clarifying changes to Section 4.14.1.2 of the LR GEIS as a result of this comment.*

To aid in understanding Table 4.14-1, a footnote was added to the text in Section 4.14.1.2 explaining that the units provided in an environmental considerations header apply to the items within that environmental consideration. For example, under the environmental consideration of "Water," the units of millions of gallons also applies to the items "Discharged to air;" "Discharged to water bodies;" and "Discharged to ground." The NRC made clarifying changes to Section 4.14.1.2 of the LR GEIS as a result of this comment.

A.2.19 Termination of Plant Operations and Decommissioning

Comment: <u>Subsection xx (80)- Termination of Nuclear Power Plant Operations and Decommissioning</u>

This issue must be elevated to a Category 3 level. It is imperative that every nuclear power plant seeking a license renewal term must resubmit to the NRC for approval as part the application and environmental review an updated plant and plant site "Termination and Decommissioning Plan " based on the current integrity and age of the plant components and systems, feasible refurbishments to same, conditions of environmental resources affected by past and continued plant operations and foreseeable impacts of changes in climate during the proposed renewal term. The applicant, based on all the above considerations, must include a re-assessment of the service life of the major components of nuclear power plant, storage of spent fuel, feasibility of refurbishment and an updated schedule for decommissioning and termination. The plan shall state a primary federally approved site and a secondary federally- approved site for the disposal of the spent fuel stored on-site once decommissioning has commenced. Public safety demands the classification of the Applicant's submittal and the NRC review of an updated site-specific termination and decommissioning plan as a Category 3 issue. (**37-7** [Rippingille, Bonnie])

Response: *The NRC disagrees with the comment. The LR GEIS analyzes the impacts of an additional 20 years of nuclear power plant operations on the termination of plant operations and decommissioning; it neither serves as a generic analysis of the environmental impacts associated with decommissioning nor establishes decommissioning requirements. The NRC concludes that initial LR and SLR are not expected to affect the future termination of power plant operations and decommissioning, and any site-specific issues would also be unlikely to be affected by an additional 20 years of reactor operations, and would be considered as appropriate in the decommissioning process.*

NRC regulations require the licensee to submit a license termination plan at the end of decommissioning for NRC review and approval. The NRC then conducts a separate National Environmental Policy Act (NEPA) review of the activities described in the licensee's termination plan.

The NRC addresses license renewal issues generically and site-specifically. For the Category 1 issue, "Termination of plant operations and decommissioning," it represents an impact that would eventually occur at all nuclear plants. The NRC license renewal process for nuclear power plants (including SLR) includes a thorough review of the environmental impacts of the proposed action and alternatives in accordance with the Council on Environmental Quality and NRC regulations for implementing NEPA. However, the impacts of reactor shutdown and decommissioning are described in the Decommissioning GEIS, Supplement 1 (NUREG-0586, NRC 2002d) and summarized in Section 4.14.2.1 of this LR GEIS. No changes were made in the LR GEIS, final rule, or guidance as a result of this comment.

A.2.20 Alternatives: Alternative Energy Sources

Comment: I think also it would be good for the NRC to evaluate a comparison of sustainable energy to the nuclear energy. (**9-7-7** [Gosslee, Susybelle])

Response: *The NRC agrees with the comment. Section 2.4 of the LR GEIS provides a summary comparison of the environmental impacts of the proposed action (license renewal) as discussed in Chapter 4, and the environmental impacts of alternatives to the proposed action (including the no action alternative, and potential fossil fuel, nuclear, and renewable energy alternatives for replacing an existing nuclear power plant's generating capacity), as discussed in Appendix D. These discussions provide the NRC staff with a basis, when conducting future plant-specific license renewal environmental reviews, from which to pursue an evaluation of alternatives such as suggested by the comment. No changes were made in the LR GEIS, final rule, or guidance as a result of this comment.*

Comment: 13. Section/Page 7.1 Alternative Energy Sources 74, Comment/Recommendation: NEI supports the removal of purchase power from the alternatives review.
(**19-2-20** [Uhle, Jennifer])

Response: *The NRC disagrees with the comment, which suggests that the NRC is proposing to eliminate the consideration of purchased power as an option for replacing or offsetting baseload power generation capability beyond the term of the current nuclear power plant operating license to meet future system generating needs. Section 7.1 of Regulatory Guide 4.2, Supplement 1, Revision 2 (NRC 2024a) specifies that alternatives meeting the purpose and need include (1) replacing existing nuclear generating capacity using other energy sources (i.e., constructing and operating new fossil fuel, nuclear, and renewable energy power plants); and (2) offsetting existing nuclear generation capacity using conservation and energy efficiency (demand-side management), delayed retirement, or purchased power. In addition, Appendix D, Section D.3.4.3 of this LR GEIS includes a discussion of purchased power as a non-power generating alternative that should be addressed in future plant-specific license renewal environmental reviews. Accordingly, the range of alternatives evaluated in depth in each plant-specific environmental review would be based on the reasonableness of alternatives specific to that plant. No changes were made in the LR GEIS, final rule, or guidance as a result of this comment.*

Comment: Page 13,334 of the Supplementary Information outlines "New Category2 Issues(s)" and requires the applicant to address the "environmental impacts of alternatives to license renewal." It would be helpful if the NRC could expand on the scope of what "alternatives" should be covered. (**14-3** [Johnson, Johnny])

Response: *The NRC acknowledges the comment concerning the information presented in the proposed rule regarding environmental impacts of alternatives to the proposed action within the scope of Category 2 issues. Sections 7.1 and 7.2 of Regulatory Guide 4.2, Supplement 1, Revision 2 (NRC 2024a) describe the types of alternatives to license renewal whose impacts should be considered in future project-specific environmental reviews. These include alternatives for replacing existing nuclear generating capacity with alternative energy sources, alternatives for offsetting existing capacity with other non-power generating approaches, and alternatives for reducing adverse impacts. Accordingly, the range of alternatives evaluated in depth in each plant-specific environmental review would be based on the reasonableness of alternatives specific to that plant. No changes were made in the LR GEIS, final rule, or guidance as a result of this comment.*

Comment: 4. The GEIS's consideration of energy alternatives is inadequate and unreasonable. (**20-15** [Judson, Timothy])

Comment: 4. The GEIS's consideration of energy alternatives is inadequate and unreasonable. (**44-12** [Lee, Gary])

Comment: 4. The GEIS's consideration of energy alternatives is inadequate and unreasonable. (**45-15** [Hutar, J Jeremy])

Response: *The NRC disagrees with these comments. As stated in Section 1.4, Alternatives to the Proposed Action, of this LR GEIS:*

> *In plant-specific license renewal environmental reviews, the NRC considers the environmental consequences of the proposed action, the no action alternative (i.e., not renewing the operating license), and the environmental consequences of various alternatives for replacing or offsetting the nuclear power plant's generating capacity. No definitive conclusions are made in the LR GEIS about the relative environmental consequences of license renewal, the no action alternative, and the construction and operation of alternative facilities for generating electric energy. However, information presented in the LR GEIS can be used by the NRC and applicants in performing the plant-specific analysis of alternatives.*

Thus, the energy alternatives discussed in the LR GEIS are adequate and reasonable because the environmental impacts of the potential alternative energy sources for each plant would be evaluated in future plant-specific supplements to this LR GEIS. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.

Comment: - It unjustifiably relies on valuing the outdated, irrelevant characteristic of "baseload generation." (**20-16** [Judson, Timothy])

Comment: - It discounts the value of renewable energy sources, such as solar and wind, by emphasizing the intermittency of their electricity generation, even though they are proving equally predictable and more reliable than fossil fuel and nuclear power plants. (**20-17** [Judson, Timothy])

Comment: -Adopting these inaccurate assumptions into a 10-year Generic Environmental Impact Statement fails to meet the requirements of the National Environmental Policy Act. (**20-18** [Judson, Timothy])

Comment: <u>1. The Purpose and Need and Alternatives Violate NEPA and the APA.</u>

a. Purpose and Need

Under NEPA, "[a]gencies have discretion in drafting the purpose and need statement, but the statement must not unreasonably narrow the agency's consideration of alternatives so that the outcome is preordained."[88] The Draft GEIS limiting the Purpose and Need as to provide "baseload power" unreasonably narrows the alternatives analysis. The NRC must reframe the Purpose and Need without "baseload power" and significantly revise the alternatives discussion.

[88] City of Los Angeles, California v. Fed. Aviation Admin., 63 F.4th 835, 843 (9th Cir. 2023) (cleaned up).

By the NRC's own statement in the Draft GEIS, it lacks the authority to determine if baseload power generation is needed.[89] The NRC's authority comes from the Atomic Energy Act, which requires the NRC ensure that nuclear reactors only operate if their design, condition, and operations are in compliance with safety standards. This is what the NRC must rely on to define the Purpose and Need.[90] Contrary to this, the Draft GEIS does weigh in on factors outside its jurisdiction by defining the purpose and need as "to provide an option that allows for *baseload power generation capability* beyond the term of the current nuclear power plant operating license to meet future system generating needs."[91] The Draft GEIS wanders off into the realm of advancing policy prescriptions, rather than staying in its lane of fairly evaluating the environmental impacts of the licensing action.

[89] Draft GEIS at 1-3 ("A renewed license is just one of several conditions that each licensee must meet to operate its nuclear power plant during the license renewal term. State regulators, system operators, and in some cases, other Federal agencies, ultimately decide whether the nuclear power plant will continue to operate based on factors such as need for power or other factors within the State's jurisdiction or owner's control.").

[90] See e.g. 2013 GEIS at S-3 ("The purpose and need for NRC's proposed action is to provide an option to continue plant operations beyond the current licensing term to meet future system generating needs, as such needs may be determined by State, utility, system, and, where authorized, Federal (other than NRC) decision-makers. Unless there are findings in the safety review required by the Atomic Energy Act or in the NEPA environmental review that would lead the NRC to reject a license renewal application, the NRC has no role in the energy-planning decisions of power plant owners, State regulators, system operators, and, in some cases other Federal agencies, as to whether the plant should continue to operate.").
[91] Draft GEIS at 1-4 (emphasis added).

Further, framing the Purpose and Need around "baseload" suggests that the NRC failed to consider the proposed action in a modern framework, and it unreasonably narrows the alternatives analysis. With this Draft GEIS, the NRC is setting the regulatory landscape and environmental analysis for reactors that could operate well past the 2050s, but seemingly doing so on the "baseload" nomenclature of the last century. And in May of 2023, it's already clear that the power grid where these reactors will operate today and tomorrow and into the 2050s does not look like the grid of the last century.[92]

[92] See The Brattle Group, Advancing Past 'Baseload' to a Flexible Grid, (June 26, 2017) https://www.brattle.com/wp-content/uploads/2022/09/Advancing-Past-Baseload-to-a-Flexible-Grid.pdf.
[See ML23123A412 for Figure 3 and Figure 5 on electricity demand and supply mix in traditional planning and with high renewables penetration.]

Historically, the term "baseload" "functioned as shorthand for a category of resources that provided electricity production at relatively low operating costs," and therefore today "is often perceived to be connected with the concepts of system need and system reliability."[93] But baseload is not equivalent to reliability. In today's market, there are other characteristics of value, such as dispatchability.[94] Defining the Purpose and Need by "baseload power" suggests that the grid will always need the same level of baseload energy as what is on the grid today. This is simply not true.

[93] Id.
[94] Id.

To make this point clear, see this visual representation of California's grid on May 1, 2023.[95] [See ML23123A412 for this image.]

[95] California ISO https://www.caiso.com/TodaysOutlook/Pages/supply.html (taken for May 1, 2023).

In fact, "inflexible baseload generators are becoming an impediment" to the grid.[96] The modern grid will be a flexible grid, not one founded on baseload generators.[97] The NRC might disagree, and the agency certainly has that right. But there is no support, analysis, or hard look at reliance on the baseload terminology as a potential anachronism that is unavailing for a decision on what energy resources will be available well into the latter half of this century. The NRC must follow the most up-to-date technical projections for the makeup of the grid, and the Draft GEIS simply does not do this.

[96] Amory Lovins, Do Coal and Nuclear Generation Deserve Above-Market Prices?, 7-8 https://rmi.org/wp- content/uploads/2017/07/ElJ6May2017_preprint.pdf ("The modern view is that supposed storage and backup needs are less a need of variable renewables than a consequence of central thermal plants' relative inflexibility"); Rocky Mountain Institute, Amory Lovins, Fourteen Alleged Magical Properties That Coal and Nuclear Plants Don't Have and Shouldn't Be Paid Extra for Providing (July 21, 2017) https://rmi.org/fourteen-alleged-magical-properties-coal- nuclear-plants-dont-shouldnt-paid-extra-providing/; Department of Energy, On the Path to SunShot (2016) https://www.energy.gov/eere/solar/path-sunshot.
[97] Institute of Electrical and Electronics Engineers, Irina Oleinikova, How Flexibility Can Support Power Grid Resilience (Feb. 2022) https://smartgrid.ieee.org/bulletins/february-2022/how-flexibility-can-support-power-grid- resilience; Energy Innovation, Sonia Aggarwal and Robbie Orvis, Grid Flexibility: Methods for Modernizing the Power Grid (Mar. 2016) https://energyinnovation.org/wp-content/uploads/2016/05/Grid-Flexibility-report.pdf.
(**32-7-1** [Reiser, Caroline])

Comment: Limiting the Purpose and Need to "baseload power generating capability" unreasonably narrows the Draft GEIS's discussion of alternatives and is likely to skew future site-specific reviews as well.[98] While we appreciate that Section 2.3 of the Draft GEIS includes a diverse mix of potential alternative energy sources, the Draft GEIS unreasonably requires "[t]he amount of replacement power generated or offset must equal the baseload capacity previously supplied by the nuclear plant and reliably operate at or near the nuclear plant's demonstrated capacity factor."[99] Thus, the alternatives analysis unreasonably favors traditional "baseload" energy sources like coal, natural gas, and nuclear over wind, solar, and non-power resource alternatives.

[98] See e.g. Beyond Nuclear v. U.S. Nuclear Regul. Comm'n, 704 F.3d 12, 21 (1st Cir. 2013) (Court rejected petitioner's challenge to applicant's conclusion that wind power is not a reasonable alternative because it is not baseload energy).
[99] Draft GEIS at 2-17 (emphasis added).

The following are examples of how the Draft GEIS is biased toward fossil resources over renewable resources:

- The Draft GEIS erroneously highlights the "proven reliability" of natural gas and coal.[100] Defining fossil resources as reliable ignores the most up-to-date information about

the modern electric grid. Year after year, in the face of extreme weather when energy is needed the most, fossil fuel plants struggle and fail while renewable energy resources outperform expectations.[101]

- The Draft GEIS in Section 2.3 highlights the negative environmental impacts of renewable energy alternatives while touting the "clean" aspects of fossil fuel resources. Section 2.3 includes a paragraph and more on the negative environmental impacts of renewable energy alternatives.[102] Yet the same section only includes brief mention of the environmental impacts of fossil fuel resources.[103] In fact, the section on coal highlights the allegedly "cleaner" aspects of the technology.[104] The best available science concludes that fossil fuel resources are far from "clean," and the environmental impacts of renewable resources are minimal in comparison.
- The Draft GEIS highlights that "[p]rojections for the amount of electricity produced from coal in the future vary widely across planning scenarios, primarily due to cost uncertainties associated with anticipated future environmental regulations such as cap- and-trade regulations for nitrogen dioxide, sulfur dioxide and the regulation of greenhouse gases emissions, primarily carbon dioxide."[105] The sentences immediately before and after this statement, both of which include citations, contradict the substance of this statement. Yet this sentence includes no citation. If the NRC cannot provide a source for its claim, the NRC must remove this sentence from the Draft GEIS.
- The Draft GEIS states that "the highest-value solar resources in the United States exist in the desert regions of the Southwest. However, solar resources of *adequate* quality to support utility-scale solar energy facilities, particularly PV, are located--*to varying extents*--throughout the country."[106] Solar projects are being successfully built across the United States.[107] The GEIS must be a forward-looking document that should not be acting like renewable resources are of limited use.
- The Draft GEIS acknowledges that 30 percent of the solar additions are anticipated to be from end-use PV such as residential and commercial rooftop solar.[108] The Draft GEIS, however, does not explain if it considers rooftop solar in its alternatives analysis. Rather, the Draft GEIS discusses "solar," "utility-scale solar," "solar PV", "solar thermal," or "concentrated solar." Some discussions appear to exclude rooftop solar, for example, "*Solar PV facilities* occupy large areas of land that could reduce or preclude natural vegetation communities and wildlife use."[109] The Draft GEIS must clarify whether it includes rooftop solar in its alternatives analysis, and if it does not, then it must provide a reasoned basis for failing to include it.

[100] Draft GEIS at 2-19, 2-25, 2-26.
[101] Christy Walsh, Power Grid Failures Reveal the Myth of Fossil Fuel Reliability (Feb. 2, 2023), https://news.bloomberglaw.com/us-law-week/power-grid-failures-reveal-the-myth-of-fossil-fuel-reliability; North American Electric Reliability Corporation, Polar Vortex Review (Sept. 2014) https://www.nerc.com/pa/rrm/January%202014%20Polar%20Vortex%20Review/Polar_Vortex_Review_29_Sept_2014_Final.pdf; Federal Energy Regulatory Commission, Final Report on February 2021 Freeze Underscores Winterization Recommendations (Nov. 2021) https://www.ferc.gov/news-events/news/final-report-february-2021- freeze-underscores-winterization-recommendations.
[102] Draft GEIS at 2-24, lines 21-33; Draft GEIS at 2-25, lines 10-11.
[103] Draft GEIS at 2-18, line 23.
[104] Draft GEIS at 2-20, lines 2, 5, 14-17.
[105] Draft GEIS at 2-19.
[106] Draft GEIS at 2-25 (emphasis added).

[107] U.S. Energy Information Administration, Solar power will account for nearly half of new U.S. electric generating capacity in 2022 (Jan. 10, 2022) https://www.eia.gov/todayinenergy/detail.php?id=50818#:%7E:text=Most%20planned%20solar%20additions%20in,by%20California%20(4.0%20GW); Berkeley Lab, Utility-Scale Solar (2022) https://emp.lbl.gov/utility-scale-solar. See also, Department of Energy Solar Futures Study (Sept. 2021) https://www.energy.gov/sites/default/files/2021-09/Solar%20Futures%20Study.pdf; Department of Energy, On the Parth to SunShot (2016) https://www.energy.gov/eere/solar/path-sunshot.
[108] Draft GEIS at 2-26.
[109] Draft GEIS at 4-125. (**32-7-2** [Reiser, Caroline])

Comment: The Draft GEIS also unreasonably favors alternative nuclear technology over non-power generating alternatives.

- The Draft GEIS's discussion of alternative nuclear power technology suggest that this technology is currently commercially viable--it is not and the NRC must explicitly state this. This is a technology that is in development and only *may* be commercially viable by the 2030s, though the date has already slipped multiple times.[110] The farthest along the path to a commercial viability of any SMR is NuScale with a design certification in January 2023. This is the first and only SMR design to receive NRC approval, and it took nearly seven years for the process. At a minimum, the NRC must update the timeline for NuScale's potential operation, which the company is now projecting to be 2029 at the earliest.[111]
- On the other hand, the Draft GEIS implies that non-power alternatives are not sufficiently viable to include in each discussion of environmental consequences of alternatives to the proposed action. Unlike SMRs, energy efficiency measures ("non-power alternatives" in the Draft's obscure jargon) have been contributing substantially to the nation's energy mix for several decades, but one would never know this from the discussion in the Draft GEIS. While the Draft GEIS acknowledges that demand-side management "may play an important role in the evaluation of a combination of alternatives,"[112] it does not include non-power alternatives in its issue-by-issue analysis. The fact that "the NRC staff is not aware of any cases where a [demand-side management] program has been implemented expressly to replace or offset a large, baseload generation station,"[113] signifies that the NRC has not done its homework to find new and significant information regarding the power grid and reasonable energy resources.[114] For example, in the Pacific Northwest, energy efficiency has been displacing baseload energy resources, cumulatively sufficient now to replace five Seattle's worth of baseload generation.[115] The NRC must state explicitly that non-power alternatives are a viable alternative and, as such, must include them in each discussion of environmental consequences of alternatives to the proposed action.

[110] Los Alamos, Carbon Free Power Project (CFPP) - Small Modular Nuclear Reactor (SMR) https://www.losalamosnm.us/government/departments/utilities/energy_resources/CFPP
[111] Draft GEIS at 2-23.
[112]Draft GEIS at 2-34.
[113] Draft GEIS at 2-34.
[114] See Synapse Energy Economics, Inc, Aiming Higher, Realizing the Full Potential of Cost-Effective Energy Efficiency in New York (Apr. 22, 2016) https://www.synapse-energy.com/sites/default/files/Aiming-Higher-NY- CES-White-paper-15-056.pdf. M.J. Bradley & Associates, LLC, Joint Proposal for the Orderly Replacement of Diablo Canyon Power Plant with Energy Efficiency and Renewables (June 21, 2016) https://www.pge.com/includes/docs/pdfs/safety/dcpp/MJBA_Report.pdf.
[115] Northwest Power and Conservation Council, Energy

Efficiency https://www.nwcouncil.org/energy/energy- topics/energy-efficiency/; Northwest Power and Conservation Council, Energy Efficiency in the Northwest https://www.nwcouncil.org/sites/default/files/eeonepager.pdf.

This is a document that may not include a policy fight about what are the better energy choices for the new century. But, contrary to its assertion that "the NRC does not engage in energy-planning decisions and makes no judgment about which alternative energy source(s) evaluated would be chosen in any given case,"[116] the Draft GEIS's Purpose and Need and Alternatives sections do in fact engage in forwarding a distinct (and, frankly, dated) view of energy policy. The NRC must revise this section by striking the concept of "baseload generation" and providing an equal discussion of the alternatives based on the best available technical projections of viable energy resources.

[116] Draft GEIS at 2-17. (**32-8-1** [Reiser, Caroline])

Comment: It unjustifiably relies on valuing the outdated, irrelevant characteristic of "baseload generation. (**44-13** [Lee, Gary])

Comment: It discounts the value of renewable energy sources, such as solar and wind, by emphasizing the intermittency of their electricity generation, even though they are proving equally predictable and more reliable than fossil fuel and nuclear power plants. (**44-14** [Lee, Gary])

Comment: - It unjustifiably relies on valuing the outdated, irrelevant characteristic of "baseload generation." (**45-16** [Hutar, J Jeremy])

Comment: - It discounts the value of renewable energy sources, such as solar and wind, by emphasizing the intermittency of their electricity generation, even though they are proving equally predictable and more reliable than fossil fuel and nuclear power plants. (**45-17** [Hutar, J Jeremy])

Comment: - Adopting these inaccurate assumptions into a 10-year Generic Environmental Impact Statement fails to meet the requirements of the National Environmental Policy Act. (**45-18** [Hutar, J Jeremy])

Comment: The GEIS's consideration of energy alternatives relies on valuing the outdated, irrelevant characteristic of "baseload generation." (**46-8** [Kirby, Laurence])

Comment: It discounts the value of renewable energy sources, such as solar and wind, by emphasizing the intermittency of their electricity generation, even though they are proving equally predictable and more reliable than fossil fuel and nuclear power plants. (**46-9** [Kirby, Laurence])

Response: *The NRC agrees in part and disagrees in part with these comments. This LR GEIS describes alternative energy sources that the NRC has identified as being potentially capable of meeting the purpose and need of the proposed action (license renewal). Accordingly, the alternative energy sources described and evaluated in the LR GEIS are those that could replace or offset the power generation capability provided by the current fleet of nuclear power plants that could come up for license renewal in the next 10 to 20 years.*

The NRC disagrees that the alternatives discussion in the LR GEIS fails to meet the requirements of the National Environmental Policy Act (NEPA). In accordance with NEPA, the NRC has considered alternatives to renewing nuclear power plant operating licenses. As stated in the introduction to Chapter 2 of this LR GEIS, the NRC does not reach a generic conclusion regarding the impacts of alternatives to license renewal in the LR GEIS and rule and will consider these impacts in nuclear power plant-specific supplements to the LR GEIS.

The NRC also disagrees with the comments regarding NRC's focus on baseload generation and the claim that the NRC is advancing policy prescriptions in its statement of purpose and need for the proposed action. The NRC employs the baseload generation concept to establish a common basis upon which to perform its comparative analysis of alternative energy sources or approaches that may be suitable for replacing or offsetting the baseload generating capacity of a nuclear power plant. This is done to facilitate the analysis of alternative energy technologies rather than discount their effectiveness or suitability for serving as viable sources of replacement power. Additionally, the NRC is not making a policy statement in the purpose and need section. As described in Section 1.3 of this LR GEIS, the licensee, state regulators, system operators, and in some cases, other Federal agencies, decide whether a nuclear power plant should apply to continue operations for additional license terms, and the NRC does not express a policy position about whether any plant should continue to operate for additional license terms. The NRC reviews license renewal applications to determine whether all regulatory requirements for the license renewal have been satisfied and grants or denies the license renewal based solely on those requirements.

The term baseload refers to the minimum amount of electric power delivered or required over a given amount of time at a steady rate. Historically, coal-fired and nuclear power plants served as the primary types of baseload plants that were operated around-the-clock to serve minimum system loads at an essentially constant rate. However, the NRC understands that today's modern electric grid incorporates not only traditional baseload generation sources, but also substantial amounts of generation from non-baseload sources. These non-baseload sources include intermittent generation sources (that are controlled by the natural variability of the energy resource, such as with wind and solar), as well as dispatchable sources (that adjust their output as demand for electricity fluctuates, such as with natural gas peaking units). Therefore, NRC's analysis of replacement energy sources includes both baseload and non-baseload energy sources. To conduct a comparable analysis of the relative potential environmental impacts across energy sources, NRC uses technology-specific capacity factors to appropriately scale non-baseload power technology factors to determine the relative size or number of these plants that would be needed to generate a baseload-equivalent amount of electricity. Such a common basis is needed to support the staff's analysis, specifically the identification of key characteristics and impact parameters associated with each type of replacement power generating technology or offset. This does not unreasonably narrow the alternatives analysis, but rather establishes a common basis that enables quantitative comparison of fundamentally different types of energy generation.

The NRC also disagrees with comments suggesting the NRC is biased against the consideration of renewable energy sources and non-power generating approaches. NRC recognizes the ongoing changes in the nation's energy landscape, including continuing trends in the reduced use of many fossil fuels and the increased deployment of renewables and storage. The NRC has revised the discussion in Appendix D, Section D.3 (formerly Chapter 2, Section 2.3) of this LR GEIS where appropriate to reflect the latest developments in these trends. However, the NRC does not analyze distributed generation (such as rooftop solar installations) as reasonable replacement energy sources because they do not generally meet

the definition of utility-scale generation, i.e., electricity generation from power plants with at least 1 MW (or 1,000 kilowatts) of total electricity generating capacity. The NRC agrees with the comment that the LR GEIS should clarify the viability of non-power generating alternatives and whether rooftop solar is included in its alternative analysis and has revised Appendix D, Sections D.3.3.1 and D.3.4 (formerly Chapter 2, Sections 2.3.3.1 and 2.3.4) of the LR GEIS.

The NRC also agrees that the discussion of alternatives should reflect the best available information and has updated this LR GEIS to incorporate the latest information about alternative energy sources, including the latest information about the commercial viability of small modular reactors presented in Appendix D, Section D.3.2.2 (formerly in Chapter 2, Section 2.3.2.2) of the LR GEIS. However, it is inevitable that rapidly evolving technologies will continue to outpace the information presented. As technologies improve, the NRC expects that some alternative energy sources not currently viable for replacing or offsetting the baseload power generated by a nuclear power plant, with the same or similar capacity factor, may become viable at some time in the future. The NRC will make that determination during plant-specific license renewal environmental reviews, as documented in plant-specific supplements to this LR GEIS.

Comment: 2. Section/Page 2.3.2 2-21, Comment/Recommendation: Sections 2.3.2 and 2.3.2.1 characterize the AP1000 design as an "Advanced Light Water Reactor." Given this terminology is used within other discussion on future GEIS activities associated with advanced nuclear reactors, to avoid confusion as to which GEIS any AP1000 or other large light water reactors should be addressed in the future, consider recharacterizing the ALWR as a "Large Light Water Reactor." The next update to NUREG-1437 should include the necessary operating experience and data to include Vogtle Units 3 & 4 for coverage in potential future initial and subsequent license renewal activities. (**19-2-7** [Uhle, Jennifer])

Response: *The NRC agrees with the comment recommending that the AP1000 reactor design discussed in Appendix D, Sections D.3.2 and D.3.2.1 (formerly Chapter 2, Sections 2.3.2 and 2.3.2.1) of the LR GEIS be recharacterized as a "Large Light Water Reactor." Historically, the AP1000 design had been characterized as an "Advanced Light Water Reactor" or ALWR. However, given the variety of new reactor designs that have since come under NRC's review, the NRC now characterizes new reactor designs as falling into one of three groups: Advanced Reactors (non-LWR designs), Small Modular Reactors (LWR designs), and Large Light Water Reactors (which generate at least 700 MWe using ordinary water as coolant). There are currently six certified large light water reactor designs, including the AP1000 design licensed for Vogtle Units 3 and 4. The NRC has revised Sections D.3.2, D.3.2.1, and D.3.2.2 in this LR GEIS to reflect this updated nomenclature.*

A.2.21 Alternatives: No Action Alternative

Comment: b. No Action Alternative

We agree with the Draft GEIS that "[t]he no action alternative represents a decision by the NRC not to renew the operating license of a nuclear power plant beyond the current operating license term."[117] However, the Draft GEIS fails to "discuss ... in detail"[118] this alternative. "The rule of reason guides both the [agency's] choice of alternatives as well as the extent to which the EIS needs to discuss each alternative."[119] Stating what the no action alternative is but failing to analyze the environmental impacts of that alternative does not meet the rule of reason.

[117] Draft GEIS at 2-16.
[118] 40 C.F.R. § 1502.14(b).
[119] City of Los Angeles, California v. Fed. Aviation Admin., 63 F.4th 835, 843 (9th Cir. 2023).

In discussing the environmental consequences of the proposed action and alternatives, the Draft GEIS leaves out the no action alternative. In each section on "Environmental Consequences of Alternatives to the Proposed Action," the Draft GEIS only analyzes the environmental effects of building a replacement power resource, detailing the construction and operation of a replacement power, fossil energy, new nuclear, and renewable energy alternatives. This is important analysis to include, but it does not allow decisionmakers or the public to evaluate the "comparative merit" of operating or not operating a nuclear power plant an additional 20 years in the specific location, as is required by NEPA.[120] There is no discussion of environmental benefits to shutting down the reactors early.

[120] See 40 C.F.R. § 1502.14.

The extent that the Draft GEIS considers the no action alternative is to conclude that it "may lead to a variety of potential outcomes, but these would be essentially the same regardless of whether operations cease at the expiration of the original operating license or at the expiration of a renewed license."[121] The Draft GEIS provides no basis for this conclusion, and it is an erroneous conclusion.

[121] Draft GEIS at 2-16 (emphasis added). The Draft GEIS does include a brief mention that the no action alternative would reduce accident risk sooner and reduce the need for nuclear fuel. *See* Draft GEIS at 2-37 - 2-41.

The Draft GEIS itself suggests how environmental consequences of ending operating 20-years earlier would have different environmental consequences. For example, in discussing aesthetic impacts the Draft GEIS admits that "a case study found a limited number of situations where nuclear power plants have had a negative effect on the public."[122] The Draft GEIS does not, however, take the next requisite step and explain that choosing the no action alternative could mitigate this negative effect 20 years earlier. The Draft GEIS instead erroneously concludes that "it is believed that these negative perceptions would persist regardless of any mitigation."[123] The Draft GEIS gives no basis for why the no action alternative--ending operating of the nuclear power plant 20 years early--would not mitigate the negative effect on the public.[124]

[122] Draft GEIS at 4-8.

[123] Draft GEIS at 4-8.

[124] For additional examples, we incorporate by reference Comments Submitted by the Office of the Attorney General of the State of New York (Jan. 12, 2010). These comments are written in response to the draft for the 2013 GEIS, NRC Docket ID NRC-2008-0608. However, as the NRC admits, most of the substance of the Draft GEIS is not different than the 2013 GEIS. Therefore, these comments remain relevant.

Further, Turkey Point Nuclear Power Plant is an excellent example of how the outcomes of ceasing operations of a plant at the expiration of the renewed license rather than at the expiration of the subsequent renewed license would not "be essentially the same." The Turkey Point plant uses a cooling canal system that is exacerbating a hypersaline plume. Ceasing operation of the plant 20 years early would eliminate the pressure pushing saline water into the Everglades, Biscayne National Park, and the local water supply, and it would increase the likelihood of success of retracting the contaminant plume.[125] On the other hand, operating the cooling canal system an additional 20 years could irrevocably foul the freshwater resource critical to the Everglades Restoration Plan and the drinking water supplies of numerous South Florida communities.

[125] See Miami Waterkeeper, Subject: Proposed Rule amending environmental protection regulations pursuant to Revision 2 to NUREG-1437 "Generic Environmental Impact Statement for License Renewal of Nuclear Plants (LR GEIS) (May 2, 2023).

The NRC must discuss in detail the environmental consequences of the no action alternative for nuclear power plant sites themselves. (**32-8-2** [Reiser, Caroline])

Response: *The NRC disagrees with the comment. The generic direct impacts resulting from no action and the termination of reactor operations are introduced in Section 4.1 of the LR GEIS and addressed in further detail for each resource area in Section 4.14.2. The indirect impacts of no action (i.e., constructing and operating fossil, new nuclear, and renewable energy alternatives) are addressed in Appendix D of this revised LR GEIS and organized by resource area.*

Plant-specific impacts from no action will continue to be addressed in plant-specific supplements to the LR GEIS documenting the environmental review of each initial LR and SLR application. As stated in Section 1.4, Alternatives to the Proposed Action, of this LR GEIS:

> *In plant-specific license renewal environmental reviews, the NRC considers the environmental consequences of the proposed action, the no action alternative (i.e., not renewing the operating license), and the environmental consequences of various alternatives for replacing or offsetting the nuclear power plant's generating capacity. No definitive conclusions are made in the LR GEIS about the relative environmental consequences of license renewal, the no action alternative, and the construction and operation of alternative facilities for generating electric energy. However, information presented in the LR GEIS can be used by the NRC and applicants in performing the plant-specific analysis of alternatives.*

Thus, the environmental impacts of the no action alternative, including any potential environmental benefits of shutting down reactors early, would be evaluated in future plant-specific supplements that tier from this LR GEIS.

The NRC also disagrees with the comment questioning the NRC's assumption that outcomes from no action would be essentially the same regardless of whether operations cease at the expiration of the original operating license or at the expiration of a renewed license. The NRC acknowledges the example cited in the comment that impacts from operating the cooling canal system (CCS) at Turkey Point provide an example of where this would not occur.

The no action alternative represents a decision by the NRC to not issue renewed operating licenses to a nuclear power plant beyond the current operating license term. The LR GEIS describes the environmental impacts that arise directly from permanent plant shutdown. The NRC expects shutdown impacts to be relatively similar whether they occur at the end of the current license term or at the end of an initial or subsequent renewal term. After permanent shutdown, plant operators will initiate decommissioning in accordance with 10 CFR 50.82, "Termination of license." The NRC staff describes the environmental impacts of decommissioning a nuclear power plant and related activities in the Decommissioning GEIS (NUREG-0586; NRC 2002d). The analysis in the Decommissioning GEIS is intended to bound the environmental impacts of decommissioning subsequent to the termination of reactor operations.

In connection with the SLR environmental review for Turkey Point Nuclear Generating Units 3 and 4 and documented in NUREG-1437, Supplement 5, Second Renewal (NRC 2019a), the NRC staff determined that the impacts on groundwater quality for the proposed action would be SMALL. The NRC staff's impact conclusion was based on consideration of the existing groundwater resource conditions, the current efforts to mitigate the effects of the CCS, and the existing regulatory oversight by State and County agencies. The NRC staff's impacts projection during the SLR term was based on the continuance of the licensee's ongoing mitigative actions (freshening and plume recovery) and continued oversight by State and County regulatory agencies (with the authority to impose alternate methodologies, if necessary), to reduce the effects of past and ongoing operations on groundwater quality. The NRC staff determined that, while there was substantial uncertainty in timing and the ultimate effectiveness of the mitigative actions, the mitigation is subject to regulatory oversight by State and County agencies and is continually evaluated through a comprehensive water quality monitoring program. The staff also determined that the CCS would continue to be used and that enforceable mitigative actions would continue to apply regardless of whether Turkey Point Units 3 and 4 would continue to operate. No changes were made in the LR GEIS, proposed rule, or guidance as a result of this comment.

A.2.22 Alternatives: Plant System Design and Mitigation

Comment: d. While NEPA Requires Reasonable Consideration of Potential Mitigation Measures, It Does Not Require the Implementation of Such Measures

Although NEPA includes an implicit duty to discuss mitigation measures, that duty also is subject to NEPA's rule of reason.[87] Thus, mitigation measures only need to be "discussed in sufficient detail to ensure that environmental consequences have been fairly evaluated."[88] In the NRC licensing context, this means an applicant need only provide "'sufficient detail' . . . on mitigation measures to show a fair [applicant] evaluation of mitigation and environmental consequences, and that [it] has not "ignored or minimized pertinent environmental effects.'"[89] There is no requirement "to determine the best mitigation measures for a potential environmental harm."[90]

[87] Pilgrim, CLI-10-22, 72 at 208.
[88] Methow Valley, 490 U.S. at 352; see also id. at 353 ("[I]t would be inconsistent with NEPA's reliance on procedural mechanisms - as opposed to substantive, result-based standards - to demand the presence [in an EIS] of a fully developed plan that will mitigate environmental harm before an agency can act.").
[89] Powertech USA, Inc. (Dewey-Burdock In Situ Uranium Recovery Facility), LBP-15-16, 81 NRC 618, 688 (2015) (quoting Duke Energy Corp. (McGuire Nuclear Station, Units 1 and 2; Catawba Nuclear Station, Units 1 and 2), CLI-03-17, 58 NRC 419, 431-32 (2003)).
[90] Fla. Power & Light Co. (Turkey Point Nuclear Generating Units 3 and 4), CLI-16-18, 84 NRC 167, 173 (2016).

The U.S. Supreme Court has held that NEPA does not require that "a complete mitigation plan be actually formulated and adopted" before the agency makes its decision,[91] or that any identified mitigation measures be implemented.[92] With regard to NRC license renewal, this means that NEPA "neither requires nor authorizes the NRC to order implementation of mitigation measures analyzed in an environmental analysis."[93] Indeed, such measures are likely to fall within the jurisdiction of other federal and state agencies.[94] For example, the revised LR GEIS states that "[t]he NRC will not make a decision or any recommendations on the basis of information presented in this LR GEIS regarding changes to nuclear power plant cooling

systems, other than those involving safety-related issues, to mitigate adverse impacts under the jurisdiction of State or other Federal agencies."[95] Similarly, other federal agencies (e.g., the U.S. Fish and Wildlife Service, National Marine Fisheries Service, and National Oceanic and Atmospheric Administration) with which NRC consults during the NEPA review process have jurisdiction over federally protected species and ecological resources.

[91] Methow Valley, 490 U.S. at 352.

[92] Id. at 353 ("We thus conclude that the Court of Appeals erred first in assuming that NEPA requires that action be taken to mitigate the adverse effects of major federal actions."). See also 40 CFR 1508.1(s) ("While NEPA requires consideration of mitigation, it does not mandate the form or adoption of any mitigation.").

[93] Entergy Nuclear Generation Co. (Pilgrim Nuclear Power Station), CLI-12-10, 75 NRC 479, 485-86 (2012) (citing Methow Valley, 490 U.S. at 353).

[94] Like other types of alternatives analyzed under NEPA, the NRC may discuss in an EIS mitigation alternatives that are outside of the NRC's regulatory jurisdiction. See 10 CFR Part 51, Subpart A, Appendix A, § 5 ("An otherwise reasonable alternative will not be excluded from discussion solely on the ground that it is not within the jurisdiction of the NRC."). However, as Methow Valley and Commission case law make clear, the NRC does not have the authority to require implementation of such mitigation measures. This is also reflected in the current LR GEIS. See, e.g., LR GEIS, Revision 1 (2013), Vol. 2, App. A at A-313 ("The NRC can only require a licensee to mitigate impacts of those actions that are within NRC's jurisdictional authority, i.e., safety-related actions. Other mitigation requirements may be imposed by those Federal and State agencies that have jurisdiction over affected resources.").

[95] Revised LR GEIS, Vol. 1 at 1-9. (**19-1-17** [Uhle, Jennifer])

Response: *The NRC agrees with the comment. The LR GEIS discusses mitigation measures for environmental issues in sufficient detail to ensure that the potential environmental effects of continued nuclear power plant operation and refurbishment have been considered in proportion to the significance of the potential impact. For example, as discussed in Section 1.5.2.3 of the LR GEIS, the definition of a Category 1 issue states that "Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are not likely to be sufficiently beneficial to warrant implementation." Further, the NRC agrees that resource-specific mitigation requirements generally fall within the jurisdiction of the other Federal and State agencies with which the NRC consults during the license renewal environmental review process. No changes were made in the LR GEIS, final rule, or guidance as a result of this comment.*

A.2.23 General Environmental Concerns

Comment: To take a hard look at both LR and SLR, the Draft GEIS must analyze the difference in the cumulation of stress of operating a reactor for the original license (40yrs), for LR (40-60yrs), and for SLR (60-80yrs). At a minimum, the Draft GEIS should include this discussion for Exposure of Terrestrial Organisms to Radionuclides, Impingement Mortality and Entrainment Impacts, Thermal Effluents on Aquatic Organisms, Infrequently Reported Effects of Thermal Effluents,[29] Exposure of Aquatic Organisms to Radionuclides, Socioeconomics, and Radiation Exposures to Plant Workers and the Public.

[29] Alyssa M. Petitdemange, Impacts of the Oyster Creek Nuclear Generating Station on the Zooplankton Community Structure on Community Barnegat Bay, New Jersey (Aug. 2020) https://digitalcommons.montclair.edu/cgi/viewcontent.cgi?article=1624&context=etd; Dan Radel, How Oyster Creek 'super predator' nuke plant changed climate all by itself (Aug. 28, 2019) https://www.app.com/story/news/local/land-environment/2019/08/28/how-oyster-creek-

super-predator-changed- climate-all-itself/2007056001/; Shutdown of Oyster Creek Nuclear Power Plant Has Surprising Stinging Consequence -- Tiny Jellyfish (Oct. 24, 2019) https://www.nbcphiladelphia.com/news/national-international/oyster-creek-nuclear-power-plant-closing-tiny- stinging-jellyfish-thrive/1993643/ (**32-3-4** [Reiser, Caroline])

Response: *The NRC disagrees with the comment. The NRC has and will continue to take the requisite "hard look" at the potential environmental impacts associated with its proposed actions and resulting decisions, whether resulting from the preparation of the LR GEIS, the promulgation of the accompanying rule, or the preparation of a plant-specific supplement to the LR GEIS. The NRC's proposed action of concern under the subject rule and LR GEIS is the renewal of commercial nuclear power plant operating licenses. Therefore, as discussed in Chapter 1 of the LR GEIS, the LR GEIS documents the NRC staff's evaluation of the incremental environmental effects (impacts) of renewing the operating licenses of commercial nuclear power plants for an additional 20 years, either an initial license renewal (initial LR) term or the first subsequent license renewal (SLR) term, plus the number of years remaining on the current license, up to a maximum of 40 years. As stated in Section 1.5.2.2, information, including lessons learned and knowledge gained, from license renewal environmental reviews performed since development of the 2013 LR GEIS was collected and reviewed. The staff specifically considered whether the environmental issues and findings in the 2013 LR GEIS needed to be revised for initial LR and to update those findings to apply to SLR. The LR GEIS provides the technical basis for the environmental findings codified in Table B-1 of Appendix B to Subpart A of 10 CFR Part 51. For a discussion of the potential environmental impacts of the proposed action with respect to the specific issues identified in the comments, refer to the discussion of these subjects in Chapter 4 of the LR GEIS and Table B-1 in the final rule. For Category 2 issues, the NRC staff will perform a detailed analysis in plant-specific supplements to the LR GEIS. For Category 1 issues, the NRC staff may adopt the generic findings from the LR GEIS, subject to the staff's consideration of any new and significant information. No changes were made in the LR GEIS, final rule, or guidance as a result of this comment.*

Comment: The undersigned appreciate the opportunity to comment on the Nuclear Regulatory Commission's plans to update environmental protection regulations concerning subsequent nuclear power plant license renewals. We support the Commission's commitment to update the GEIS, although in our view the staff has positioned too many important, site-specific issues as "Category 1".

This letter, in response to the March 10, 2023 Federal Register notice (Renewing Nuclear Power Plant Licenses-Environmental Review, 88 Fed. Reg. 13,329), identifies existing environmental concerns at the Turkey Point Nuclear Power Plant in Miami-Dade County that should be fully vetted in any subsequent license renewal. Given the increasing gravitas of climate change and sea level rise in our region, we cannot overstate the need for site-specific review of environmental factors that will be increasingly affected in ways not previously contemplated. The NRC should evaluate the following factors on a site-specific basis at Turkey Point:

(11) Altered Salinity Gradients
(14) Discharge of Metals into Cooling System Effluent
(16) Surface Water Use Conflicts (plants with cooling ponds or cooling towers using makeup water from a river)
(22) Groundwater Use Conflicts (plants that withdraw more than 100 gallons per minute)
(25) Groundwater Quality Degradation (plants with cooling ponds)
(26) Radionuclides released to groundwater

(32) Water use conflicts with terrestrial resources (generating plants with cooling ponds or cooling towers)
(41) Effects of non-radiological contaminants on aquatic organisms
(47 and 48) Endangered Species Act: Federally listed species and critical habitats under U.S. Fish and Wildlife and National Marine Fisheries Service jurisdiction
(56) Transportation
(74) Climate Change Impacts on Environmental Resources (**31-1** [Silverstein, Rachel])

Comment: We then discuss how the significant issues of Climate Change and Environmental Justice, which the NRC has correctly categorized as requiring site-specific review, demonstrate the reasons why the NRC cannot wall off from site-specific review most of the environmental impacts. The Biden Administration has directed agencies to take climate change and environmental justice seriously.[4] For the NRC to adhere to the Administration's direction, the agency cannot wall off site-specific considerations as it has done in the Draft GEIS.

[4] See e.g. Executive Order 14008, Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis (Jan. 27, 2021) https://www.whitehouse.gov/briefing-room/presidential- actions/2021/01/27/executive-order-on-tackling-the-climate-crisis-at-home-and-abroad/; White House Environmental Justice Advisory Council, Final Recommendations: Justice40 Climate and Economic Justice Screening Tool & Executive Order 12898 Revisions (May 21, 2021) https://www.epa.gov/sites/default/files/2021-05/documents/whiteh2.pdf. (**32-1-5** [Reiser, Caroline])

Comment: A1. Impact Definitions and Categories

In general, the NRC simplifies and groups environmental impacts into three categories as follows:[3]

- SMALL: Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource. For the purposes of assessing radiological impacts, the Commission has concluded that those impacts that do not exceed permissible levels in the Commission's regulations are considered SMALL.
- 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.

[3] NUREG-1437, Section S.3.

Using these impact classifications, the NRC then determines whether the analysis in the generic license renewal environmental impact statement (GEIS) could be applied to all nuclear power plants (or plants with specified design or site characteristics) by assigning them into Category 1 or Category 2 as follows:

Category 1 issues are those that meet all of the following criteria:
- The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristics;
- A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for offsite radiological impacts of spent nuclear fuel and high-level waste

disposal and offsite radiological impacts--collective impacts from other than the disposal of spent fuel and high-level waste); and
- Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are not likely to be sufficiently beneficial to warrant implementation.
For issues that meet the three Category 1 criteria, no additional plant-specific analysis is required in future site-specific environmental impact statements (SEISs) unless new and significant information is identified.
Category 2 issues are those that do not meet one or more of the criteria of Category 1, and therefore, require additional plant-specific review.

Thus, presuming an issue to be a Category 1 impact does not require any further site-specific analysis and NRC's generic impact analysis for that issue is deemed sufficient. For a licensee, it is obviously advantageous to have an impact be deemed to be Category 1 since no further site-specific analysis is required. My comments address whether this classification is appropriate for impacts to surface water and air quality as suggested in the proposed Revision 2 to NUREG-1437. (**32-10-2** [Reiser, Caroline])

Comment: D. NRC Ignores the Site-Specific Impact Analysis It Itself Has Described

Contrary to its summary and unsupported conclusions that almost all of the surface water and air quality impacts are Category 1, the proposed Revision 2 to NUREG-1437 provides examples of plants where such impacts are unique, mainly because the ambient environments are unique, thus justifying a Category 2 determination. The discussions in Sections 3.1.3 (covering air quality) and 3.5.1 (covering surface water) - specifically in subsections 3.5.1.1 dealing with surface water use and various subsections within 3.5.1.2 dealing with surface water quality such as thermal effluents, other effluents, 3.5.1.3 dealing with hydrologic changes and flooding - all point to the need for site specific as opposed to generic analysis such as Category 1. I will walk through Section 3.1.3[11] as an example.

[11] Proposed Revision 2 to NUREG-1437, p. 3-13 - 3-17.

"[S]everal nuclear plants use hybrid cooling systems that may be used in different configurations at different times of the year (Figure 3.1-4c). For instance, some once-through cooling system plants also operate cooling towers (sometimes referred to as "helper towers") seasonally 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. The Peach Bottom Atomic Power Station (Peach Bottom) (NRC 2003b, NRC 2020g) has helper mechanical draft cooling towers that can process up to 60 percent of the plant's heated effluent, while the remaining effluent is discharged as part of the once-through system. The Monticello Nuclear Generating Plant (Monticello) (NRC 2006c) uses once-through cooling in the winter but has mechanical draft cooling towers for closed-cycle cooling in the summer. The Dresden Nuclear Power Station (Dresden) (NRC 2004c) is similar in that it relies on a cooling pond system in the fall, winter, and spring, but in the summer, the plant operates as a once-through system that uses the cooling pond and helper mechanical draft cooling towers to reduce effluent temperatures before releasing the water to the Kankakee River (see Table 3.1-4). The Browns Ferry Nuclear Plant (Browns Ferry) (NRC 2005b) uses mechanical draft cooling towers in helper mode in accordance with conditions in its National Pollutant Discharge Elimination System (NPDES) permit to limit thermal impacts on Wheeler Reservoir."

Discussing the many different configurations that are possible, Section 3.1.3 notes that while all existing sites with two or three reactor units use the same cooling system for all units, there are exceptions: the Arkansas Nuclear One (Arkansas) plant in Arkansas and Nine Mile Point Nuclear Station (Nine Mile Point) in New York. "[T]hese two sites use once-through cooling for one unit and closed-cycle cooling for the other."

Discussing the diversity of the source of the cooling water, Section 3.1.3 notes that "[T]he Turkey Point Nuclear Plant (Turkey Point) also draws groundwater from the Upper Floridan Aquifer as a supplemental source of makeup water to the cooling canal system (CCS). These withdrawals primarily address salinity levels in the system and are part of a State-mandated mitigation program to restore salinity to a level similar to that of nearby surface waters (i.e., Biscayne Bay) (NRC 2019c)."

The discussions in Section 3.5.1 follow a similar pattern. Collectively, these examples illustrate why the respective impacts should have all been Category 2 as opposed to Category 1 as proposed. (**32-13-6** [Reiser, Caroline])

Comment: Based on the discussions in these comments, it is my opinion that the proposed Revision 2 to NUREG-1437 in support of NRC's license renewal decisions should not classify most of the surface water impacts and the two air quality impacts as Category 1. Rather, all of these should be presumptively Category 2, unless a specific plant or set of plants can demonstrate that a site- specific analysis is not required for that plant's license renewal.

In addition, it is my opinion that NRC's proposed Revision 2 to NUREG-1437 is incomplete is several aspects. First, with regards to air quality, it does not adequately address continued radiological airborne impacts, especially as populations grown and change in the vicinity of the plants in future decades. Second, the proposed Revision does not address climate-related changes to the surrounding environments and how this changes the environmental impacts. It is my opinion that both of these factors require a Category 2 analysis. (**32-16-2** [Reiser, Caroline])

Comment: 5. Impacts on communities and ecosystems must be considered site-specifically. The risks and environmental impacts of nuclear disasters are inherently site-specific. (**44-15** [Lee, Gary])

Comment: 5. Every nuclear power plant site is different. Impacts on communities and ecosystems must be considered site-specifically, except for specific instances where NRC has strong evidence that impacts are truly generic. The risks and environmental impacts of nuclear disasters are inherently site-specific. NRC must evaluate them as such in reviewing applications to operate reactors even 60 years. (**45-19** [Hutar, J Jeremy])

Comment: -Each nuclear power plant has site-specific conditions that affect the nature of a radiological disaster, such as: ASR, Geology and seismicity, Hydrology, Severe weather events and coastal conditions, and D) Security risks and vulnerabilities (**45-20** [Hutar, J Jeremy])

Response: *The NRC agrees in part and disagrees in part with these comments. The NRC recognizes that Federal agencies are required to take a "hard look" at the potential environmental impacts associated with the agency's proposed actions. As noted in the proposed rule, the changes to the LR GEIS as well as to the NRC's regulations in 10 CFR Part 51, including the findings for environmental issues in Table B–1 in Appendix B to Subpart A of 10 CFR Part 51, are designed to maintain the accuracy of the LR GEIS and ensure*

that future environmental reviews meet the "hard look" standard to fully account for the environmental impacts of initial LR and SLR.

The NRC disagrees that the LR GEIS is incomplete, ignores site-specific information, and otherwise improperly designates issues as Category 1 issues. The LR GEIS provides a thorough assessment of the potential environmental impacts (effects) of renewing the operating licenses of commercial nuclear power plants for an additional 20 years beyond the current license term (whether an initial LR or SLR term), plus the number of years remaining on the current license, in accordance with the Council on Environmental Quality's regulations and the NRC's regulations for implementing the National Environmental Policy Act (NEPA) in 10 CFR Part 51. The LR GEIS and the NRC's environmental findings contained in Table B-1 of Appendix B to Subpart A of 10 CFR Part 51 establish a robust and effective environmental evaluation process for license renewal. The LR GEIS is used to avoid duplication, ensure the most effective use of resources, and allow the NRC staff to focus specifically on those issues that are important for a particular nuclear plant (i.e., unique to that plant or exceptional in size and scope for those issues ordinarily assumed to be similar for all plants) in plant-specific supplemental environmental impact statements (SEISs) for an individual license renewal application.

This revision to the LR GEIS was informed by lessons learned and knowledge gained from conducting initial LR and SLR environmental reviews since development of the 2013 LR GEIS, as discussed in Section 4.1.3 of this LR GEIS. This includes information and conditions identified by the NRC staff during the SLR environmental review for Turkey Point Nuclear Generating Units 3 and 4, as documented in NUREG-1437, Supplement 5, Second Renewal (NRC 2019a).

While the NRC recognizes that each nuclear plant is sited in a unique location, the LR GEIS considers the circumstances of every facility for each issue analyzed in the LR GEIS, as further explained in Chapter 1. Specifically, the NRC has stated its methods and criteria for environmental issue identification, categorization, and definitions in Section 1.5 of this LR GEIS as well as in the footnotes to Table B–1 in Appendix B to Subpart A of 10 CFR Part 51, as revised pursuant to this final rule. However, designation of an issue as a Category 1 issue does not mean that potential impacts are not considered. During preparation of plant-specific supplements to the LR GEIS, the NRC staff considers changes in nuclear power plant operating parameters and new and potentially significant information provided by the applicant or identified through public comments, or resulting from the NRC's due diligence in reviewing relevant information. Data are reviewed in part for information that could change the conclusion in the LR GEIS with regard to an issue. Thus, even though an issue is a Category 1 issue, mechanisms are in place to conduct a full plant-specific review if new and significant information warrants such a review.

As detailed in Section 1.7 of this LR GEIS, the NRC's license renewal environmental review process, which is the focus of this LR GEIS and rulemaking, is confined to analyzing the effects (impacts) on the environment of continued operation of nuclear power plants through the period of extended operation (either initial LR or SLR). Contrary to assertions made in some comments, security risks and vulnerability assessments, and nuclear power plant operational safety issues are outside the scope of the NRC's license renewal environmental review. The NRC provides continuous oversight for the safe operation of nuclear power plants through its ongoing reactor oversight process to verify that the nuclear plants are being operated and maintained in accordance with NRC regulations.

The effects of climate change on structures, systems, and components are outside the scope of the NRC staff's license renewal environmental review and this LR GEIS and rulemaking. The NRC's environmental review documents 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 seismic, meteorological, and hydrologic siting criteria, including maximum probable precipitation criteria, as set forth in 10 CFR Part 100, "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 phenomena hazards. The NRC conducts safety reviews prior to allowing licensees to make operational changes due to changing environmental conditions. Additionally, the NRC evaluates nuclear power plant operating conditions and physical infrastructure to ensure 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 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 license renewal environmental review that it conducts in accordance with and the NRC's regulations for implementing NEPA in 10 CFR Part 51. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.

A.2.24 NEPA Process

Comment: So, you know, again, it's hard to understand why the agency is so driven by schedule, when, in fact, it should be more focused on quality. So, again, the fact that schedule is driving this process is contrary to the intent and stated purpose of NEPA, which requires a hard look, not a quick look.

So that, again, I think that you're missing the point and just you're creating more likelihood of delay than actually, you know, coming about and taking the necessary measures to come up with a quality project and quality output. (**4-4-2** [Gunter, Paul])

Response: *The NRC disagrees with the comment. Section 1.6 of this LR GEIS provides a chronology of the events associated with developing this revised LR GEIS and associated rulemaking. In accordance with requirement specified in Appendix B to Subpart A of 10 CFR 51, the NRC began the process to review and update the material in Appendix B, including Table B-1, in April 2020. This was approximately 7 years after the completion of the previous revision cycle in June 2013. Upon completing its preliminary analysis, the NRC published its notice of intent to review and potentially update the LR GEIS on August 4, 2020 (85 FR 47252). This notice contained the staff's preliminary analysis, including for subsequent license renewal (SLR). The notice invited public comments and proposals for specific environmental areas that should be updated. Pursuant to 10 CFR 51.29, the NRC conducted scoping and held a series of public meetings. The scoping period concluded on November 2, 2020. Subsequently, the NRC staff submitted a rulemaking plan to the Commission in July 2021 via SECY-21-0066 (NRC 2021f), followed by a revised rulemaking plan via SECY-22-0024 (NRC 2022d) in March 2022 that requested Commission approval to initiate a rulemaking that aligned with the Commission's Order CLI-22-03 and recent decisions in Orders CLI-22-02 and CLI-22-04*

regarding the National Environmental Policy Act (NEPA) analysis of SLR applications. In April 2022, the Commission issued SRM-SECY-22-0024 (NRC 2022e) approving the staff's recommendation to proceed with the rulemaking. After nearly a year of development and review and after receiving Commission approval, the draft LR GEIS and proposed rule were published on March 3, 2023, for a 60-day public comment period. The 60-day comment period was appropriate for this rulemaking and consistent with NRC regulations (see 10 CFR 51.73).

The NRC's license renewal environmental review process, which this LR GEIS and final rule support, has been effective in ensuring that the NRC takes the necessary "hard look" under NEPA while focusing associated environmental reviews on important site-specific issues and concerns at each nuclear power plant site. The NRC has performed a thorough analysis of the potential impacts of continued nuclear power plant operations and refurbishment during the license renewal term (initial license renewal [initial LR] or SLR) on all potentially affected environmental resources. The NRC's review and update of the LR GEIS in support of the rulemaking were performed in accordance with the Council on Environmental Quality (CEQ) and NRC regulations for implementing NEPA. No changes were made into the LR GEIS, final rule, or guidance as a result of these comments.

Comment: Our group has examined the varying environments in which nuclear power plants are situated with the majority of them being near water. As this is the case, we feel it is arbitrary to have generic EIS systems in place across the country where conditions differ significantly. (**6-1** [Carson, Jonathan] [Francis, Meshelle] [Frankl, Harrison] [McReynolds, Clif] [Rizo, Britsy])

Comment: I have identified 14 different sections that were categorized as Category 1, which I conclude are geographically unique to the Turkey Point FL nuclear generating facilty, and thus should be recategorized as Category 2, site specific. I explain the rationale for each of my determinations below. (**7-1** [Stoddard, Philip])

Comment: In general, I am opposed to all the generic Category 1 classifications proposed in Table B-1 of 10 CFR Part 51.

Instead, I recommend that each nuclear power plant applying for subsequent license renewal conduct a comprehensive design-basis reconstitution, which would proactively identify new and significant information. I recommend that design-basis reconstitutions be performed in accordance with the IAEA-TECDOC-2018 design-basis reconstitution for long-term operation of nuclear power plants. The impacts of climate change should be factored into the design-basis reconstitutions. These reconstitutions would also ensure that Public Law 112-74, Section 402, is appropriately enforced.

It states, in part, the Nuclear Regulatory Commission shall require reactor licensees to reevaluate the seismic tsunami flooding and other external hazards at their sites against current applicable Commission requirements and guidance for such licensees, as expeditiously as possible, and thereafter, when appropriate. Based upon the evaluations conducted pursuant to this section, the Commission shall require licensees to update the design-basis for each reactor, if necessary.

Regardless of subsequent license renewal, this Public Law essentially requires that each nuclear power plant perform a design-basis reconstitution. Notwithstanding, subsequent license renewal seems an appropriate time to ensure compliance with Public Law 112-74. Accordingly, I recommend that the NRC require subsequent license renewal applicants to

comply with this Public Law. I believe these recommendations are necessary to satisfy the hard look standard under the NEPA. (**8-2-3** [Magnuson, Brian])

Comment: Table B-1 evaluates the various categories, and comes up with conclusions of the risk being either small, moderate, or high. Is that correct, so far?

Many of them, not all of them, essentially. And the question I have there is, are those qualitative or quantitative measures? And to me, that's important. Otherwise, you have just a bunch of people kind of throwing darts at the board after analyzing a bunch of information. And I'm not sure that that's how you need to evaluate a 60-or 80-year-old nuclear power plant.
So, in order to make meaningful comments, we would need to know how many of those 80 criteria that you had here are qualitative assessments or quantitative. In other words, can we go to a table or a chart, or a engineering spec, that makes this a moderate, as opposed to a small, hazard?

And I think that's an attitude that has to be taken on a complex machine like this. You can't just throw the darts and have a bunch of folks in a room --but then, ultimately, I guess that is what you will do, but I would like to see more quantitative information, and make that part of the decision process that's made part of the document to comment on.

Along with that, we would really benefit from the thought processes and the methodology used to make those decisions. What was the decision tree that led up to it being small, as opposed to high? That would be meaningful information in order to get meaningful comments from the public.

And I guess, ultimately, what's the point of the exercise? At the end of the day, how many moderate and high evaluations would end up denying a license?

Or does that even exist? Is that the way the decision is made? Again, it's more of a quantitative thing, but I don't see any indication coming out of 80 criteria, that if 67 percent of them were moderate, maybe that plant shouldn't get a license?

There has to be some sort of standardization. There's some sort of -- especially if you're going to use as many generics as are in here.

There has to be some cutoffs. And you have to have some rationale for it, you have to indicate your methodology for it, and you have to be able to point to some hard data to prove it.
(**8-3-2** [Kraft, David])

Comment: So, I plead with you. I ask each of you, individually, and I think you really honestly do, but look for your unconscious biases when you're making state evaluations. And we'd really appreciate that.

And for example, when the company is doing their own evaluations, I was glad that you, Ms. Davis, described that you go back and you check more. Did I understand you correctly? That builds confidence. So, thank you. (**9-6-11** [Gosslee, Susybelle])

Comment: I am, also would like clarity on what is inadequate. It was one of your slides that said that you would change rules. Something about inadequate. I would have to look that up, but I can tell you after. But who defines what is inadequate information to research? Who is going to say, oh, that's nothing. Well, it really could be something. So that's part of that information bias

that I'm talking about. So, look at that word and clarify your slide that says inadequate. And your attitude towards defining what is inadequate. (**9-6-12** [Gosslee, Susybelle])

Comment: As demonstrated below, the Draft GEIS is grossly inadequate to justify a determination of insignificant impact for any one of the reactors that may apply for license renewal or subsequent license renewal (SLR) - let alone a generic determination that applies to all ## operating reactors at ## sites in the U.S. The Draft GEIS abysmally fails to satisfy the requirements of the National Environmental Policy Act ("NEPA") for an independent, up-to-date, and rigorous analysis of the environmental impacts of extending reactor licenses for two or four decades beyond their original license terms. In particular, the NRC has failed to demonstrate that the environmental impacts of accidents at nuclear plants are insignificant or subject to broad generalization in a GEIS. (**24-1-1** [Curran, Diane])

Comment: As discussed in this report, the NRC does not have a reasonable basis for concluding that the environmental impacts of extended operation of nuclear reactors are insignificant because it lacks the "reasonable assurance" of safe extended operation of reactors that is required by the Atomic Energy Act and NRC regulations.

The NRC has made invalid assumptions in the revised GEIS draft that undermine the thorough and valid assessment of potential environmental consequences to include:

a. License renewal will involve nuclear power plants for which the environmental impacts of operation are well understood as a result of lessons learned and knowledge gained from operating experience and completed license renewals;
b. Activities associated with license renewal are expected to be within the range of operating experience; thus, environmental impacts can be reasonably predicted. (**24-2-3** [Curran, Diane])

Comment: The Draft GEIS is inadequate to satisfy NEPA because the NRC has failed to justify treating the environmental impacts of re-licensing nuclear reactors as a generic issue. Nor has the NRC justified its generic finding of no significant impact. (**27-1** [Curran, Diane])

Comment: Rather than produce a Draft GEIS commensurate with the scale of the task, the Draft GEIS submits a quantitatively baseless set of environmental conclusions (that impacts will be SMALL) about an arbitrarily and generically presented set of broad assumptions. Out of the 80 environmental issues identified, the proposed rule and Draft GEIS remove from scrutiny 60 of those from any site specific and subsequent analysis. Most important, this is the first time that the NRC was supposed to have analyzed those 60 issues in the context of a "Subsequent License Renewal," (SLR)--the NRC license approval to operate a nuclear reactor an unprecedented 80 years. These nuclear reactors could now be operating in vastly disparate communities across the country for twice the time originally proposed and these communities deserve to understand, at the most site-specific level, what that extension means. We urge the NRC Commission not to treat this rulemaking and environmental review as a check-the-box activity.[3] Unfortunately, this exercise reeks of paper compliance.

[3] We have urged the NRC not to treat other aspects of regulation as a check-the-box activity, as well. The NRC's job is to be a regulator, not run through the motions. See, NRDC et al., Comments on Systematic Assessment for How the NRC Addresses Environmental Justice in Its Programs, Policies, and Activities, Docket ID NRC-2021-0137 (Oct. 29, 2021).
(**32-1-3** [Reiser, Caroline])

Comment: NEPA requires agencies take a hard look at environmental impacts. "This examination must be taken objectively and in good faith, not as an exercise in form over substance, and not as a subterfuge designed to rationalize a decision already made."[5]

[5] Wyoming v. U.S. Dep't of Agric., 661 F.3d 1209, 1263-64 (10th Cir. 2011).
(**32-2-1** [Reiser, Caroline])

Comment: Here, the NRC has not demonstrated that LR (40-60yrs) and SLR (60-80yrs) are the appropriate circumstances for generic review and has not conducted a thorough and comprehensive analysis.

1. The NRC's original basis for conducting a generic review for LR (40-60yrs) is no longer accurate and must be updated, which the NRC failed to do in this iteration.

The Draft GEIS arbitrarily and capriciously fails to provide a reasoned basis for conducting a generic review for LR or SLR, and therefore the agency must provide a new, accurate basis for conducting a generic analysis of the environmental impacts of LR and SLR.

From the early 1990s, when the NRC first suggested a generic environmental review for license renewal, the NRC reasoned it can conduct a generic review for LR is because:

[1] License renewal will involve nuclear power plants for which the environmental impacts of operation are well understood as a result of lessons learned and knowledge gained from operating experience and completed license renewals.
[2] Activities associated with license renewal are expected to be within this range of operating experience; thus, environmental impacts can be reasonably predicted.
[3] Changes in the environment around nuclear power plants are gradual and predictable.[11]

[11] Draft GEIS at 1-2. See also 88 Fed. Reg. at 13,332; NRC, Environmental Review for Renewal of Nuclear Power Plant Operating Licenses, Final Rule, 61 Fed. Reg. 28,467 (June 5, 1996) ("The Commission's initial decision to undertake a generic assessment of the environmental impacts associated with the renewal of a nuclear power plant operating license was motivated by its beliefs that:..."); NRC, Environmental Review for Renewal of Nuclear Power Plant Operating Licenses, Proposed Rule, 56 Fed. Reg. 47,016 (Sept. 17, 1991) ("To prepare for possible license renewal applications, the Commission considered the merits of relying on the existing framework for environmental review in part 51 rather than revising part 51. In reaching its decision to revise part 51, the Commission considered the following factors:...").

These assumptions are no longer true. (**32-2-3** [Reiser, Caroline])

Comment: 2. The NRC failed to provide a rational basis that the GEIS for LR (40-60 yrs) also applies to SLR (60-80 yrs).

The Draft GEIS arbitrarily and capriciously concludes without a reasoned basis that environmental impacts of operating a nuclear power plant for LR will be the same as operating a nuclear power plant for SLR.[19] The Commission held that the 2013 GEIS did not address SLR and that "*there is no technical basis* in the 1996 GEIS or the 2013 GEIS upon which to conclude that operational years sixty through eighty would have the same environmental impacts as operational years forty through sixty."[20] The Commission's explicit holding means that the NRC staff would have to make a persuasive contrary case to the Commission if it wished to rely upon the LR analysis for SLR. The Draft GEIS provides no such analysis.

[19] See e.g. Draft GEIS at xxxi, 1-2, 1-7 - 1-8.
[20] In the Matter of Fla. Power & Light Co. (Turkey Point Nuclear Generating Units 3 & 4), CLI-22-02, 95 N.R.C. 26 (Feb. 24, 2022). See also Draft GEIS at 1-7 (The Commission "dissapprov[ed] the staff's recommendation [in Staff Requirements Memorandum (SRM)-SECY-21-16 0066, Rulemaking Plan for Renewing Nuclear Power Plant Operating Licenses-Environmental Review (RIN 3150-AK32; NRC-2018-0296)] and direct[ed] the staff to develop a rulemaking plan that aligned with the Commission's adjudicatory orders CLI-22-03, CLI-22-02, and CLI-22-04, which concluded that the 2013 LR GEIS did not apply to SLR applications.").

The 1996 and 2013 GEISs were specific to LR (40-60yrs), as the regulations, GEISs, and Commission indicated. The Atomic Energy Act allowed for SLR, but the 1996 and 2013 GEISs did not even suggest that licensees might be able to use the generic reviews as a reference document for SLR. If this Draft GEIS now is to be an update to those, rather than a new analysis, the NRC must clearly and transparently explain how it reached its conclusions that SLR (60- 80yrs) has new, the same, or different impacts as LR (40-60yrs). As it is, this is exactly "form over substance" to come to a "decision already made."[21]
[21] Supra note 5.

For example, on March 30, 2023, the NRC acknowledged that "only 14 of the 80 environmental issues to be codified in Table B-1 of Appendix B ... reflect a substantially revised analysis."[22] This indicates that the application of this analysis to SLR at most affected 14 environmental issues. Yet in wading through changes, one still does not find a clear or transparent explanation for why the analysis done on environmental impacts of LR apply to SLR.

[22] Letter from Patricia Holahan, SLED Director, to Ms. Caroline Reiser, Esq., RESPONSE TO REQUEST FOR AN EXTENSION OF THE COMMENT PERIOD OF RENEWING NUCLEAR POWER PLANT OPERATING LICENSES--ENVIRONMENTAL REVIEW, DOCKET ID NRC-2018-0296, 88 FED. REG. 13,329 (MARCH 3,2023) (Mar. 30, 2023). We note that the NRC was not explicit to the public in either the Federal Register notice or Draft GEIS one this point, nor did the NRC ever clarify which 14 issues contain substantial revised analysis.
(**32-3-1** [Reiser, Caroline])

Comment: Moreover, multiple times the Draft GEIS explicitly acknowledges that the degree of the potential environmental impact depends on plant- or site-specific elements, but then in a non sequitur concludes that "the impact of [an environmental issue] would be SMALL during the initial LR and SLR terms for all nuclear plants. This is a Category 1 issue." As examples, the Draft GEIS follows this pattern and concludes that impacts would be small for all nuclear plants even while acknowledging site-specific variables for the following issues:

- Geology and Soils. "Depending on the plant location and design, riverbank or coastline protection might need to be upgraded, especially at water intake or discharge structures, if natural flows, such as storm surges, cause an increase in erosion."[42]
- Altered Current Patterns at Intake and Discharge Structures. "The large flow rates associated with cooling system water use have the potential to alter current patterns. The degree of influence depends on the design and location of the intake and discharge structures and the characteristics of the surface water body. The effect on currents near the intake and discharge locations is expected to be variable and localized...."[43]
- Scouring Caused By Discharged Cooling. "The degree of scouring depends on the design of the discharge structure and the character of the sediments...Natural sediment transport

processes could bring fresh sediment into the discharge flow area. These processes include transport due to ocean currents, tides, river meandering, and storm events."[44]

- Discharge of Biocides, Sanitary Wastes, and Minor Chemical Spills. "[T]he the types of chemicals, their amounts or concentrations, and the frequency of their use may vary... NPDES permits normally include special conditions."[45]
- Effects of Dredging on Surface Water Quality. "In areas affected by Industries, dredging can also mobilize heavy metals, polychlorinated biphenyls (PCBs), or other contaminants in the sediment. The frequency of dredging depends on the rate of sedimentation."[46]
- Groundwater Quality Degradation Resulting from Water Withdrawals. "The degree of saltwater intrusion depends on the cumulative pumping rates of wells, their screen depths, and hydrogeologic conditions. Deep, confined aquifers, for example, may be separated from saline aquifers closer to the surface."[47]

[42] Draft GEIS at 4-20 (emphasis added).
[43] Draft GEIS at 4-25 - 4-26 (emphasis added).
[44] Draft GEIS at 4-27.
[45] Draft GEIS at 4-28.
[46] Draft GEIS at 4-32.
[47] Draft GEIS at 4-40.

In sum, the NRC has failed to provide a reasoned basis for its proposed determination that the environmental impacts associated with dozens of issues that it concludes are Category 1 "apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristics."[48] This is arbitrary and capricious agency action, and the NRC must remedy it.

[48] See Exhibit 1, Comments by Dr. Ron Sahu (suggesting that the 1996 GEIS, 2013 GEIS, and Draft GEIS all failed to support conclusions that surface water impacts are Category 1).

The NRC must reassess the issues it has designated as Category 1 (generic) and start from the assumption that an issue must be analyzed site-specifically unless there is a reasoned basis that the issue can be analyzed generically. The NRC must focus its analysis "on whether the environmental impacts themselves differ from facility site to facility site and not on ... the mechanism by which such environmental impacts may come about [or] may have a common descriptive term, such as once-through cooling or impingement."[49]

[49] Comments Submitted by the Office of the Attorney General of the State of New York, NRC Docket ID NRC-2008- 0608, RIN 3150-AI42 (Jan. 12, 2010).

There are clear examples of Category 1 issues that must be Category 2, as Dr. Ranajit (Ron) Sahu details in Exhibit 1. We also incorporate by reference the Nuclear Information and Resource Service's comment that summarizes documented site-specific environmental impacts at multiple nuclear power plants,[50] and Miami Waterkeeper's comment that details the site-specific nature of environmental impacts for the Turkey Point Nuclear Power Plant.[51] Below, we detail a few additional examples of issues the Draft GEIS erroneously designates as Category 1.

[50] Comments by Nuclear Information and Resource Service, EFMR Monitoring Group at Three Mile Island, Et al, on Proposed Rule and Draft Generic Environmental Impact Statement for

Renewing Nuclear Power Plant Licenses (May 2, 2023).
[51] Miami Waterkeeper, Subject: Proposed Rule amending environmental protection regulations pursuant to Revision 2 to NUREG-1437 "Generic Environmental Impact Statement for License Renewal of Nuclear Plants (LR GEIS) (May 2, 2023). (**32-4-1** [Reiser, Caroline])

Comment: 3. The NRC's Process Does Not Allow for New and Significant Information.

The current process for license renewal--the NRC relying on a revision to a revision of a document from 1996 to rigidly limit the review of environmental impacts to what the NRC will concede is new and significant information--hampers the NRC's ability to respond to changing conditions. The fact that the NRC rejected new information as not being significant repeatedly before finally acknowledging the significance of the information here demonstrates that the current process is not working.

The NRC acknowledges for the first time in the Draft GEIS that there is new and significant information for groundwater quality degradation (plants with cooling ponds) that requires the issue to be Category 2. The Draft GEIS points to the site-specific review for subsequent license renewal of Turkey Point as the source of the new and significant information. But the Turkey Point SLR (60-80 yrs) site-specific review adamantly disagreed that there was new and significant information. Rather, it claimed that "the NRC staff did not identify any information that is both new and significant during its review of Florida Power & Light Company's (FPL's) environmental report, the site audits, the scoping period, or its review of public comments on the draft SEIS, that would change the conclusions in the GEIS. Therefore, there are no impacts related to these Category 1 issues beyond those already discussed in the GEIS."[138] The SEIS acknowledged there is new information, but it never conceded that that information is also significant. The Atomic Safety and Licensing Board that considered whether there was new and significant information held that petitioners had failed to prove that the information provided was significant, and the Commission itself never addressed the matter.

[138] 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, at xvii (Oct. 2019).

We appreciate that the NRC has recognized the new and significant information on this issue. However, we point out the lengths needed for the NRC to concede. NRDC, Friends of the Earth, and Miami Waterkeeper brought this information to the NRC in 2018. We challenged it before the Atomic Safety and Licensing Board and the Commission twice.[139] And it is not until now, almost five years later, that the NRC admits that the information we brought before it is significant. The NRC must reassess this process. Although the NRC "may issue a rulemaking to address and evaluate environmental impacts that are 'generic,'" "NEPA requires the [NRC] to undertake careful consideration of environmental consequences."[140] The Turkey Point saga demonstrates that the NRC is failing to undertake careful consideration of the environmental consequences designated to its generic review. [141]

[139] In the Matter of Florida Power & Light Co. (Turkey Point Nuclear Generating Units 3 and 4), LBP-19-3 (Mar. 7, 2019); LBP-19-08 (Oct. 24, 2019); CLI-20-03 (Apr. 23, 2020); CLI-22-02 (Feb. 24, 2022).
[140] Kelley v. Selin, 42 F.3d 1501 (6th Cir. 1995).
[141] We would be grateful if the NRC would provide a direct response to our claim with evidence of when else it has acknowledged that there is new and significant information and granted a waiver to Appendix B. Our own knowledge is limited to this one instance. See In the Matter of

Virginia Elec. & Power Co. (N. Anna Power Station, Units 1 & 2), No. 21-970-01-SLR-01, 2021 WL 8087741, at *8 (N.C.M.E.C.H.L.I.E.N. Mar. 29, 2021); In the Matter of Fla. Power & Light Co. (Turkey Point Nuclear Generating Units 3 & 4), 90 N.R.C. 139, 167 (Oct. 24, 2019); In the Matter of Exelon Generation Co., LLC (Limerick Generating Station, Units 1 & 2), 78 N.R.C. 199, 215 (Oct. 31, 2013); In the Matter of Entergy Nuclear Generation Co. & Entergy Nuclear Operations, Inc. (Pilgrim Nuclear Power Station), No. 06-848-02-LR, 2011 WL 12473893, at *3 (N.C.M.E.C.H.L.I.E.N. Nov. 28, 2011); In the Matter of Pac. Gas & Elec. Co. (Diablo Canyon Nuclear Power Plant, Units 1 & 2), 74 N.R.C. 427, 452 (Oct. 12, 2011); In the Matter of Entergy Nuclear Operations, Inc. (Indian Point Nuclear Generating Units 2 & 3), 68 N.R.C. 655, 657 (Nov. 6, 2008); In the Matter of Entergy Nuclear Vermont Yankee LLC & Entergy Nuclear Operations, Inc. (Vermont Yankee Nuclear Power Station) in the Matter of Entergy Nuclear Generation Co. & Entergy Nuclear Operations, Inc. (Pilgrim Nuclear Power Station), Nuclear Reg. Rep. (CCH) ¶ 31525 (N.R.C. Jan. 22, 2007); In the Matter of Fla. Power & Light Co. (Turkey Point Nuclear Generating Plant, Units 3 & 4), 54 N.R.C. 3 (July 19, 2001). (**32-9-2** [Reiser, Caroline])

Comment: The federal and state governments and the public have been criticizing the NRC on this issue for decades. In comments to the 1996 GEIS, the public and decisionmakers pointed out the site- specific nature of many of the issues, questioned the use of generic review, and questioned how new and significant information could be folded into the GEIS. "A group of commenters, including CEQ and EPA, noted that the rigidity of the proposed rule hampers the NRC's ability to respond to new information or to different environmental issues not listed in the proposed rule." The NRC papered over the concerns then. But the intervening three decades have demonstrated that the rigidity of the rule has indeed hampered the NRC's ability to thoroughly consider the impacts. It is time for the NRC to acknowledge that it cannot analyze 75% of environmental impacts generically. (**32-9-3** [Reiser, Caroline])

Comment: B. Conceptual Shortcomings of NRC's Category 1 Classification
Before I get into specifics, it is important to note that the NRC's Category 1 classification is conceptually flawed. It should be obvious that an environmental impact (for any potential issue) is the result of the interaction of the source of the issue (which is the power plant or some activity at the power plant) and the ambient environment in the vicinity of the power plant. As an example, the source of an impact could be the quality of cooling water needed by the plant or the quantity of diesel particulate matter emitted from the engines at the plant. Crucially, even if these sources of the impacts were the same for two different plants (i.e., the volume of cooling water or the quantity of diesel particulate matter), their environmental impact could be vastly different depending on the surrounding ambient conditions. Thus, the environmental impact of the same quantity of cooling water discharged at the same temperature from two plants would be very different if the discharge were to a receiving river as opposed to a bay, an estuary, or a closed impoundment/lake - because each is located in different geographies. This should be conceptually obvious.

Similarly, the same mass of diesel particulate matter and/or radiological contaminants discharged from a plant would have very different air quality impacts depending on the location of the plant (i.e., the specific airshed, with its own meteorological factors such as prevailing winds), the number of persons living in the vicinity of the plant, their relative locations to the plant and prevailing winds, and other factors. And, as the exposed population near a plant increases over time the effect of the same transmission lines would increase the adverse impacts on that population.

In simple terms, an environmental impact is the combination of the source of the impact (i.e., at the plant) and the ambient environment in the vicinity of the plant. In fact, that is self-evident by the fact that the proposed GEIS, like all environmental impact analyses, first discusses the affected environment, in Section 3, before it discusses the impacts and mitigating actions, in Section 4.

Keeping this in mind, the NRC, as noted above, has determined that in order to be deemed to be a Category 1 issue, three conditions have to be met. (**32-11-1** [Reiser, Caroline])

Comment: The first condition is that the environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristics. This first condition discusses the "environmental impact" but then only focuses on the source of the impact - namely all plants or subsets of plants with similar or specific types of cooling systems or some other plant characteristics. While there is passing mention of "site characteristics" this is supposed to encompass all of the diverse ambient conditions near all plants or subsets of plants. At this level of classification, for example, subsets of plants that all have once-through cooling water systems discharging to a river would be deemed to have similar impacts, just based on the fact that the cooling systems are similar and the receiving water body is also similar (i.e., a river) as opposed to a lake, estuary, etc. Crucially, the diversity of the "site characteristics" - i.e., the multitude of river types and conditions, is not a factor. Yet, as should be obvious, the specific diversity of the site characteristic, i.e., the river in this example, will dictate the magnitude, scale, and severity of the environmental impact. The same quality of thermal energy in the cooling water discharging into a large river with large flows will result in vastly different environmental impacts than that same thermal energy discharging into a smaller river with lesser flows. This first condition, however, does not distinguish between these two vastly different river conditions.

The second requirement for an impact to be deemed Category 1 is that the significance level of the impact, whether SMALL, MODERATE, or LARGE should be the same in all circumstances. The fatal flaw in this condition is that it is purely subjective and where the impact belongs in these three categories is completely arbitrary. In later discussion on surface water impacts which are the focus of these comments in Section C2, I will point out that prior determinations and classifications of impacts into these subjective categories are simply unsupported and conclusionary. Thus, an impact is deemed to the SMALL based on a pronouncement by the NRC that it is SMALL. No analysis is provided in support of this determination and therefore no objective assessment supports this conclusionary "determination."

The final condition that must be satisfied for an impact to be deemed Category 1 is that mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are not likely to be sufficiently beneficial to warrant implementation. Again, I note that as there is no objective or quantitative analysis to begin with, it is meaningless to claim that some type or types of mitigation have been "considered." The NRC would need to explain which mitigation types it had considered and why those mitigation types would not likely be sufficiently beneficial. However, without site-specific analysis, it is impossible to conclude that plant-specific mitigation is not likely to be beneficial - especially when the impacts, as I explained in the previous paragraph, will depend substantially on the highly plant-specific local ambient conditions. In other words, mitigation and its effectiveness can only be "considered" under plant-specific conditions and not in some generic matter. A good example of this is the use of cooling towers, which can reduce the volumes of cooling water needed compared to once-through cooling. In that sense, cooling towers, with their comparatively smaller "make-up" water requirements, can

serve as mitigation for several adverse environmental impacts associated with the use of the vastly greater quantities of once-through cooling water. While this is true in the general sense, the specific level of mitigation afforded by using cooling towers can only be evaluated by properly considering the local ambient conditions at the plant site. Specific mitigations cannot be determined in any sort of generic analysis.

Thus, taken together, deeming an impact to be Category 1 by applying these three conditions - each of which is flawed by not accounting for the site-specific ambient environment at a plant - is meaningless. Unless two plants have identical ambient conditions, their environmental impacts will be different, even if the plants are identical and are operated identically. Since no two plants have identical ambient environments, impacts are not and will not be "similar." Thus, force-fitting the impacts mostly into Category 1 as the proposed Revision 2 to NUREG-1437 does, simply and impermissibly bulldozes any consideration of the highly diverse ambient conditions near each plant - all in the quest for simplifying the impact analysis for licensees as a matter of administrative convenience.

The only proper course of action for the NRC is to recognize that environmental impacts are highly plant and site-specific and therefore all impacts should belong presumptively in Category 2. Only if a plant is able to show that a particular impact is generic and does not depend on site- and ambient conditions, may the NRC allow that impact to be Category 1, thus escaping any site- specific analysis. (**32-11-2** [Reiser, Caroline])

Comment: These inconsistencies, and others identified in my comments, indicate that some scientific integrity has been lost in Draft NUREG-1437 Revision 2 and in referenced research products. The losses of scientific integrity also appear to circumvent Public Law 112-074 and may constitute research misconduct.

Protecting the Integrity of Government Science (January 2022):

The American public has the right to expect from its government accurate information, data, and evidence and scientifically-informed policies, practices, and communications. This requires scientific integrity— based on rigorous scientific research that is free from politically motivated suppression or distortion. Violations of scientific integrity damage trust in both science and government. These lapses are contrary to the core ideals of the U.S. scientific enterprise, including openness, transparency, honesty, equity, and objectivity. They also erode the morale and innovation of Federal scientists and technologists.

Protecting scientific integrity in government is vital to the Nation. The convergence of economic, public health, social justice, biodiversity, and climate crises facing the Nation underscores the need for evidence-based decisions guided by the best available science.1 Scientific integrity aims to make sure that science is conducted, managed, communicated, and used in ways that preserve its accuracy and objectivity and protect it from suppression, manipulation, and inappropriate influence—including political interference. (**33-1-7** [Magnuson, Brian])

Comment: These inconsistencies, and others identified in my comments, indicate that some scientific integrity has been lost in Draft NUREG-1437 Revision 2 and in referenced research products. The losses of scientific integrity also appear to circumvent Public Law 112-074 and may constitute research misconduct.

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Protecting scientific integrity in government is vital to the Nation. The convergence of economic, public health, social justice, biodiversity, and climate crises facing the Nation underscores the need for evidence-based decisions guided by the best available science. 1 Scientific integrity aims to make sure that science is conducted, managed, communicated, and used in ways that preserve its accuracy and objectivity and protect it from suppression, manipulation, and inappropriate influence—including political interference. It is a central issue not only for Federal departments and agencies (referred to collectively as "agencies" in this report) that conduct and fund scientific research, 2 but also for all agencies that communicate or make use of scientific and technical information in decision-making and for members of the American public who are affected by government decisions. (**33-1-14** [Magnuson, Brian])

Comment: The proposed License Renewal GEIS must be substantially revised, and then republished for public review. (**46-4** [Kirby, Laurence])

Response: *The NRC disagrees with these comments and statements. The NRC recognizes that Federal agencies are required to take a "hard look" at the potential environmental impacts associated with the agency's proposed actions. As noted in the rule, the changes to the LR GEIS as well as to the NRC's regulations in 10 CFR Part 51, including the findings for environmental issues in Table B–1 in Appendix B to Subpart A of 10 CFR Part 51, are designed to maintain the accuracy of the LR GEIS and ensure that future environmental reviews meet the "hard look" standard to fully account for the environmental impacts of initial LR and SLR.*

As detailed in Section 1.7 of this LR GEIS, the NRC's license renewal environmental review process, which is the focus of this LR GEIS and rulemaking, is confined to analyzing the effects (impacts) on the environment of continued operation of nuclear power plants through the period of extended operation (either initial LR or SLR); this is the action under consideration. While environmental impacts from nuclear power plant operations are evaluated in the LR GEIS, the LR GEIS is not a safety analysis document. The NRC provides continuous oversight for the safe operation of nuclear power plants through its ongoing reactor oversight process to verify that the nuclear plants are being operated and maintained in accordance with NRC regulations. The NRC will also separately evaluate the safety of any proposed nuclear power plant license renewal (initial LR or SLR) consistent with NRC regulations in 10 CFR Part 54, and will document that evaluation in a safety evaluation report.

This LR GEIS provides a thorough assessment of the potential environmental impacts (effects) of renewing the operating licenses of commercial nuclear power plants for an additional 20 years beyond the current license term (whether an initial LR or SLR term), plus the number of years remaining on the current license, in accordance with CEQ's regulations and the NRC's regulations for implementing NEPA in 10 CFR Part 51. The LR GEIS and the NRC's environmental findings contained in Table B-1 of Appendix B to Subpart A of 10 CFR Part 51 establish a robust and effective environmental evaluation process for license renewal. The LR GEIS is used to avoid duplication, ensure the most effective use of NRC resources, and allow the NRC staff to focus specifically on those issues that are important for a particular

nuclear plant (i.e., unique to that plant or exceptional in size and scope for those issues ordinarily assumed to be similar for all plants) in plant-specific supplemental environmental impact statements (i.e., plant-specific supplements).

The NRC has stated its methods and criteria for environmental issue identification, categorization, and definitions in Section 1.5 of this LR GEIS as well as in the footnotes to Table B-1 in Appendix B to Subpart A of 10 CFR Part 51, as revised pursuant to this final rule. The NRC's three significance levels (i.e., SMALL, MODERATE, and LARGE) were developed in consideration of CEQ's terminology as referenced in Section 1.5.2.3 of this revised LR GEIS. In considering whether the reasonably foreseeable effects (impacts) of the proposed action are significant, the NRC analyzes the potentially affected geographic area and intensity of the effects of the proposed action (license renewal—either initial LR or SLR).

The NRC agrees with the comments that suggest that the NRC needs to consider unique issues and operational impacts at nuclear power plant sites, both as part of this review and update of the LR GEIS and as part of the NRC's plant-specific environmental reviews that provide a major source of information for this LR GEIS revision. The NRC has considered information as documented throughout this LR GEIS when determining whether to modify, add to, group, subdivide, or delete any of the Category 1 or Category 2 issues evaluated in the 2013 LR-GEIS and using the NRC's criteria set forth in Section 1.5.2.3 of this LR GEIS.

During preparation of plant-specific supplements to the LR GEIS, the NRC staff considers changes in nuclear power plant operating parameters and new and potentially significant information provided by the applicant or identified through public comments, or resulting from the NRC's due diligence in reviewing relevant information. Data are reviewed in part for information that could change the conclusion in the LR GEIS with regard to an issue (i.e., information that is new and significant). Thus, even though an issue is a Category 1 issue, mechanisms are in place to conduct a full plant-specific review if new and significant information warrants such a review.

As discussed in Section 1.11 of this LR GEIS, the NRC considered changes to applicable laws and regulations, new data in its possession, collective experience, and lessons learned and knowledge gained from conducting environmental reviews for initial LR and SLR since development of the 2013 LR GEIS to inform this revised LR GEIS and final rule.

In developing this revised LR GEIS and final rule, the NRC considered the best available information as part of its independent review of the potential environmental impacts of nuclear power plant continued operations and refurbishment during the license renewal term. All sources of information consulted or relied upon by the NRC staff are cited in this LR GEIS, with the references listed in either Chapter 5 or at the end of each supporting appendix. Further, in updating the 2013 LR GEIS for this revision, the NRC specifically considered whether SLR presented any unique aspects that would require additional analysis for any issue. The LR GEIS contains the NRC's conclusions with respect to SLR for each issue. Generally, the NRC concluded that because the 2013 LR GEIS analyzed the incremental impacts of 20 additional years of operation and refurbishment, the impacts of operating from year 61 to 80 were similar or identical to those that would arise from operating from year 40 to 60.

In all of its work, the NRC is committed to ensuring the quality of all information that it relies on or disseminates. The NRC's policies and practices are designed to ensure that the agency establishes and maintains an appropriate level of quality commensurate with the nature of the information. Thus, the most influential scientific, financial, and statistical data are subject to the

most rigorous quality standards. Information, including third-party information, that the NRC relies on or disseminates must meet both the NRC Information Quality Standards and Office of Management and Budget Information Quality Guidelines in order to ensure and maximize information quality. These information quality standards also apply to the creation, collection, acquisition, and maintenance of information by the NRC. The NRC refers the reader to its information quality guidelines at 67 FR 61695 and Management Directive 3.1 (NRC 2021g). No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.

Comment: My comments relate to proposed environmental review rule changes in Document ID NRC -2018-0296-0017, Article II, Section D Proposed Actions and Basis for Changes to 10 CFR Part 51, Appendix B to Subpart A of 10 CFR Part

It appears from reviewing the NRC current nuclear power plant license renewal process, that the NRC would use and evaluate the applicants' site-specific environmental report and then proceeds directly to prepare and issue its draft EIS without a public review and comment period for the applicant's site-specific environmental report? If this is the case, I strongly suggest that the provisions under 10CFR 51.53 be changed to allow public review of and comment on the site specific environmental report submitted by the applicant seeking a renewal of a nuclear plant license before the NRC completes and issues its draft for public comment. It is reasonable and prudent for the NRC, when performing its independent review and scrutiny of applicant's site specific environmental report, to also consider the feedback on the accurate and completeness of said document from local agencies and stakeholders who have knowledge of and a vested interested in the area around the nuclear power plant and could be affected by the manner in which the nuclear power plant is operated and maintained. It is not in the NRC's and the public's best interest for the NRC to proceed directly in completing and issuing its draft EIS based solely on statements and information from the applicant on the impact of the continued operation and proposed refurbishments of the plant on the surrounding environment without providing an opportunity for the public, local and state agencies and stakeholders to fact check the content of the applicants' site specific document and offer missing and additional information critical to the accuracy and completeness of the NRC Draft SEIS. (**17-1** [Rippingille, Bonnie])

Response: *The NRC disagrees with this comment. As detailed in Section 1.8 of this LR GEIS, the NRC's license renewal environmental review process requires that an applicant submit an environmental report, in accordance with the requirements of 10 CFR 51.53(c), as part of its license renewal application.*

The applicant's environmental report is intended to assist the NRC in complying with NEPA and the NRC's regulations for implementing NEPA in 10 CFR Part 51. While the NRC staff may make extensive use of the environmental report as a starting point for its review, the NRC license renewal environmental review process ensures that the NRC relies upon the best available information. During the process, the public at large, organizations, and Federal, State, Tribal, and local agencies have the opportunity to provide information that informs the NRC's environmental review. Ultimately, in accordance with 10 CFR 51.70(b), the NRC staff must independently evaluate and be responsible for the reliability of all information used in preparing the plant-specific supplemental environmental impact statement (SEIS) to the LR GEIS.

In summary, after receiving the applicant's environmental report, the NRC staff performs an acceptance review to determine whether the environmental report contains sufficient information for the staff to begin the environmental review. Significant deficiencies may result in the NRC rejecting the environmental report or requiring that the applicant submit supplemental information before the staff's environmental review can proceed.

Once the environmental report and entire license renewal application, including safety analysis documentation, are accepted by the NRC for docketing, the NRC staff initiates its environmental review and prepares the plant-specific SEIS to the LR GEIS. The NRC also publishes a notice of intent to conduct an initial LR or SLR environmental review and to prepare the plant-specific SEIS in the Federal Register in accordance with 10 CFR 51.95(c) and 10 CFR 51.116, and sends copies of the notice to appropriate Federal, State, and local agencies and Indian Tribes; public interest groups; and any other persons that have expressed interest in the environmental review. The notice describes the proposed action, explains the NRC environmental scoping process, provides information about public meeting locations and where copies of the environmental report are available for public examination, and invites members of the public to participate in the scoping process. The NRC also publishes a notice of acceptability and opportunity for hearing in the Federal Register. Requests for hearing and petitions for leave to intervene are part of an adjudicatory process. Safety and environmental contentions raised by intervenors will be considered by an Atomic Safety and Licensing Board that will determine the admissibility of the contentions and set a hearing schedule, if appropriate.

During the environmental review, the NRC staff may conduct a site visit to the nuclear power plant site and issue requests for additional information to the applicant to inform the preparation of the draft plant-specific SEIS. When developing the draft plant-specific SEIS, the NRC staff will evaluate (verify and validate) information provided by the applicant and will seek and collect information from independent sources. A review and comment period for the draft plant-specific SEIS is then required as described in 10 CFR 51.73. When finalizing the plant-specific SEIS, the NRC will consider and respond to all substantive comments submitted on the draft SEIS. No changes were made in the LR GEIS, final rule, or guidance as a result of this comment.

Comment: Finally, if the NRC does not make this change, it must update the stated baseline. The Draft GEIS explains:

For purposes of the evaluation in this LR GEIS revision, the "affected environment" is the environment currently existing around operating commercial nuclear power plants. Current conditions in the affected environment are the result of past construction and operations at the plants. The NRC has considered the effects of these past and ongoing impacts and how they have shaped the environment. ... These existing conditions serve as the baseline for the evaluation and include the effects of past and present actions at the nuclear power plant sites and vicinity. This existing affected environment comprises the environmental baseline against which potential environmental impacts of license renewal are evaluated.[133]

[133] Draft GEIS at xxxvi.

If, however, an applicant's existing license would not expire for ten plus years, then the NRC should be considering the reasonably foreseeable environment at that future time as the baseline. CEQ has said that "[t]he temporal bounds for the analysis are determined by the projected initiation of the action and the expected life of the proposed action and its effects."[134] Without an accurate description of the affected environment, an agency is unable to meaningfully "understand the effects of the alternatives,"[135] which is, of course, the heart of NEPA.[136] When the impacts occur can be as important as where.[137] A description of the affected environment as it exists today is legally insufficient when the environment will undergo reasonably foreseeable and significant changes by the time the project commences 20 years in the future.

[134] Council on Environmental Quality, National Environmental Policy Act Guidance on Consideration of Greenhouse Gas Emissions and Climate Change, 88 Fed. Reg. 1,196, 1,204 (Jan. 9, 2023) (CEQ Interim Guidance) (emphasis added).
[135] 40 C.F.R. § 1502.15.
[136] See e.g., Citizens Against Burlington, Inc. v. Busey, 938 F.2d 190, 194 (D.C. Cir. 1991).
[137] 10 C.F.R. § 51.53(c)(3)(ii) (requiring analyses of "environmental impacts of the proposed action . . . during the renewal term."). (**32-9-1** [Reiser, Caroline])

Response: *The NRC agrees in part and disagrees in part with this comment. The NRC agrees with the comment to the extent that it suggests that the affected environment description for a resource area must reflect that which may be potentially affected by the proposed agency action. The NRC's definition of the affected environment for the purposes of license renewal, which has been revised for clarity in this revised LR GEIS, is stated in Section 3.0 of this revised LR GEIS as follows:*

> *For purposes of the evaluation in this revision of NUREG-1437, Generic Environmental Impact Statement for License Renewal of Nuclear Plants (LR GEIS), the "affected environment" is the environment that currently exists at and around operating U.S. commercial nuclear power plants. Because existing conditions are at least partially the result of past construction and ongoing operations at the nuclear plants as well as reasonably foreseeable environmental trends, the impacts of these past and ongoing activities and how they have shaped the environment are summarized here. Thus, it is this existing environment that composes the environmental baseline against which potential environmental effects (impacts) of license renewal are evaluated.*

While for purposes of the immediate proposed action to promulgate changes and updates to the LR GEIS it is appropriate to define the "affected environment" as stated above, this definition recognizes that the impacts of continued operations at any individual nuclear power plant site are "incremental to these baseline conditions." As a result, as nuclear power plant licensees submit applications for the renewal of their operating licenses (proposed action), the NRC expects the "affected environment" associated with each nuclear power plant site will reflect those "incremental" impacts, including environmental trends. The impacts of continued operations and any refurbishment during the license renewal (initial LR or SLR) term that are presented in Chapter 4.0 of this LR GEIS are incremental to the baseline conditions, which include the effects of past and present actions, as well as any identified trends in resource conditions surrounding the nuclear plant sites.

As detailed in Section 1.11 of this revised LR GEIS, the NRC considered changes to applicable laws and regulations, new data in its possession from scientific literature and nuclear power plant operations, collective experience, and lessons learned and knowledge gained from conducting environmental reviews for initial LR and SLR since development of the 2013 LR GEIS. When developing this revised LR GEIS and final rule, the NRC considered the best available information relevant to its analysis of the potential environmental impacts of nuclear power plant continued operations and refurbishment during the license renewal term (initial LR or SLR). While the projection of environmental impacts associated with the proposed agency action (license renewal) includes a degree of uncertainty that generally increases with time into the future, this uncertainty does not preclude the NRC from developing reasonable impact determinations based on the available information and supporting assumptions. Specifically, and as described in Section 1.1 of this LR GEIS, the results of the NRC's review and update of this LR GEIS continue to demonstrate that (1) the environmental impacts of nuclear power plant

operation are well understood as a result of lessons learned and knowledge gained, (2) activities associated with license renewal are expected to be within this range of environmental operating experience, and (3) changes in the affected environment around nuclear power plants are gradual and predictable.

The Commission also recognized with publication of the 1996 license renewal environmental review rule that the LR GEIS will need to be examined periodically to ensure the conclusions and assumptions remain valid and to incorporate new information. To this end, as specified in Appendix B to Subpart A of 10 CFR Part 51, the NRC intends to review and update, if necessary, the rule including the NRC's environmental findings for license renewal in Table B-1 and the underlying LR GEIS every 10 years. No changes were made in the LR GEIS, final rule, or guidance as a result of this comment.

Comment: Second, in the 1996 GEIS, there is reference to NRC's "consultations" with utilities and regulatory agencies - with no further citations or details. The reference to regulatory agencies is particularly interesting. I note that in September 2008 EPA published a directly relevant document called "§309 Reviewers Guidance for New Nuclear Power Plant Environmental Impact Statements Final."[9] This document predates the 2013 LR GEIS. Yet it is not cited in either the 2013 LR GEIS or the proposed Revision 2 to NUREG-1437. This is a glaring omission to say the least. The very purpose of the EPA document, as the title makes clear, is to provide guidance for addressing construction and operational impacts for nuclear power plants. While the document is for new plants, substantial discussions in the document are relevant for license renewals, which are effectively extensions for existing plants.

[9] https://www.epa.gov/sites/default/files/2014-08/documents/309-reviewers-guidance-for-new-nuclear-power-plant- eiss-pg.pdf (**32-13-3** [Reiser, Caroline])

Response: *The NRC disagrees with this comment. The LR GEIS does not reference or rely upon the 2008 U.S. Environmental Protection Agency (EPA) guidance, "Section 309 Reviewers Guide for New Nuclear Power Plant Environmental Impact Statements--Guidance for EPA Staff" (EPA 2008). This is because it is not relevant to the NRC's license renewal environmental review process, which is the focus of this LR GEIS and rule. The referenced document is guidance for EPA staff when reviewing NEPA documents prepared by the NRC and is, therefore, outside the scope of the LR GEIS and rulemaking. No changes were made in the LR GEIS, final rule, or guidance as a result of this comment.*

A.2.25 License Renewal Process and Rulemaking

Comment: This underlying document could be used for reactor life extensions across the country. (**2-2** [Bilz, Reed])

Comment: Do we expect all Category 2 issues to be addressed by a subsequent environmental assessment or an EIS? Just so I understand the process for addressing those issues. (**3-3-1** [Littleton, Brian])

Comment: Likewise, a decision to continue operating nuclear reactors should be based on complete updated studies that are readily available to the public. (**18-6** [Hadden, Karen])

Comment: The Generic Environmental Impact Statement for License Renewal of Nuclear Plants assesses the effects that an extended license would have on environmental concerns such as endangered species, the effects of cooling water systems on fish and ground water

quality. The NRC also conducts a review of the environmental impacts a particular plant might have on its surrounding area if the license were renewed. (**25-9** [Evgeniadis, Ted])

Comment: The NRC is proposing changes to the licensing renewal process and updates for the management of nuclear energy. The NRC must consider environmental and safety factors when considering an entity for a license. The licensing progress has gained much more focus as nuclear energy becomes a more viable and "green" energy source, especially for the current administration. NEPA requires an environmental impact statement for a nuclear power plant's initial granting of a license and renewals. Several plant-specific issues must be analyzed with a specific plan to combat or mediate; such would be the case for a "severe accident." This proposed rule aims to edit the language of the law dealing with licensing specifics and how strict and specific the regulations and impact statements should be. The agency is tasked with deeming the standards to the level they seem fit and enforcing them so.
(**40-1** [Cassiere, Daniel])

Response: *The NRC acknowledges these comments and questions. The LR GEIS and the NRC's environmental findings contained in Table B-1 of Appendix B to Subpart A of 10 CFR Part 51 establish a robust and effective environmental evaluation process for license renewal. The LR GEIS is used to avoid duplication, ensure the most effective use of resources, and allow the NRC staff to focus specifically on those issues that are important for a particular nuclear plant (i.e., unique to that plant or exceptional in size and scope for those issues ordinarily assumed to be similar for all plants) in plant-specific SEISs to the LR GEIS, which will address Category 1 and Category 2 issues, for an individual license renewal application. The NRC has stated its methods and criteria for environmental issue identification, categorization, and definitions in Section 1.5 of this LR GEIS as well as in the footnotes to Table B-1 in Appendix B to Subpart A of 10 CFR Part 51, as revised pursuant to this final rule.*

As detailed in Section 1.11 of this revised LR GEIS, the NRC considered changes to applicable laws and regulations, new data in its possession from scientific literature and nuclear power plant operations, collective experience, and lessons learned and knowledge gained from conducting environmental reviews for initial license renewal (initial LR) and subsequent license renewal (SLR) since development of the 2013 LR GEIS. The NRC also considered comments received on the draft LR GEIS and proposed rule (see Section 1.10) when finalizing this LR GEIS. As detailed in Section 1.7 of this LR GEIS, the NRC's license renewal environmental review process, which is the focus of this LR GEIS and rulemaking, is confined to analyzing the effects (impacts) on the environment of continued operation of nuclear power plants through the period of extended operation (either initial LR or SLR). No changes were made in the LR GEIS, the final rule, or guidance as a result of these comments.

Comment: I wanted to just elaborate on one of my earlier comments about the existing processes for dealing with things like, for example, hazard increases. I think there's an opportunity for the staff to clearly delineate things like the LIC-208 process for ongoing analysis and natural hazard information; the 50.9 process; other processes that exist to take into account changes in the environment surrounding the plant, and really focus the environmental reviews on what the plant's impact is on the environment. (**4-5-1** [Titus, Brett])

Response: *The NRC acknowledges the comment. As detailed in Section 1.7 of this LR GEIS, the NRC's license renewal environmental review process, which is the focus of this LR GEIS and rulemaking, is confined to analyzing the effects (impacts) on the environment of continued operation of nuclear power plants through the period of extended operation (either initial LR or SLR). Nuclear power plant operational safety issues related to the management of aging*

systems, structures, and components are outside the scope of the NRC's environmental reviews conducted under 10 CFR Part 51 as well as this LR GEIS and rulemaking. Similarly, changes in natural hazards affecting the safe operation of a nuclear power plant are not within the scope of the NRC's license renewal environmental review (except, where appropriate, in the analysis of postulated accidents) or this LR GEIS and rulemaking. Such design issues are considered during plant-specific safety reviews and are addressed on an ongoing basis through the reactor oversight process and other NRC safety programs. If the NRC discovers an unsafe condition, or that a licensee is not complying with its licensing basis, the NRC has the authority to take whatever action is necessary to protect public health and safety. No changes were made in the LR GEIS, final rule, or guidance as a result of this comment.

Comment: I don't have a lot of comments because I have not had an opportunity to review the changes that you are proposing. But from what [you] have provided tonight, I see a lot of good and I see a lot of things that I have to look into lot more because some of the things could be explained a little bit better so that we could understand what the changes are. I'm concerned that it was not as clear about what you were talking about regarding the terms for the GEIS being able to cover one term and a subsequent. Because to me, if you have a GEIS that is to cover all the plants, and you have new plants coming in, then you should always have an updated GEIS for the new plants that would cover the current regulations that are in there because if we have new regulations on what's covered under Endangered Species Act, et cetera, then it would need to be updated to reflect the current laws of the land. (**9-1-1** [Mattern, Janet])

Comment: I would appreciate it if you would summarize what you think the effects are of the rule changes, after you give all the rule changes because for the layperson it's certainly not very clear. (**9-5-1** [Collins, Charlotte])

Response: *The NRC acknowledges these comments. The findings in this LR GEIS are applicable to the 20-year license renewal increment, either an initial LR or the first SLR, per the Commission's direction. Not only will the LR GEIS be updated as needed and as appropriate, but applicants for license renewal are required to identify in their environmental reports any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware in accordance with 10 CFR 51.53(c)(3)(iv). For this review and update of the LR GEIS and associated rulemaking, the NRC considered the need to modify, add to, group, subdivide, or delete any of the environmental issues evaluated in the 2013 LR GEIS. After this review and evaluation, the NRC identified 80 environmental issues (i.e., 59 Category 1, 20 Category 2, and 1 uncategorized issue) that were evaluated in this LR GEIS. As detailed in Section 1.11 of this revised LR GEIS, the NRC considered changes to applicable laws and regulations, new data in its possession from scientific literature and nuclear power plant operations, collective experience, and lessons learned and knowledge gained from conducting environmental reviews for initial LR and SLR since development of the 2013 LR GEIS. Section 1.11 also includes a summary of the Table B-1 changes. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.*

Comment: So, understanding these benefits that nuclear power provides, as well as the public health risks that have been seen with carbon-intensive energy use, we at Generation Atomic, which is a grassroots advocacy organization --we ask that in its new environmental assessment rulemaking, any changes that the NRC considers and adopts be ones that prioritize ways to streamline the relicensing process of existing nuclear plants. The NRC should also consider the impacts of not licensing plants in a timely fashion. Implementing a relicensing process that is

onerous, time-exhaustive, and difficult to navigate will hurt our energy security and ability to meet key environmental objectives. (**10-1-2** [Luse, Jeff])

Comment: Our comments on specific aspects of the proposed rule and draft revised LR GEIS that we believe warrant clarification or modification to ensure consistently timely and efficient environmental reviews are included in Attachment 1. Our comments concern: (1) the scope and applicability of the proposed rule and LR GEIS, (2) the effective and compliance dates for the final rule, (3) issues related to greenhouse gas emissions and climate change analysis, and (4) NRC's reclassification of postulated severe accidents as a Category 1 issue. Also, in Attachment 2, we provide some additional comments on specific portions of the draft documents issued by the NRC staff, including (1) the proposed rule, (2) the revised LR GEIS, (3) draft regulatory guide DG-4027, (4) draft NUREG-1555, Supplement 1, Revision 2, and (5) the draft regulatory analysis. To the extent a comment on a particular document may be applicable to other documents, we respectfully request that the NRC consider the comment across all documentation, as appropriate. (**19-1-3** [Uhle, Jennifer])

Comment: The NRC should apply more leniency toward license renewals and reviews of licensing compliance. The NRC should remain strict enough to ensure the safety and success of the parties who engage with nuclear power, but acting too strictly may prohibit either the continuation or beginning of a party applying to work with or working with nuclear power. (**40-8** [Cassiere, Daniel])

Comment: The NRC, like any agency, deals with licensing requests and compliance strictly and consistently. Numerous court cases have defended the agency and others for showing leniency or for not going through "the full motions" where they see fit. In Vt. Yankee Nuclear Power Corp. v. Nat. Res. Def. Council, Inc. -435 U.S. 519, 98 S. Ct. 1197, Yankee Nuclear Power Corp was sued for failing to comment and acknowledge the Uranium fuel cycle in their environmental impact statement. The court ruled in favor of the corporation, ruling that the Atomic Energy Commission had the right to pick and choose what regulations they saw as big or small enough to cover in an impact statement, as it would be impossible to acknowledge every single potential impact on the environment in a nuclear project or powerplant. The NRC should consider alleviating specific requirements found through the licensing renewal process. NEPA also grants ruled in Balt. Gas & Elec. Co. v. NRDC -462 U.S. 87, 103 S. Ct. 2246. If the NRC decides that certain factors are unnecessary to involve in the impact statement and overall licensing process, the law gives them the discretion to do so. (**40-9** [Cassiere, Daniel])

Comment: The NRC proposes combining and editing issues in Category 1 and Category 2. The NRC should remain lenient with its reviews and renewal of licensing. The sole prevention of a license renewal should be a failure to comply with standards. Parties should be able to change parts, update and advance machinery and do general maintenance without issue or hindrance, except for those that cause a difference in aspects including but not limited to water cooling, aquatic and animal life, and air quality. If a change has no immediate impact or change to the operations or issues acknowledged in the impact statement, there should be no need for agency review. There is already precedent on this topic under the doctrine of Chevron Deference. In Chevron, U.S.A., Inc. V. NRDC, Inc. -467 U.S. 837, 104 S. Ct. 2778, there was a question of to what extent the EPA could define and construct rules around what the agency deemed a "stationary source." The ruling in Chevron set a precedent for agencies having power under their deference from Congress to regulate how they see fit without concern of overruling. This leaves the decision of how much to cover and how to cover up to the experts rather than those in Congress who also have to balance political and personal biases and motivations. (**40-10** [Cassiere, Daniel])

Comment: The NRC should go through with the proposed regulations after finding out previously listed and considered issues to be nonissues or less significant. These include changes to bird collisions with plant structures and transmission lines, cooling tower impacts on terrestrial plants, water use conflicts with terrestrial resources, air quality impacts, and more. Changes supported also include combining specific issues to fall under the same umbrella, specifically relating to during the licensing renewal process. The agency found that instances of cold shocks were rare and have not occurred or been reported since 1996, and neither has resulted in detrimental impacts on aquatic populations. Thermal plumes have been observed, but research and evaluation deemed their impacts minimal to null. The NRC should not include their evaluations to be a necessary part of the licensing process. The LR GEIS also found that heat effluents may contribute to the growth of organisms that present a nuisance to aquatic life or ecosystems but found no other significant impacts. These minimal impacts should not warrant intense reconsideration or prevention of parties obtaining the license to operate nuclear power. (**40-11** [Cassiere, Daniel])

Response: *The NRC agrees in part and disagrees in part with these comments. The NRC agrees that ways to improve the efficiency of the reactor license renewal process should be considered. To that end, the LR GEIS and the NRC's environmental findings contained in Table B-1 of Appendix B to Subpart A of 10 CFR Part 51 establish a robust and effective environmental evaluation process for license renewal. The LR GEIS is used to avoid duplication, ensure the most effective use of resources, and allow the NRC staff to focus specifically on those issues that are important for a particular nuclear plant (i.e., unique to that plant or exceptional in size and scope for those issues ordinarily assumed to be similar for all plants) in plant-specific supplemental environmental impact statements (SEIS) to this LR GEIS for an individual license renewal application.*

The NRC disagrees that license renewal should be a lenient process. The NRC takes its mission of protecting the public health and safety, common defense and security, and the environment very seriously, and as such, the NRC's review of an application for license renewal has four components: a safety review, an environmental review, inspections, and an independent review by the Advisory Committee on Reactor Safeguards. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.

Comment: 1. Section 88FR13329, Page 13351, Comment/Recommendation: NEI supports the change in 10 CFR 51.53paragraph (c)(3) introductory text, removing "an initial" and adding in its place "a" so that this applies not just to initial license renewal. (**19-2-1** [Uhle, Jennifer])

Comment: 1. Section/Page General Comment, Comment/Recommendation: The regulatory analysis cost-benefit could be further strengthened if the NRC would use this opportunity to change the proposed applicability from "INITIAL AND ONE TERM OF SUBSEQUENT LICENSE RENEWAL" to "Initial and Subsequent License Renewals." Each time rulemaking is undertaken, there is a significant expenditure of resources. The NRC could leverage this rulemaking opportunity to eliminate the need for another future rulemaking that will be otherwise required if the proposed changes are finalized. Limiting the rule language to one term of subsequent license renewal is unnecessary since the Atomic Energy Act does not restrict the number of times a license may be renewed. The current requirement in the introductory paragraph of 10 CFR 51 Appendix B to review the material in the appendix on a 10-year cycle and update, if necessary, will ensure that the technical bases of the GEIS remain valid for any additional terms of subsequent license renewal in the future. (**19-2-24** [Uhle, Jennifer])

Comment: The current fleet of nuclear reactors is immensely important in the fight against climate change, reducing impacts to public health from pollution, and minimizing environmental impact from energy generation. As such, the Nuclear Regulatory Commission (NRC) needs to be able to process license renewals efficiently to enable current reactors to operate for as long as safely possible. The LR GEIS showcases the NRC's present difficulties with efficient regulation.

The current rulemaking is happening because the wording of the LR GEIS was found to be ambiguous — was not clear if it should apply to just initial license renewal or also subsequent license renewal (SLR), which resulted in the reversal of several license renewal approvals.[1] As noted by NRC Chairman Hanson, the decision to reverse the approvals is not a technical one, it is a legal, procedural decision that is related to the specific wording of the LR GEIS.[2]

[1] The two plants that had their SLR approvals reversed were Turkey Point and Peach Bottom: see ML22055A496 and ML22055A557 respectively.
[2] See https://www.nrc.gov/docs/ML2205/ML22054A054.pdf

As a result, the Commission directed the current rulemaking to clarify the LR GEIS. This rulemaking is taking significant NRC resources. It is also costing the SLR license holders who had to submit new Environmental Impact Statements for review while this rulemaking is ongoing. This approach does not represent the least impactful option and is not in line with the Reliability principle of good regulation.

The proposed language in the current rulemaking would only allow the LR GEIS to apply to initial license renewal and one term of subsequent license renewal. This ensures that the language of the GEIS will become a problem yet again if a licensee pursues a second term of subsequent license renewal. (**38-1** [LLoveras, Leigh Anne])

Response: *The NRC agrees in part and disagrees in part with these comments. The NRC agrees that the LR GEIS should not be limited to an initial LR. The NRC disagrees that the scope of the LR GEIS and final rule should extend beyond one SLR term at this time. As prescribed by the NRC's regulations in Appendix B to Subpart A of 10 CFR Part 51 and as directed by the Commission in SRM-SECY-21-0036 (NRC 2022f), the NRC will have the opportunity to assess any new information about the potential environmental impacts of continued nuclear power plant operations and any refurbishment during a second subsequent license renewal period during the next 10-year review and update of the analysis in the LR GEIS. This review and update is currently scheduled to begin no earlier than 2031. Thus, per the Commission's direction, the NRC staff has revised the analysis in the LR GEIS, Table B-1 in this final rule, and associated guidance to fully account for one term of SLR. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.*

Comment: B. Applicability of the LR GEIS and Table B-1 for Plants That Were Issued Construction Permits or Operating Licenses as of June 30, 1995

The proposed rule contains an additional revision to 10 CFR 51.53(c)(3). Namely, it would revise the phrase "and holding an operating license, construction permit, or combined license as of June 30, 1995" to read "for a nuclear power plant for which an operating license, construction permit, or combined license was issued as of June 30, 1995."[15] This change seeks to clarify that Watts Bar Nuclear Units 1 and 2 (for which construction permits were issued by that date but are no longer held by the licensee) "are within the scope of the LR GEIS and Table B-1."[16] The

revised phrasing also clarifies that holders of renewed licenses for nuclear power plants that previously held initial operating licenses within the scope of the LR GEIS remain within its scope during the license renewal term.[17]

[15] Proposed Rule, 88 Fed. Reg. at 13,346-47, 13,351.
[16] Id.
[17] Id. at 13,346. This clarification is important because 10 CFR 54.31(c) provides that a renewed license "supersed[es] the operating license or combined license previously in effect."
While NEI supports the proposed change because it addresses certain ambiguities, we suggest removing the reference to June 30, 1995, in 10 CFR 51.53(c)(3) altogether. Like the proposed change to 10 CFR 51.95(c) to remove the date of issuance of NUREG-1437,[18] removing the limitation in the rule to plants for which a construction permit or operating license was issued as of June 30, 1995, would provide clarity and broader future application of the rule.[19] It also would promote efficiency by eliminating the need to revise 10 CFR 51.53(c)(3) each time the NRC updates the LR GEIS.

[18] See Proposed Rule, 88 Fed. Reg. at 13,346-47 ("The proposed rule would revise Section 51.95(c), 'Operating license renewal stage,' to remove the date of issuance of NUREG-1437. This change is made for clarity and to ensure that the regulation refers to the latest revision of the LR GEIS.").
[19] The Staff's proposed revision to 10 CFR 51.53(c)(3), as well as the proposed conforming revisions suggested by NEI above, include a reference to a "combined license" under 10 CFR Part 52. While the NRC first promulgated Part 52 in 1989, it did not issue any combined licenses for proposed new reactors until 2012. For those units that have received combined licenses, only Vogtle Units 3 and 4 have been constructed. Thus, "plants for which a combined license was issued as of June 30, 1995" would appear to be a null set.

Importantly, the scope of the LR GEIS would continue to be limited by the introductory paragraph to Table B-1 in Appendix B of the proposed rule.[20] However, for the same reasons stated above, we suggest that the first sentence of the introductory paragraph to Table B-1 be revised to remove the reference to June 30, 1995. We propose the following alternative language: "The Commission has assessed the environmental impacts associated with granting a renewed operating license for a licensee holding an operating license, construction permit, or combined license based on the data contained in NUREG-1437." This approach is both logical and viable because footnote 1 of Table B-1 identifies the specific revision of NUREG-1437 on which Table B-1 is based.

[20] We do not read the revised LR GEIS to include Vogtle Units 3 and 4 within its scope. During the next periodic review and update of the LR GEIS, the NRC should expand its scope to ensure that Vogtle Units 3 and 4 any other large LWR facilities licensed before that time are covered. While the environmental impacts of Vogtle Unit 3 and Unit 4 operations are expected to be consistent with those of currently operating large LWRs (as confirmed by the NRC's final and supplemental EISs for the Vogtle Units 3 and 4 early site permit and combined license applications, respectively), the new units will have accrued substantial operating experience by the time the NRC staff issues the next GEIS update.

If the NRC does not adopt NEI's suggested approach (i.e., eliminating the current regulations' references to June 30, 1995), then it still should revise the introductory sentence to Table B-1 as follows: "The Commission has assessed the environmental impacts associated with granting a renewed operating license to a licensee for a nuclear power plant for which ~~holding~~ an operating license, construction permit, or combined license was issued as of June 30, 1995." A similar

conforming change also should be made in footnote 1 of the preamble to the proposed rule, which contains similar language (see 88 Fed. Reg. at 13,329-30 n.1). As with 10 CFR 51.53(c)(3), these changes are necessary to make clear that Watts Bar Units 1 and 2 and all nuclear power plants that have received renewed operating licenses are within the scope of the revised LR GEIS. (**19-1-6** [Uhle, Jennifer])

Comment: 2. Section 88FR13329, Page 13351, Comment/Recommendation: NEI suggests additional changes to 10 CFR 51.53(c)(3) and the 10 CFR 51 Appendix B introductory paragraph to remove references to issuance dates for construction permits, operating licenses, or combined licenses in order to create a more inclusive regulatory framework for potential future license renewal actions. The specific change proposed for 51.53(c)(3) is: "for a nuclear power plant for which an operating license, construction permit, or combined license has been issued." The specific change proposed for the Appendix B introductory paragraph is: "The Commission has assessed the environmental impacts associated with granting a renewed operating license for a licensee holding an operating license, construction permit, or combined license based on the data contained in NUREG-1437." (**19-2-2** [Uhle, Jennifer])

Response: *The NRC disagrees with these comments. The NRC is retaining the date as it is applicable to commercial light water reactors within the scope of this LR GEIS and final rule for which an operating license, construction permit, or combined license was issued as of June 30, 1995. The next 10-year review and update of the LR GEIS, which is scheduled to begin in fiscal year 2031, will consider lessons learned, knowledge gained, and experience from license renewal environmental reviews performed since development of this revised LR GEIS; include changes to applicable laws and regulations; and factor in new information (emerging technologies and any operating experience) and new scientific data and methodologies with respect to the assessment of potential environmental impacts of nuclear power plant license renewal. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.*

Comment: 3. NRC must not consider 80-year license extensions so soon.
(**20-10** [Judson, Timothy])

Comment: -Nuclear plant owners are applying for second license extensions more than ten years - and in one case, nearly 20 years - before the current 60-year extended licenses expire. (**20-11** [Judson, Timothy])

Comment: -We cannot consider the environmental impacts of a FURTHER 20 years of operation so far before the ACTUAL impacts of the CURRENT 20 years of extended operation can possibly be known. (**20-12** [Judson, Timothy])

Comment: -This policy sends a dangerous signal to nuclear operators that if they apply for license extensions incredibly early, they do not have to consider certain alternatives or impacts. (**20-13** [Judson, Timothy])

Comment: -NRC must not allow license renewal applications to be submitted more than 10 years before the current licenses expire. (**20-14** [Judson, Timothy])

Comment: Finally, we express our other concerns with the Draft GEIS, namely that the Purpose and Need unreasonably narrows the analysis of alternatives, that the NRC should not allow applications for SLR more than 10 years before a current license expires, and that the NRC missed certain new and significant information. (**32-1-6** [Reiser, Caroline])

Comment: 2. As a policy matter, the NRC should not allow applications for LR to be submitted so far in advance of license expirations.

NRC regulations currently allow LR (40-60yrs) or SLR (60-80yrs) applications to be submitted to the Commission up to 20 years in advance of the expiration of the license currently in effect.[126] While we could not be more supportive of the idea that the regulatory process should not be a truncated rush, designed to jam in decisions (much like this short comment window for which no necessary extensions of time were granted), the NRC should revise this regulation to prohibit SLR applications from being submitted not more than 10 years before the expiration of the license currently in effect. This would provide applicants a reasonable 5-year window in which to file an application, with the timely renewal doctrine maintaining the existing license until the fate of the application is determined, no matter how long that takes.[127]

[126] 10 C.F.R. §54.17(c).
[127] 10 C.F.R. § 2.109.
Applicants have been applying for SLR an average of 13.5 years in advance of LR expirations.[128]
[128]

- Surry, LR expires 3032 and 2033, applied for SLR 2018
- Turkey Point, LR expires 2032 and 2033, applied for SLR 2018
- Peach Bottom, LR expires 2033 and 2034, applied for SLR 2018
- North Anna, LR expires 2038 and 2040, applied for SLR 2020
- Point Beach, LR expires 2030 and 2032, applied for SLR 2020
- Oconee Units, LR expires 2033 and 2034, applied for SLR 2021
- St. Lucie, LR expires 2036 and 2043, applied for SLR 2021
- Monticello, LR expires 2030, applied for SLR 2023
- Browns Ferry, LR expires 2033, 2034, and 2036, will apply for SLR 2023
- Virgil Summer, LR expires 2042, will apply for SLR 2023
- Dresden, LR expires 2029 and 2031, will apply for SLR 2024
- Edwin Hatch, LR expires 2034 and 2038, will apply for SLR 2025

[See ML23123A412 for graph showing quantity of reactors vs the number of years submitted application before current license expires]

The NRC chose to limit applications to being submitted no more than 20 years in advance "to ensure that substantial operating experience is accumulated by a licensee before it submits a renewal application."[129] The NRC rightly was concerned about having sufficient information to understand age-related degradation and plant-specific concerns. The same reasoning should hold true for understanding the degradation and concerns that occur during LR (40-60 yrs). The NRC acknowledged that certain aspects of a plant are designed with 40 years in mind. It would therefore be reasonable for the NRC to require a nuclear power plant operate some of its LR before applying for SLR (60-80 yrs) to ensure sufficient information is gained to understand how a reactor operates past the original license term.[130]

[129] NRC, Nuclear Power Plant License Renewal, Final Rule, 56 Fed. Reg. 64,943 (Dec. 13, 1991).
[130] For example, at this time, Seabrook Station is the only nuclear power plant that is experiencing micro-cracking in concrete, https://www.nrc.gov/reactors/operating/ops-experience/concrete-degradation.html#develop. It would be beneficial to wait and test other reactors for this concerning development.

Additionally, local governments and communities do not have the resources to address projects more than a decade in advance. In preparing these comments, we spoke with state agencies and local community groups who were either unaware of the importance of the Draft GEIS or did not have the resources to comment when license renewal does not appear imminent. By allowing applications so early in advance, the NRC again limits public participation.[131] The NRC is also requiring consideration of environmental impacts of an additional 20 years of operation before the actual impacts of the current 20 years of operation can possibly be known.

[131] NRDC has written about these matters to the NRC for years and nearly a decade ago made the following observation: "The compartmentalized, tightly-choreographed, and exclusionary character of the current licensing process--in which critical safety determinations are made in disparate, narrowly-focused proceedings with multiple trails of cross-referenced documentation, separated in time, space, and never holistically revisited--increases the risk that serious issues will be overlooked, forgotten, or indeed never identified. But unlike the last big nuclear build out, today's accretion of exclusionary rules ensures that few if any public interveners will be positioned within the process to force consideration of important safety issues that, for whatever reason, have slipped through the cracks in the Commission's regulatory scheme." Prepared Statement of Christopher Paine, The Big Moat, How NRC Rules Suppress Meaningful Public Participation In NRC Regulatory Decision-making, 12 (Jan. 31, 2013). This latest draft rulemaking is consistent with that dismal history. As this is a draft, the NRC has a chance to revisit this morbid history and should do so.

Further, by allowing applications to be submitted so far in advance, the NRC sends a dangerous signal to nuclear operators that if those operators can submit their SLR application early, they do not have to consider certain alternatives or impacts. The power market is changing rapidly. The projected viable alternative energy resources, including renewable energies and non-power resources like energy efficiency, continue to blow past projections.[132] Moreover, the climate is rapidly changing. By waiting, the NRC also could have a better understanding of the "new normal" environments and the most up-to-date projections. By waiting, the NRC and public would have a better and more complete list of reasonable alternatives that could help inform any decision.

[132] See, National Renewable Energy Laboratory (NREL), A Decade of Transformation: What We Have Learned Since RE Futures Showed What Was Possible (June 6, 2022) https://www.nrel.gov/news/features/2022/re- futures.html; U.S. Energy Information Administration, New renewable power plants are reducing U.S. electricity generation from natural gas (Jan. 18, 2022) https://www.eia.gov/todayinenergy/detail.php?id=50918; Forbes, Silvio Marcacci, U.S. Electricity Markets Aren't Designed To Handle 100% Clean Energy. Here's How To Fix That (July 1, 2019) https://www.forbes.com/sites/energyinnovation/2019/07/01/u-s-electricity-markets-arent-designed-to- handle-100-clean-energy-heres-two-ways-to-fix-that/?sh=243524966e4b; New York Times, Elena Shao, Renewables Will Overtake Coal by Early 2025, Energy Agency Says (Dec. 6, 2022)

https://www.nytimes.com/2022/12/06/climate/iea-renewable-energy-coal.html; World Resources Institute, Joel Jaeger, Explaining the Exponential Growth of Renewable Energy (Sept. 20, 2021) https://www.wri.org/insights/growth-renewable-energy-sector-explained.
(**32-8-3** [Reiser, Caroline])

Comment: 3. NRC must not consider 80-year license extensions so soon. (**44-9** [Lee, Gary])

Comment: Nuclear plant owners are applying for second license extensions decades before the current 60-year extended licenses expire. (**44-10** [Lee, Gary])

Comment: This policy sends a dangerous signal to nuclear operators that if they apply for license extensions incredibly early, they do not have to consider certain alternatives or impacts. (**44-11** [Lee, Gary])

Comment: 3. NRC must not consider 80-year license extensions. We are dealing with worse public good than DDT or cigarette tobacco. (**45-10** [Hutar, J Jeremy])

Comment: -Nuclear plant owners are applying for second license extensions more than ten years - and in one case, nearly 20 years - before the current 60-year extended licenses expire. The process is flawed. (**45-11** [Hutar, J Jeremy])

Comment: -We cannot consider the environmental impacts of a FURTHER 20 years of operation so far before the ACTUAL impacts of the CURRENT 20 years of extended operation can possibly be known. (**45-12** [Hutar, J Jeremy])

Comment: -This policy sends a signal to owners that if they apply for license extensions incredibly early, they do not have to consider certain alternatives or impacts.
(**45-13** [Hutar, J Jeremy])

Comment: -NRC must not allow renewal applications to be submitted more than 10 years before the current licenses expire. Any extension should be considered on emergency basis only. (**45-14** [Hutar, J Jeremy])

Comment: NRC must not allow license renewal applications to be submitted more than 10 years before the current licenses expire. (**46-7** [Kirby, Laurence])

Comment: A 10-year renewal window will allow assessment of individual plants without locking them in for multidecade timeframes (**46-11** [Kirby, Laurence])

Response: *The NRC disagrees with these comments. With respect to the timing of license renewal applications, Section 54.17(c) of 10 CFR Part 54 allows licensees to submit license renewal applications up to 20 years before the expiration of the licenses currently in effect. The Commission established this earliest date for submission of license renewal applications after soliciting and considering public comments (56 FR 64943). In the 1991 statements of consideration for 10 CFR 54.17(c), the Commission rejected the suggestion that 20 years of operational and regulatory experience with a particular plant was an insufficient period in which to accumulate information on plant performance. Further, the Commission rejected suggestions that a 5-year or even a 15-year time limit for filing renewal applications would be adequate. The Commission stated that, in establishing the earliest date for license renewal applications, it considered the time necessary for utilities to plan for replacement of retired nuclear plants. The Commission found that the lead time for building new electric generation facilities was*

10–14 years depending on the technology. When the license renewal rule was revised in 1995, the Commission again solicited comments on the earliest date for filing license renewal applications. After considering the comments, the Commission concluded that there was no new information warranting a change in the earliest date for license renewal applications, either to make it earlier or later (60 FR 22461).

As a practical matter, the NRC does not agree that an application for license renewal cannot be considered in advance of 10 years prior to expiration of the license, nor does the NRC agree that there needs to be considerable additional operating experience before reasonable generic judgments about the likely environmental impacts of issues can be made. Facilities seeking license renewal have operated for more than 20 years before filing their initial LR applications, and for more than 40 years before filing their SLR applications. Thus, the NRC and other affected stakeholders at all levels have had decades to gain a better understanding of the environmental equilibrium and impacts of plant operations. The NRC has determined that having at least 20 years of operating experience at each power reactor facility is sufficient for the NRC to assess the aging and environmental issues and impacts at the site and make informed generic judgments about the impacts of many environmental issues.

Regarding the purpose and need, the NRC regulates the civilian use of radioactive materials; it does not promote their use. As such, the purpose and need for the proposed action (i.e., license renewal) has been defined in Section 1.3 of this revised LR GEIS as follows:

> *The purpose and need for the proposed action (issuance of a renewed license) is to provide an option that allows for baseload power generation capability beyond the term of the current nuclear power plant operating license to meet future system generating needs. Such needs may be determined by other energy-planning decisionmakers, such as State, utility, and, where authorized, Federal agencies (other than the NRC). Except to the extent that findings in the safety review required by the Atomic Energy Act or the NEPA environmental review that could lead the NRC to reject a license renewal application, the NRC does not have a role in the energy-planning decisions about whether a particular nuclear power plant should continue to operate.*

No changes were made in the LR GEIS, the final rule, or guidance as a result of these comments.

Comment: And then I do have another comment, and that is, with this rule change you did say it would take 24 months to come into play, so it would not impact any of the current license renewals that are in progress, is that correct? The Comanche Peak license renewal, would that be impacted by it? (**9-1-2** [Mattern, Janet])

Comment: II. Effective and Compliance Dates for the Final Rule
Under the current rulemaking schedule, the NRC plans to issue the final rule and revised LR GEIS by April 2024. We anticipate that there will be multiple LR and SLR applications under NRC review at that time, and that additional SLR applications will be filed within six months to one year of that date. Given the long lead time associated with an applicant's preparation and/or updating of a license renewal environmental report (ER), we therefore recommend that the NRC provide both an effective date and a one-year compliance date in the final rule (tied to the date of final rule's publication). This approach is consistent with that followed by the NRC in its 2013 revisions to 10 CFR Part 51.[21]

[21] See Revisions to Environmental Review for Renewal of Nuclear Power Plant Operating Licenses; Final Rule, 78 Fed. Reg. 37,282, 37,293 (June 20, 2013) ("The amendments made by the final rule shall be effective 30 days after the final rule's publication in the Federal Register. License renewal applicants are not required to comply with the amended rule until 1 year after the final rule's publication in the Federal Register. The Commission has decided on a 1-year compliance date given the long lead time required for preparation of license renewal applicant environmental reports."). (**19-1-7** [Uhle, Jennifer])

Comment: 4. Section 88FR13329, Comment/Recommendation: The effective date of the rule should address applicability to SLR applications currently under review at the time the rule is published, as well as applications anticipated to be submitted following the publication of the rule. NEI requests NRC consider an effective date of 30 days from publication of the rule, with a future compliance date of no later than one year from the effective date of the rule. (Reference one year compliance date from 2013 GEIS update rulemaking: https://www.govinfo.gov/content/pkg/FR-2013-06-20/pdf/2013-14310.pdf) (**19-2-4** [Uhle, Jennifer])

Comment: Duke Energy offers an additional comment related to the ongoing NRC staff review of the Subsequent License Renewal Application (SLRA) for the Oconee Nuclear Station (Reference 1). Under the current NRC schedules, the NRC plans to issue the final rule and revised LR GEIS by April 2024 and plans to issue the final Supplemental Environmental Impact Statement (SEIS) for the Oconee SLRA in June 2024. Under this scenario, in which the final rule becomes effective before the final SEIS is issued and before the final decision on the Oconee SLRA is rendered, the rule could be construed as requiring the NRC to perform further environmental reviews to address the new final rule, potentially delaying the proceeding. However, that would be inconsistent with Commission order CLI-22-3, in which the Commission provided applicants the option of proceeding with a site-specific environmental review that is not subject to the new final rule. Accordingly, Duke Energy recommends that the Statement of Consideration for the final rule acknowledge the effect of CLI-22-3 and expressly confirm that the NRC's review of the Oconee SLRA is subject to the provisions of Part 51 in effect as of June 7, 2021, as supplemented by CLI-22-3. (**23-2** [Ray, Thomas])

Response: *The NRC acknowledges the comments and questions. Any application for an initial LR received before the effective date of the final rule will be processed under the current rule and the 2013 LR GEIS. Any application for an SLR received before the effective date of the final rule will be processed in accordance with Commission direction contained in CLI-22-02 (NRC 2022g) and CLI-22-03 (NRC 2022h). However, the NRC will consider any new and significant information relevant to a particular license renewal proceeding during its plant-specific review, regardless of the status of the revised LR GEIS and final rule. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.*

Comment: Therefore, Beyond Nuclear and the Sierra Club demand that the NRC withdraw the Proposed Rule and the Draft GEIS. Because the environmental impacts of extending the operation of nuclear reactors are unique to each reactor site and potentially significant, the NRC must prepare plant-specific environmental impact statements ("EISs") for each license renewal and SLR application at the time of submission. Further, in reviewing site-specific license renewal and SLR applications, the NRC should cease to rely on voluntary and patchwork risk assessments prepared by reactor licensees and establish minimum standards for risk analysis to support environmental reports and NRC reviews, including consideration of all relevant internal and external events. (**24-1-21** [Curran, Diane])

Comment: South Florida is a highly transmissive area due to its unique geology and Turkey Point has a CCS that, at the time of licensing, was an experimental design, it has never been replicated anywhere else in the world. It is not a closed loop system as determined recently by the Department of Environmental Protection in its new operating license. The towns concern is that we protect the investments of resiliency efforts, flood protection efforts and Everglades Restoration activities by ensuring there are no conflicts with our future health and resiliency. We ask that you not use a one size fits all generic EIS process for this unique area and circumstance, but instead consider the uniqueness of this area and ensure you are taking into account all of this site specific information and data that has been collected by various agencies, nonprofits and governments. (**26-7** [Casals, Rafael])

Comment: As we discuss in detail below, the Draft GEIS, if adopted, would violate the National Environmental Policy Act (NEPA) and the Administrative Procedure Act (APA) by failing to provide a current reasoned basis for why a generic review is appropriate for license renewal (LR, or the 40 to 60 year period) and subsequent license renewal (SLR, or the 60 to 80 year period), by failing to explain why the generic analysis of environmental impacts done for LR applies to SLR, and by failing to adhere to its own requirements for determining which environmental issues can be assessed generically. Simply put, the NRC has not built a record in the Draft GEIS upon which it can lawfully base the proposed rule. (**32-1-4** [Reiser, Caroline])

Comment: Under the APA, agency decisions cannot be arbitrary and capricious.[6] "The touchstone of arbitrary and capricious review is reasoned decision-making."[7] The Supreme Court has explained that "the agency must examine the relevant data and articulate a satisfactory explanation for its action including a rational connection between the facts found and the choice made."[8] The Supreme Court expanded that, "[n]ormally, an agency rule would be arbitrary and capricious if the agency has relied on factors which Congress has not intended it to consider, entirely failed to consider an important aspect of the problem, offered an explanation for its decision that runs counter to the evidence before the agency, or is so implausible that it could not be ascribed to a difference in view or the product of agency expertise."[9]

[6] 5 U.S.C. § 706.
[7] Sec'y of Lab., Mine Safety & Health Admin. v. Westfall Aggregate & Materials, Inc., 64 F.4th 315 (D.C. Cir. 2023) (citing Allentown Mack Sales & Serv., Inc. v. NLRB, 522 U.S. 359, 374 (1998)).
[8] Motor Vehicle Mfrs. Ass'n of U.S., Inc. v. State Farm Mut. Auto. Ins. Co., 463 U.S. 29, 43 (1983).
[9] Id.

While "[b]oth the Supreme Court and [D.C. Circuit Court of Appeals] have endorsed the Commission's longstanding practice of considering environmental issues through general rulemaking in appropriate circumstances ... [and the courts saw] no reason that a comprehensive general analysis would be insufficient to examine on-site risks that are essentially common to all plants ... Nonetheless, whether the analysis is generic or site-by-site, it must be thorough and comprehensive."[10] The NRC is allowed to conduct generic reviews, but only where appropriate and only so long as the agency takes a hard look at the consequences.

[10] New York v. Nuclear Regul. Comm'n, 681 F.3d 471, 480-81 (D.C. Cir. 2012) citing Baltimore Gas & Elec. Co. v. Nat. Res. Def. Council, Inc., 462 U.S. 87, 100 (1983).
(**32-2-2** [Reiser, Caroline])

Comment: 3. The NRC arbitrarily and capriciously fails to adhere to its own criteria for determining Category 1 issues.

The Draft GEIS sets out three characteristics that an issue must have to be a Category 1 issue: The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristics;

A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts ...; and Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are not likely to be sufficiently beneficial to warrant implementation.[35]

[35] Draft GEIS at xxxvi.
However, the Draft GEIS arbitrarily and capriciously fails to demonstrate these criteria are met--in particular the first--for most of the impacts the Draft GEIS concludes to be Category 1.[36]
[36] Motor Vehicle Mfrs. Ass'n of U.S., Inc. v. State Farm Mut. Auto. Ins. Co., 463 U.S. 29, 42-43 (1983). F.C.C. v. Nat'l Citizens Comm. for Broad., 436 U.S. 775, 802-03 (1978) (regulations "may be invalidated by a reviewing court under the 'arbitrary or capricious' standard if they are not rational and based on consideration of the relevant factors.").

The first characteristic is required by caselaw. Federal courts have upheld generic review of environmental impacts where those impacts can be shown to not be plant- or site-specific. Thus, a court upheld a generic review for offsite storage of waste because "the rule was predicated upon storage of wastes at *a common* long-term repository."[37] A court also upheld generic review of nuclear waste storage casks because "free-standing casks, being very strong and massive structures, are independent of the effects of site-specific natural phenomena."[38] But a court rejected generic review for severe accidents because "the NRC...pointed out that the occurrence of a severe accident is more likely at some plants than at others" and "the impact of SAMDAs on the environment will differ with the particular plant's design, construction and location."[39]

[37] Limerick Ecology Action, Inc. v. U.S. Nuclear Regul. Comm'n, 869 F.2d 719, 736 (3d Cir. 1989) (citing Baltimore Gas) (emphasis added).
[38] Kelley v. Selin, 42 F.3d 1501, 1513 (6th Cir. 1995) (emphasis added).
[39] Limerick Ecology Action, Inc. v. U.S. Nuclear Regul. Comm'n, 869 F.2d 719, 737-38 (3d Cir. 1989) (emphasis added).

We repeat the concern raised when the NRC was first publishing its 1996 rule "that the category definitions and the impact-significance definitions were ambiguous and appeared somewhat interconnected . . . [such that] [t]he GEIS appears to use Category 1 and 'small' interchangeably."[40] At the time, the NRC revised the definition of Category 1 to the current version above. However, it appears that the NRC never applied the definition it adopted. The Draft GEIS simply does not address the legal requirement to provide a record demonstrating that the characteristics identified as necessary in the NRC's own regulations (environmental impacts same for all plants, same impact level, and no further mitigation) are present.[41]
[40] 61 Fed. Reg at 28,473.
[41] Consider, for example, how for the Category 1 issue of Altered Salinity Gradients, the Draft GEIS discusses the real measured impacts at three separate plants and then concludes the issue is Category 1 without addressing how the environmental impacts are the same for each plant. Draft GEIS at 4-26 - 4-27. (**32-3-7** [Reiser, Caroline])

Comment: In order to comply with NEPA and the APA, the NRC must withdraw the proposed rule and Draft GEIS. The NRC should complete full site-specific environmental reviews upon licensees' submission of application for license renewal. (**32-9-4** [Reiser, Caroline])

Response: *The NRC disagrees with the comments. The LR GEIS and the NRC's environmental findings contained in Table B-1 of Appendix B to Subpart A of 10 CFR Part 51 establish a robust and effective environmental evaluation process for license renewal. The LR GEIS is used to avoid duplication, ensure the most effective use of resources, and allow the NRC staff to focus specifically on those issues that are important for a particular nuclear plant (i.e., unique to that plant or exceptional in size and scope for those issues ordinarily assumed to be similar for all plants) in plant-specific supplements to the LR GEIS for an individual license renewal application.*

Further, the methodology used in the LR GEIS for categorizing issues as generic or plant-specific is an appropriate and effective use of the concept of tiering that was originally promulgated by the Council on Environmental Quality in its 1978 regulations, as revised, that implemented the requirements of the National Environmental Policy Act (NEPA), and the NRC's regulations for implementing NEPA in 10 CFR Part 51.

Nevertheless, this revised LR GEIS takes the necessary "hard look" under NEPA while focusing on important site-specific issues and concerns at each nuclear power plant site. The NRC has performed a thorough analysis of the potential impacts of continued nuclear power plant operations and refurbishment during the license renewal term (initial LR or SLR) on all potentially affected environmental resources. The NRC has stated its methods and criteria for environmental issue identification, categorization, and definitions in Section 1.5 of this LR GEIS as well as in the footnotes to Table B-1 in Appendix B to Subpart A of 10 CFR Part 51, as revised pursuant to this final rule. For each environmental issue, the NRC has determined the significance of the impacts and appropriately and consistently applied the definition for Category 1 and Category 2 issues. Chapter 4 of this LR GEIS provides the technical basis for each Category 1 and Category 2 issue.

As described in Section 1.11 of this LR GEIS, NRC's update of the LR GEIS included a review of changes to applicable laws and regulations, new data in its possession from scientific literature and nuclear power plant operations, collective experience, and lessons learned and knowledge gained from conducting environmental reviews for initial LR and SLR since development of the 2013 LR GEIS regarding the environmental impacts of license renewal. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.

Comment: I am asking the Nuclear Regulatory Commission (NRC) staff to investigate every part of nuclear reactors when evaluating the approval process prior to relicensing extension. Data from the inspections should be included in the site-specific GEIS process and the requirements to do so should be part of the GEIS. The integrity of the NRC, the nuclear industry, and every nuclear reactor operator is being evaluated by the public to see if they meet the mission of the agency or if the NRC is working to fulfill the wishes of the industry and reactor operators. (**21-1** [Gosslee, Susybelle])

Comment: Contrary to what one would expect or hope, the focus of the license renewal process is extremely limited. Only two aspects are examined: environmental effects and physical plant safety. (**25-1** [Evgeniadis, Ted])

Comment: Furthermore, the relicensing process often lacks fully independent safety reviews. Records show that paperwork of the U.S. Nuclear Regulatory Commission sometimes matches word-for-word the language used in a plant operator's application. Also, the relicensing process relies heavily on such paperwork, with very little onsite inspection and verification. Under relicensing rules, tighter standards are not required to compensate for decades of wear and tear. (**25-7** [Evgeniadis, Ted])

Comment: Regulators and industry contend that the 40-year limit was chosen for economic reasons and to satisfy antitrust concerns, not for safety issues. They contend that a nuclear plant has no technical limit on its life. Most of the 20-year extensions have been granted with scant public attention. The NRC has yet to reject a single application to extend an original license. The process has been so routine that many in the industry are already planning for additional license extensions, which could push the plants to operate for 80 years, and then 100.
Review of historical records, along with interviews with engineers who helped develop nuclear power, shows just the opposite: Reactors were made to last only 40 years. Period. The record also shows that a design limitation on operating life was an accepted truism. In 1982, D. Clark Gibbs, chairman of the licensing and safety committee of an early industry group, wrote to the NRC that *most nuclear power plants, including those operating, under construction or planned for the future, are designed for a duty cycle which corresponds to a 40-year life.[3]

[3] https://www.ocregister.com/2011/07/31/feds-have-never-said-no-to-nuclear-plant-relicensing/

The license renewal process must incorporate more stringent certifications, reviews, and studies to determine the functionality of current operations in order to receive another license renewal. Nuclear power stations are not designed to run forever nor are they designed to outlast 40 60-year time horizons. Reviews and studies of plant safety and environmental impacts must be expanded, not contracted. (**25-8** [Evgeniadis, Ted])

Response: *The NRC acknowledges the comments. As detailed in Section 1.7 of this LR GEIS, the NRC's license renewal environmental review process, which is the focus of this LR GEIS and rulemaking, is confined to analyzing the effects (impacts) on the environment of continued operation of nuclear power plants through the period of extended operation (either initial LR or SLR). On a plant-specific basis, the NRC's review of an application for license renewal has four components: a safety review, an environmental review, inspections, and an independent review by the Advisory Committee on Reactor Safeguards. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.*

Comment: Finally, as the Commission is aware, the Commission took action in February 2022 to reduce the expiration dates for Peach Bottom, Units 2 and 3, to 2033 and 2034, respectively, in light of its changed position on the applicability of the GEIS to subsequent license renewal. Given the uncertainty and increased litigative risk created by this decision, Constellation chose not to supplement the environmental report for Peach Bottom. However, some uncertainty remains regarding how the Peach Bottom, Units 2 and 3, subsequent license renewal proceedings will be resolved and how/when their subsequently renewed licenses' expiration dates will be restored after issuance of the final rule and GEIS in 2024. Constellation urges the Commission to carefully consider and communicate to Constellation how remaining issues for Peach Bottom, Units 2 and 3, will be expeditiously resolved upon issuance of the final rule. (**34-3** [Kaegi, Glen])

Response: *The NRC acknowledges the comment. While the NRC recognizes that additional Commission action may be needed to resolve the status of the Peach Bottom Units 2 and 3 renewed operating licenses upon issuance of the final rule, any such action is outside the scope of this LR GEIS and rulemaking. No changes were made in the LR GEIS, final rule, or guidance as a result of this comment.*

Comment: #1 The 20 environmental issues identified as Category 2 are valid and should be evaluated by the Applicant on a site specific basis. However, there should be more issues in this category, as many basic health, safety and environmental issues are being given automated clearance for license renewals. This was a problem for folks working on the Comanche Peak re-licensing application. Many of the issues that the group wanted to raise were unjustifiably "out of scope." (**18-3** [Hadden, Karen])

Comment: 5. Every nuclear power plant site is different. Impacts on communities and ecosystems must be considered site-specifically, except for specific instances where NRC has strong evidence that impacts are truly generic. The risks and environmental impacts of nuclear disasters are inherently site-specific. NRC must evaluate them as such in reviewing applications to operate reactors for 80 years. (**20-19** [Judson, Timothy])

Comment: We respectfully submit that the Proposed Rule and Draft GEIS violate the National Environmental Policy Act because the NRC's designation of "SMALL" to the environmental impacts of universally re-licensing all nuclear reactors in the U.S. is technically indefensible. Therefore, we call upon the NRC to withdraw the Proposed Rule and Draft GEIS and prepare site-specific Environmental Impact Statements that take a hard look at all environmental impacts, at the time that licensees file applications for license renewal. (**29-1** [Judson, Tim])

Comment: The Department of Regulatory and Economic Resources, Division of Environmental Resource Management (DERM) has reviewed the above-referenced draft LR GEIS submitted by the NRC. The NRC is proposing to amend its environmental regulations by updating the Commission's 2013 findings on the environmental effect of renewing the operating license of a nuclear power plant. This proposed rule would further redefine the number and scope of the environmental issues that must be addressed by the NRC and applicants during license renewal environmental reviews.

The Draft LR GEIS report identifies generic environmental issues related to the following as Category 1 issues, thereby not requiring a plant specific review. This raises concerns regarding the Turkey Point Power Plant located in Miami-Dade County because it immediately borders Biscayne National Park, the Florida Keys National Marine Sanctuary, and the Biscayne Bay Aquatic Preserve, respectively, to its east. Pursuant to 62-302.700 Florida Administrative Code, these national and state designations together afford these surface waters the highest level of protection in the state, both as Outstanding National Resource Waters and Outstanding Florida Waters, with Everglades National Park boundaries existing just south of the Sanctuary's. Over 20,000 acres of publicly owned conservation lands, portions of which are managed by Miami-Dade County's Environmental Endangered Lands program, are situated west of the plant within a wetland basin that is largely rain-driven and affected by competing freshwater needs of adjacent users, including Florida Power and Light (FPL). This unique configuration of local, state, and federally protected lands and/or surface waters warrant consideration such that review of ongoing and/or proposed impacts as well as mitigation of adverse impacts resulting from plant operations in the future should sufficiently address protection of these regional and national resources.

Based on the above, Miami-Dade County provides comments on the following environmental issues that are proposed to be categorized as Category 1 issues, thereby not requiring a site-specific review for license renewal. The County recommends that these issues, which address issues unique to Turkey Point Power Plant, be changed to Category 2 issues in order to require a site-specific review. (**30-1** [Spadafina, Lisa])

Comment: The Nuclear Regulatory Commission (NRC) has proposed Revision 2 to NUREG-14372 and has invited public comments on how the agency proposes to address environmental impacts when evaluating either the initial or subsequent license renewals for the nation's nuclear power plants. This environmental evaluation is required as part of NRC's obligation under the National Environmental Policy Act (NEPA). In an effort to streamline its license renewal evaluations, the NRC has proposed to address a significant number of environmental impacts in a generic (Category 1) manner instead of requiring a site-specific (Category 2) evaluation. It is my opinion that the NRC has it backwards and that most of the environmental impacts should undergo presumptively Category 2 evaluations unless the NRC can demonstrate that a Category 1 evaluation for a specific environmental impact is appropriate.

[2] NUREG-1437, Volume 1, Revision 2 Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Main Report Chapters 1-8, Draft Report for Comment.

I focus my comments on two of the many environmental impacts that are caused by nuclear power plants - namely impacts to surface waters and impacts to air quality. I show that - contrary to the NRC's proposal - most of the impacts in these two areas should be evaluated under Category 2 as opposed to Category 1 when the agency evaluates the initial or subsequent renewals of specific nuclear power plants. (**32-10-1** [Reiser, Caroline])

Response: *The NRC disagrees with the comments. The NRC's license renewal environmental review process, which this revised LR GEIS and final rule support, has been effective in ensuring that the NRC takes the necessary "hard look" under NEPA while focusing associated environmental reviews on important site-specific issues and concerns at each nuclear power plant site. The NRC has performed a thorough analysis of the potential impacts of continued nuclear power plant operations and refurbishment on all potentially affected environmental resources. The NRC has stated its methods and criteria for environmental issue identification, categorization, and definitions in Section 1.5 of this LR GEIS as well as in the footnotes to Table B–1 in Appendix B to Subpart A of 10 CFR Part 51, as revised pursuant to this final rule.*

Under the criteria set forth in the LR GEIS, Category 1 (generic) issues are those that meet all of the following criteria: (1) the environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristics; (2) a single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective offsite radiological impacts of spent nuclear fuel and from high-level waste disposal and offsite radiological impacts—collective impacts from other than the disposal of spent fuel and high-level waste); and (3) mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are not likely to be sufficiently beneficial to warrant implementation. An issue is considered Category 2 (plant-specific) if the analysis reported in the LR GEIS has shown that one or more of the criteria of Category 1 cannot be met, and, therefore, a plant-specific review is required.

However, a designation of an issue as a Category 1 issue does not mean that potential impacts are not considered. During preparation of plant-specific supplements to the LR GEIS, the NRC

staff considers changes in nuclear power plant operating parameters and new and potentially significant information provided by the applicant or identified through public comments, or resulting from NRC's due diligence in reviewing relevant information. Data are reviewed in part for information that could change the conclusion in the LR GEIS with regard to an issue. Thus, even though an issue is a Category 1 issue, mechanisms are in place to conduct a full plant-specific review if new and significant information warrants such a review. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.

Comment: Accepting emotional harm as standing to sue is an increasingly popular and acceptable occurrence in cases. This is also the case in environmental law, as seen in Anderson v. WR Grace & Co., 628 F. Supp. 1219 and Juliana v. United States-947 F.3d 1159 9th Cir. In Anderson v Grace, the plaintiff attempted to sue for emotional harm rather than physical injury from pollution experienced by the plaintiff. Although the court declined a new trial to review their claim thoroughly, it was based on a failure to bring a proven report of hydrogeologic contamination. The plaintiff's case fell through, but the court heard and acknowledged the emotional harm from the pollution argument. Something similar occurred in Juliana v United States. Although the plaintiff's case also ended up falling short, numerous courts heard and acknowledged the emotional harm standing concerning the United States's harm to the environment violating their constitutional rights to life, liberty, and pursuit of happiness.

Nuclear Energy mishaps and errors resulting from mismanagement are rare, but they have and can still occur. A party may be entitled to damages from the physical harm of a nuclear waste spill or reactor failure. However, there is also the possibility of a party being entitled to compensation for the emotional distress. Studies have shown increased levels of stress, depression, and anxiety in those who reside in areas next to or within close vicinity of a nuclear power plant. Fear of cancer is a major concern of those who fall within the splash zone of nuclear radiation. Mothers of young children show even greater stress and anxiety over the possibility of a nuclear failure and what it may entail. Although very unlikely to lead to a court-ordered injunction, the fear of cancer and the depreciation in the quality of life that results could fall on the shoulders of the powerplant and provide standing to a potential plaintiff seeking compensatory damages.

The NRC should include nearby residents' emotional and psychological impacts during the licensing and licensing renewal process. Psychological and emotional impacts may soon be grounds for a plaintiff to sue for financial compensation. The NRC should consider the potential psychological and emotional harm during their reviews for licensing and renewals.
(**40-12** [Cassiere, Daniel])

Response: *The NRC disagrees with this comment. As detailed in Section 1.7 of this LR GEIS, the NRC's license renewal environmental review process, which is the focus of this LR GEIS and rulemaking, is confined to analyzing the effects (impacts) on the environment from continued operation of nuclear power plants through the period of extended operation (either initial LR or SLR). Psychological or social stress resulting from risk is outside the scope of the impacts considered by the NRC under NEPA. As a result, the LR GEIS and rulemaking do not include a discussion of any potential psychological stresses caused by the perceived risk of a nuclear failure or accident. Additionally, the United States Supreme Court has explained that NEPA does not require a consideration of adverse psychological consequences from nuclear power licensing (see Metropolitan Edison Co. v. People Against Nuclear Energy, 460 U.S. 766, 775 (1980). No changes were made in the LR GEIS, final rule, or guidance as a result of this comment.*

A.2.26 Public Participation

Comment: First of all, I'd like to say thank you for coming to us. And listening to our comments. And I hope that you hear us. I will be submitting these comments now, but I will also have written comments.

And I know that you are as human as we are, and we are always looking for answers. We're always studying for what is the potential problem and what is the solution. There is an interesting thing about the human brain. And it is information bias. And that is a, it's often a sign that a person is inadvertently or consciously falling victim to it. Unfortunately, it can also be very subtle and difficult to spot. Some of these signs that might help you identify them when you or someone else experience this bias includes only seeking out information that confirms your belief and ignoring or discrediting information that doesn't support it. So, I ask that you clearly look at your own perspective and take our comments seriously. Many of us have lived here since the '40s and we've experienced the climate changes in this area. And we also look at evidence that can sometimes, for instance, for information bias, we look for evidence that confirms what you already think is true rather than considering all the elements, elements available. And we are constantly doing that. This exchange is very important for clarity. We also know that sometimes relying on stereotypes are personal biases when assessing information. So, I hope that you will respect every one of us completely. Sometimes we selectively remember things because our brains can be a little limited. But those items support our views while forgetting or discounting information that doesn't support our views. Having a strong emotional reaction to information, either positive or negative, it confirms my belief, and possibly yours, while remaining relatively unaffected by information that doesn't. So, I wanted to bring that to your attention because we are questioning each other and we are questioning ourselves. We are constantly learning and doing our best. (**9-6-1** [Gosslee, Susybelle])

Comment: I was really amazed at the statement was not completely clear in your announcement for this meeting, which was not well publicized. So please make every effort to put information in all of this. Or at least the major news releases. So, we're concerned because of some of these things like, it seems like it comes about the appearance of withholding access to the information for this meeting. I know that's not your personal intent, but it has the appearance of not being open to public comment and allowing the public to even attend when you don't publicize your meetings broadly, okay? (**9-6-2** [Gosslee, Susybelle])

Comment: If you find that you need more information about our area, we would be happy to give it to you. We don't know what you know, and we don't know what you don't know. But we would like to have a two-way communication. (**9-6-4** [Gosslee, Susybelle])

Comment: But I'll continue on that thought. I was concerned about the way you, the purpose of this meeting was presented. You're thinking is way up here. And most people thinking is really closer to the ground. Your knowledge is cumulative, and you have a great deal of knowledge. But most people don't.

So, when you communicate about your additional meetings in the future, simplify what that message is because I wasn't the only person that misunderstood what the purpose of this meeting is.

We're accustomed to EIS meetings. And as I say that, I know that you know what an EIS meeting is.

But I also know that I'm talking to other people, I always say Nuclear Regulatory Commission. I always say, environmental impact study. Because the public doesn't know what a GEIS is. Or when you refer to it as a guide. That even kind of threw me because when I read it, I read it as GEIS. You see the difference? And your job is to protect public health and the environment. And we're coming from that with that same goal in mind. (**9-6-7** [Gosslee, Susybelle])

Comment: So, when you were talking to the public, be aware that, one, there is a very low level of understanding of nuclear issues, and that there is a desire for the public to understand. In addition to that, companies tend to only present their best foot forward. And we see that often in Texas. Maybe you've not seen that in other places in the country, but it is not at all unusual to hear companies present themselves and leave out a number of facts. Like when they heard the legislative session. Or at a city council meeting. They always say their best. And so, it's what's that hidden piece of information. When you write your reports and when you communicate with the public, please be as clear as possible. And even if you can note we have considered these things and find them to not be of major danger to the public. Does that make sense? (**9-6-9** [Gosslee, Susybelle])

Comment: And this is going to sound a little snarky, but I do not believe I have participated in any NRC event of any kind since COVID that you didn't have technological problems with people [who] are participating. I just wonder how many other people were trying to get on. I know I was cut off on January 10th and wasn't able to participate and get in.
And so, I mean, we're dealing with the most incredibly important, dangerous technology in the world, but we can't even get communications down. A lot of what Ms. Gosling said was, you don't publicize these meetings. People have access trouble, getting access to them. Frankly, you could have had this at the airport and people could have gotten there using public transportation.

I mean, I don't know who does your planning, setting things up, but do register this as a complaint. Consider this snarky comment if you will, but damn it, you guys don't have the technology down to oversee nuclear power plants because you don't have the technology down for basic public participation. (**9-8-1** [Burnham, Lon])

Comment: I have to echo what Lon just said. I mean, I think it's really pitiful and it does not engender confidence when I have to try and try and try to get into a meeting. I was able to get into the last meeting using Microsoft Teams, and this time I was not able to get in at all until I went through a lot of contortions on my end to finally get in this way. And I agree with Lon. If you can't --if you're not using technological wisdom available just generally for people to get into meetings, what are you doing with nuclear energy? Honestly, I think it's a very valid question. You need to, I don't have any confidence in your ability to evaluate the, whether or not a nuclear power plant should be given a permit to continue to operate many, many years past the time it was meant to operate. (**9-9-1** [Halpin, Beki])

Comment: Another comment I would make is that the, I know that other people have said this, but the, all the acronyms and all that you use in your information that you send out are very familiar to you, but they're very unfamiliar to the general public. And yet it's the general public that's at danger here. It is the general public that wants to be able to look at this and give a comment. But it's almost impossible to understand what the meaning of your communication is without hours of dredging the internet to figure out what and the heck everything means.
So, I really think you need to give your information in a way that just "John Doe public" can understand. And, you know, laws have been passed in other areas that say, people have to give contracts and information about banking in ways that people can understand them and give

informed decisions. You need to be giving your information in ways that people can understand them and give informed comments. Your information is merely inscrutable. I'm sure it makes perfect sense to you, but it made garbled sense to me, frankly. (**9-9-2** [Halpin, Beki])

Comment: And I'm very disheartened by the whole, by the whole process. So, I'm asking that you put out your materials in a way now that people can read them and understand them and give informed comments as just a normal citizen.

And so, thanks for helping me get in. appreciate that. But I really would be much more confident in the process if it wasn't so hard to get in. And I would be much more confident if I could really understand more clearly exactly what you're asking for in your proposed amendments. (**9-9-4** [Halpin, Beki])

Comment: 2. NRC process excluded the public and rushed the process. (**20-6** [Judson, Timothy])

Comment: Thank you for considering feedback on the proposed License Renewal GEIS. The NRC should extend the comment deadline, address inadequate and unreasonable guidance, and expand opportunities for public involvement. (**44-1** [Lee, Gary])

Comment: 2. NRC process excluded the public and rushed the process. (**44-6** [Lee, Gary])

Comment: 2. NRC process excluded the public and rushed the process to no public benefit. (**45-6** [Hutar, J Jeremy])

Comment: It needs also to expand opportunities for public involvement -- the current NRC process has excluded the public as if in a rush to extend licenses without due forethought. (**46-2** [Kirby, Laurence])

Response: *The NRC acknowledges the comments and concerns raised by the comments and will continue to look for ways to improve public notifications and opportunities to comment, including the NRC's virtually delivered (webinar) and in-person public meetings. To facilitate public participation for the rulemaking, the NRC conducted six hybrid public meetings, four of which were held near NRC regional offices, and two of which were held near the NRC's headquarters in Rockville, Maryland. The NRC publicized the meetings by issuing press releases, meeting notices, Facebook and Twitter posts and issued Federal Register notices. Additionally, the NRC Headquarters (Subsequent License Environmental Directorate and Tribal Liaison) and Regional State Liaison staff also notified Federal, State, and Tribal governments and interested stakeholders via email distribution regarding the issuance of the proposed rule, the 60-day public comment period and public meetings, and how comments could be submitted. Further, to facilitate the public's review, the NRC established a website that contained pertinent rulemaking reference material, schedule information, hyperlinks to all draft documents, and discussed the different methods for submitting public comments.*

The NRC acknowledges comments concerning the use of acronyms and confusion regarding public meeting presentation materials and strives to publish documents in plain language. The NRC recognizes that the overuse of acronyms in documents can reduce their effectiveness and works to balance their use to facilitate openness and transparency. To aid in the discussion of complex scientific and regulatory topics, the NRC conducted 30-minute open houses prior to the start of the meetings where members of the public could speak directly with and ask questions of NRC staff who authored the draft LR GEIS and proposed rule. Further information regarding

the NRC's public outreach efforts and the comment period can be found in Section 1.10 and Appendix A, Sections A.1 and A.2 of this LR GEIS. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.

Comment: An extension of time is necessary for the following reasons.
Simply put, this rulemaking is both massive and vitally important. In this single notice, the NRC is asking for comments on a draft generic environmental impact statement, a draft rule, and draft guidance. While there is some overlap in the subject matter, each requires separate analysis of complex issues. Each part also could affect every single one of the 92 operating nuclear reactors across the country; this means that as commenters, we need to address not only generic points of concern, but we also need to address how the notice could affect specific plants. And the notice requires consideration of novel issues— the effects of keeping an aging nuclear power plant operating a total of 80 years. Adequately responding in a constructive and meaningful fashion therefore will require a significant investment of time and energy.

Our organizations' small staff and minor resources— and likely those of many others — are stretched thin and are about to be stretched thinner. In addition to this major rulemaking, the NRC is about to publish the draft of a second major rulemaking—the proposed rule for Part 53 Risk-Informed, Technology-Inclusive Regulatory Framework for Advanced Reactors. Asking our organizations and other interested parties to provide meaningful comments on two such vital rulemakings—one addressing the health, safety, and environmental impacts of operating nuclear reactors and the other addressing the regulation of proposed future nuclear reactors— is unduly burdensome.

Given the breadth of the issues and the significant consequences this notice could have for the many communities across the country that house nuclear power plants, we urge the NRC to extend the comment period. A mere sixty-day extension will provide the time necessary for us to provide constructive comments. (**1-1** [Reiser, Caroline])

Comment: Thank you for considering the following feedback on the proposed License Renewal GEIS. The NRC must extend the comment deadline, address inadequate and unreasonable guidance, and expand opportunities for public involvement. The proposed License Renewal GEIS must be substantially revised, and then republished for public review.
(**20-1** [Judson, Timothy])

Comment: - 60 days is too little time for the public to review the 1100 pages of documents and consider the impact of 80 years of operation. (**20-8** [Judson, Timothy])

Comment: -NRC must extend the comment period by 60 days. (**20-9** [Judson, Timothy])

Comment: Our ability to access documents was limited by the short duration of the public comment period. (**29-14** [Judson, Tim])

Comment: Like others, I respectfully request that the Nuclear Regulatory Commission (NRC) extend the deadline for public comment on the Comment Period of Renewing Nuclear Power Plant Operating Licenses— Environmental Review, 88 Fed. Reg. 13,329 (March 3, 2023), for an additional sixty (60) days. (**33-1-1** [Magnuson, Brian])

Comment: Like others, I respectfully request that the Nuclear Regulatory Commission (NRC) extend the deadline for public comment on the Comment Period of Renewing Nuclear Power

Plant Operating Licenses—Environmental Review, 88 Fed. Reg. 13,329 (March 3, 2023), for an additional sixty (60) days. (**33-1-8** [Magnuson, Brian])

Comment: The NRC must extend the comment period by 60 days. (**44-8** [Lee, Gary])

Comment: Please allow more time for comments. This is too important to rush through. (**44-19** [Lee, Gary])

Comment: There have been so many poorly conceived decisions since 2020 that the NRC must extend the comment deadline, address inadequate and unreasonable guidance, and expand opportunities for scientific unbiased factual discourse and public involvement. The proposed License Renewal GEIS must be substantially revised, and then (!) republished for public review. (**45-1** [Hutar, J Jeremy])
Comment: -60 days is too little time for the public to review the 1100 pages of documents and consider the impact of 80 years of operation. (**45-8** [Hutar, J Jeremy])

Comment: -NRC must extend the comment period by 60 days. (**45-9** [Hutar, J Jeremy])

Comment: Thank you for receiving my comments on the proposed License Renewal GEIS. The GEIS's comment deadline is too short and should be extended by at least another 60 days to allow us to digest the more than 1,000 pages of the GEIS. (**46-1** [Kirby, Laurence])

Response: *The NRC acknowledges the comments including those requesting an extension of the public comment period. The 60-day comment period was appropriate for this rulemaking and consistent with NRC regulations (see 10 CFR 51.73). The scope of this rulemaking was targeted; while the rule proposed to update each environmental issue to account for subsequent license renewal, only 14 of the 80 environmental issues to be codified in Table B-1 of Appendix B to Subpart A of 10 CFR Part 51 reflect a substantially revised analysis. Moreover, the early versions of the draft LR GEIS and proposed rule package were publicly available on the NRC's website in December 2022, shortly after the NRC staff provided the proposed rulemaking package to the Commission. To facilitate public involvement, the NRC staff hosted six hybrid public meetings to help explain the proposed changes and gather formal comments from interested members of the public. Additionally, the NRC established a website that contained pertinent rulemaking reference material, schedule information, hyperlinks to all draft documents, and discussed the different methods for submitting public comments. Moreover, while the NRC staff believes that the 60 days provided were sufficient for the comment period on the LR GEIS and rule, it considered additional comments after the close of the comment period to the extent practicable. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.*

Comment: -NRC did not conduct a public scoping process, and provided no formal opportunity for the public to weigh in before publishing the draft GEIS. (**20-7** [Judson, Timothy])

Comment: NRC did not conduct a public scoping process, and provided no formal opportunity for the public to weigh in before publishing the draft GEIS. (**44-7** [Lee, Gary])

Comment: -NRC did not conduct a public scoping process, and provided no formal opportunity for the public to weigh in before publishing the draft GEIS. (**45-7** [Hutar, J Jeremy])

Comment: In particular NRC did not conduct a public scoping process, and provided no formal opportunity for public comment. (**46-3** [Kirby, Laurence])

Response: *NRC disagrees with these comments, which suggest that the NRC did not conduct a scoping process for the LR GEIS and associated rulemaking. On August 4, 2020, the NRC published a notice of intent in the Federal Register (85 FR 47252) that notified the public of the NRC's intent to review and potentially update Table B-1 in Appendix B to Subpart A of 10 CFR Part 51 and the analysis in the 2013 LR GEIS; indicated the results of the NRC staff's preliminary review, including consideration of subsequent license renewal; and invited public comments and proposals for other areas that should be updated. The NRC staff forwarded the scoping notice to Federal and State agencies, and federally recognized Tribes. Additionally, the NRC issued a press release, Facebook and Twitter posts notifying the public of the 90-day scoping period and four public webinar meetings. In June 2021, the NRC published its summary scoping report (NRC 2021a). The NRC did not conduct a second scoping process as all LR GEIS and associated Table B-1 environmental issues were included in the original scoping effort, including updating the LR GEIS to address SLR. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.*

A.2.27 Comments Opposing the Commission's Consideration of Beyond One Term of SLR

Comment: We suggest that, as a policy matter, the agency should not extend this same process beyond SLR. The NRC has included a total 80-years of operation into other generic rulemakings and must do so for license renewal as well.[30] But the Draft GEIS is not sufficiently clear on this point. In multiple locations, the Draft GEIS refers to "40 years, 60 years, 80 years, *etc*."[31] The NRC must be clear--it will not license nuclear power plants to operate past 80 years with the same generic process.[32]

[30] Draft GEIS at 4-135 ("As defined in NUREG-2157 and clarified in the Continued Storage Final Rule (79 FR 56263), the licensed life for operation of a reactor assumes an original licensed life of 40 years and up to two 20- year license extensions for each reactor, for a total of up to 80 years of operation.").
[31] See e.g. Draft GEIS at xxxi, xxxiv, 1-2 (emphasis added).
[32] We request that the NRC include in the Draft GEIS that the years its review covers ranges to approximately 2073. NRC regulations direct that a new revision will occur 10 years (10 C.F.R. Pt. 51, Subpt. A, App. B.), and thus the latest the Draft GEIS is likely to be used would be 2033. An applicant can apply for license renewal 20 years before its current license expires and a license renewal is for 20 years--2033+40=2073. (**32-3-5** [Reiser, Caroline])

Response: *The NRC acknowledges the comment and appreciates the perspectives offered on an issue of specific interest to the Commission. As referenced in Section 1.0 of this LR GEIS, the NRC's generic environmental findings, which are described in this revised LR GEIS and support Table B-1 of Appendix B to Subpart A of 10 CFR Part 51, are applicable to the 20-year license renewal increment, either an initial license renewal (initial LR) term or the first subsequent license renewal (SLR) term, plus the number of years remaining on the current license, up to a maximum of 40 years. If the NRC makes a favorable license renewal decision, the renewed or subsequent renewed facility operating license(s) would normally be issued with an end date 20 years beyond the expiration date of the current license. Appendix C of this LR GEIS provides the current original, renewed, or subsequent renewed license expiration dates, as applicable, for all nuclear power plants subject to this revised LR GEIS and final rule.*

As prescribed by the NRC's regulations in Appendix B to Subpart A of 10 CFR Part 51 and as directed by the Commission in SRM-SECY-22-0036 (NRC 2022i), the NRC will have the opportunity to assess any new information about the potential environmental impacts of

continued nuclear power plant operations and any refurbishment during a second SLR period during the next 10-year review and update of the LR GEIS. The review and update are currently scheduled to begin no earlier than 2031. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.

A.2.28 General Opposition: LR GEIS, Rulemaking, or License Renewal

Comment: The plans for 60 years for Comanche Peak and South Texas Project are already too much. (**2-1** [Bilz, Reed])

Comment: Granting extensions is inviting a serious disaster. (**2-5** [Bilz, Reed])

Comment: And that is probably the main reason I come with a great deal of distrust for this endeavor here. Not that I don't see a lot of good in this, I just have a whole lot of distrust for the NRC as an agency that I always described as an agency that is captive of the industry. And so I'm always concerned that rules, as we all learned growing up, determine the outcome of the game more often than not. And I'm just kind of concerned about some of these rules. (**9-3-1** [Burnham, Lon])

Comment: And so I am concerned that this entire evening is dedicated to trying to, I'm afraid, streamline the re-licensing process, and that I'm afraid that I don't know enough to know how it is geared to help the industry just do what they've always been doing, which is setting up a catastrophe that the tax payers are going to have to pay for.

In our instance, it's even clearer in New Mexico, New Mexico says we don't want it. And the Governor signed legislation within the last weeks clarifying that, we don't want it.
Our Governor has sent letters. The Mayor of Forth Worth has sent letters. We've all been in the process of saying, it's your job to figure out what to do with this waste. And if I say 80 years, that would be longer than the agency existed. But there has been a long time.
And some of the people that were at the meeting in Glen Rose that aren't here tonight, live within a, literally, a stone's throw of the railroad track that if you guys don't figure out what to do with this waste, other than bringing 85 percent of it through Fort Worth to west Texas, she is going to be living with that.

And so, I'm just kind of opposed for your renewing license of plants because we've had 80 years to figure out what to do with the waste. Every mother tells their 4- or 5-year-old to clean up the room before they go do something else. You guys need to clean up the waste. Thank you. (**9-3-3** [Burnham, Lon])

Comment: Some of these things with nuclear issues are trust issues. For those of us that were born in the '40s, we've lived with that event in Japan. And that's our image of nuclear.
We understand the danger in a different way than some of you who are much younger. And we cynically are differently [sic] because we've seen the damage. I was only 7 years old when I read about it and identified with those children in the overalls. Those little girls. That could have been me. (**9-6-8** [Gosslee, Susybelle])

Comment: I am not sure who oversees you. That is a piece, I know you have checks and balances within your system, that would be a piece of information that would be helpful to clarify. You are accountable to the public. You're a public agency. You're the federal government's agency.

And we are strong believers in the Democratic process. So, in that structure itself, we don't understand those checks and balances for you. I think that would help in building trust. And we also know that there are, politics is a term that is not a dirty word when you take it by itself. It really means a way of solving problems. You negotiate, you give and you take. But sometimes people don't always use it to the best advantage to create the common good. (**9-6-10** [Gosslee, Susybelle])

Comment: As demonstrated above, the NRC has committed a serious dereliction of its statutory duty under the Atomic Energy Act to protect public health and safety through rigorous oversight and regulation of reactor operation. Instead of investigating the risks posed by operating aging equipment in the SLR term, the NRC has suppressed independent expert opinion regarding the need to obtain additional information through harvesting of aging equipment. NEPA requires the NRC to address the independent opinion of those experts regarding the safety and environmental risks posed by failing to require the harvesting of aging reactor equipment. Because the NRC has failed to do so, and because it has failed to address the significant safety and environmental issues raised by operating nuclear reactors with aging equipment during the license renewal term, the NRC has no basis to promulgate the Proposed Rule or to issue the Draft License Renewal GEIS in final form. (**24-2-21** [Curran, Diane])

Comment: For the foregoing reasons, the NRC should withdraw the Proposed Rule and the Draft GEIS and proceed with site-specific environmental impact statements for reactor license renewal. (**27-4** [Curran, Diane])

Comment: Given that the NRC is a government oversight organization, it ought to be giving greater consideration to the well-being of the inhabitants. Instead, there have been insufficient estimates of potential harmful effects due to this type of energy production. (**28-1** [Ramsay, Rebecca])

Comment: Characterizing "the scope of this rulemaking [as] targeted"[1] sends a substantial misimpression to the public and interested parties. The regulatory landscape that will result from this agency action will control reactor licensing for at least ten years, if not more--the 1996 GEIS controlled for 17 years, and it is reasonable to assume such a delay in revising this iteration of the agency's GEIS on such matters could happen again. The expanse of what's at stake here is quite clear. The proposed rule and Draft GEIS set the scope for the environmental review of any license renewal of a nuclear power plant, which the NRC estimates will include 44 license renewals, or 80% of the current operating domestic fleet.[2]

[1] Letter from Patricia Holahan, SLED Director, to Ms. Caroline Reiser, Esq., RESPONSE TO REQUEST FOR AN EXTENSION OF THE COMMENT PERIOD OF RENEWING NUCLEAR POWER PLANT OPERATING LICENSES--ENVIRONMENTAL REVIEW, DOCKET ID NRC-2018-0296, 88 FED. REG. 13,329 (MARCH 3, 2023) (Mar. 30, 2023).
[2] NRC, Office of Nuclear Material Safety and Safeguard, Regulatory Analysis for the Proposed Rule:
10 CFR Part 51, Renewing Nuclear Power Plant Operating Licenses--Environmental Review, 12 (Feb. 2023). (**32-1-2** [Reiser, Caroline])

Comment: As a final note, the efficiency of continuing to produce a generic environmental review for LR is questionable. At most, there are only eight reactors that have yet to apply for initial license renewal: Clinton Power Station (1 reactor), Comanche Peak (2 reactors), Diablo Canyon (2 reactors), Perry (1 reactor), and Watts Bar (2 reactors).[33] And the NRC suggests that this generic review will only be utilized by a single reactor for initial license renewal.[34]

[33] Vogtle Units 3 and 4 are excluded because "[t]he Commission has assessed the environmental impacts associated with granting a renewed operating license for a nuclear power plant to a licensee who holds either an operating license or construction permit as of June 30, 1995." 10 C.F.R. Pt. 51, Subpt. A, App. B.
[34] NRC, Office of Nuclear Material Safety and Safeguard, Regulatory Analysis for the Proposed Rule: 10 CFR Part 51, Renewing Nuclear Power Plant Operating Licenses--Environmental Review, 12 (Feb. 2023). (**32-3-6** [Reiser, Caroline])

Response: *The NRC acknowledges the comments. Some comments expressed concern that the NRC is not fulfilling its statutory obligation under the Atomic Energy Act regarding the need to obtain additional information by harvesting aging equipment. The NRC's statutory mission is to regulate the Nation's civilian use of radioactive materials, provide reasonable assurance of adequate protection of public health and safety, promote the common defense and security, and to protect the environment. The NRC takes its mission very seriously. The NRC provides continuous oversight for the safe operation of nuclear power plants through its ongoing reactor oversight process to verify that the nuclear plants are being operated and maintained in accordance with NRC regulations. Additionally, any member of the public who believes they would be adversely affected by aging management issues associated with a specific reactor license renewal application may request a hearing. Members of the public may also petition the Commission, in accordance with the provisions of 10 CFR 2.206, for consideration of safety issues during current operation and the period of extended operation of the plant.*

The purpose of the LR GEIS and associated rulemaking is to identify and evaluate the environmental issues that could result in the same or similar impact (i.e., generic issues) on the environment at all nuclear power plants or a specific subset of plants and determine which issues could result in different levels of impact, thus requiring nuclear power plant-specific environmental analyses for impact determination. The methodology used in the LR GEIS for categorizing issues as generic or plant-specific is an appropriate and effective use of the concept of tiering that was promulgated by the Council on Environmental Quality in its 1978 regulations, as amended, that implemented the requirements of the National Environmental Policy Act (NEPA), and the NRC's regulations for implementing NEPA in 10 CFR Part 51. As described in Section 1.7 of this LR GEIS, the NRC's process for license renewal under 10 CFR Part 51, which is supported by this LR GEIS and rulemaking, focuses on environmental impacts rather than on issues related to nuclear power plant safety, as addressed under 10 CFR Part 54. However, the NRC has evaluated the probability-weighted consequences of postulated accidents in Appendix E of this LR GEIS, and the NRC's findings for postulated accidents are summarized in 4.9.1.2 of this LR GEIS. No changes were made in LR GEIS, or final rule, or guidance as a result of these comments.

A.2.29 Comments Supporting the Commission's Consideration of Beyond One Term of SLR

Comment: We're also in favor of not limiting this to just one license renewal. Part of the issue with the recent rollback of license terms for SLR at some plants, such as Turkey Point, were due to the word "initial" being in the regulation. We want to avoid that for the future; however, maintain that when new and significant information is discovered, that that would warrant additional analysis. (**4-2-4** [Stein, Adam])

Comment: Similar to Dr. Stein, we also believe that the GEIS should be applicable to any license renewal period. We think that that predictability and stability is consistent with the

principles of good regulation, and that the existing process for updating the guidance documents is sufficient to take all things into consideration with new and significant information. (**4-3-2** [Titus, Brett])

Comment: A. Applicability of the LR GEIS and Table B-1 to Subsequent License Renewals

Consistent with the Commission's directive in SRM-SECY-21-0066, the NRC staff proposes to revise the introductory paragraph of 10 CFR 51.53(c)(3) to replace the words "an initial renewed license" with the words "a license renewal covered by Table B-1."[4] This change is intended to "reflect that the regulation governing postconstruction environmental reports for license renewal applies to applicants seeking either an initial or subsequent renewed license following this update to the LR GEIS."[5] Relatedly, and as further directed by the Commission in SRM-SECY-22-0109, the proposed rule would amend the introductory paragraph in Appendix B of Part 51 to indicate that the NRC's assessment of environmental impacts associated with license renewal (as documented in the LR GEIS) "applies to applications for initial or a first (i.e., one term) subsequent license renewal."[6]

[4] Proposed Rule, 88 Fed. Reg. at 13,346, 13,351.
[5] Id. at 13,346.
[6] Id. at 13,351.

NEI supports these proposed changes insofar as they remove any ambiguity regarding the applicability of section 51.53(c)(3) and Table B-1 to initial SLR applications. However, we agree with the NRC staff's recommendation in SECY-22-0109 that the LR GEIS, as updated, should "apply to **any** license renewal term (i.e., initial, first SLR, or a term beyond the first SLR)."[7] Attachment 1 contains suggested revisions to the proposed rule consistent with this position. Conforming changes would also need to be made to the revised LR GEIS and other draft documents made available for comment. As the revised LR GEIS notes, "[t]here are no specific limitations in the Atomic Energy Act [AEA] or the NRC's regulations restricting the number of times a license may be renewed."[8] As discussed below, limiting the LR GEIS to one SLR term in effect imposes such a limitation for reasons that are not clear.

[7] SECY-22-0109, Proposed Rule: Renewing Nuclear Power Plant Operating Licenses - Environmental Review, at 6 (Dec. 6, 2022) (ML22165A003) (emphasis added).
[8] See AEA Section 103.c, 42 USC 2133 ("Each such license shall be issued for a specified period, as determined by the Commission, ... and may be renewed upon the expiration of such period."); see also 10 CFR 54.1.

The U.S. commercial LWR fleet has accrued several thousand years of cumulative operating experience. The environmental impacts of large LWR operation are thus well understood. In developing the 1996 LR GEIS, the NRC performed an extensive, systematic study of the environmental impacts of operating nuclear plants for an additional 20 years. That evaluation found minimal (and, in some instances, beneficial) environmental impacts for those resource areas analyzed generically across the LWR fleet. The NRC's subsequent updates to the LR GEIS - in 2013 and now again in 2023 - reaffirm these findings.

We believe that the LR GEIS provides a reasonable analysis of the environmental impacts of 20 years of reactor operation, irrespective of the prior number of years of reactor operation. Every license renewal review, regardless of term, requires a site-specific supplement to the LR GEIS (i.e., SEIS), in which the NRC evaluates any issues not resolved generically by the

GEIS. The NRC also evaluates any new and significant information. In addition, the NRC updates the GEIS roughly every 10 years to incorporate material new information and lessons learned. This review cycle is reasonable given that "changes in the environment around nuclear plants are gradual and predictable."[9] Therefore, limiting the applicability of the proposed rule and GEIS to one SLR term is not necessary as a technical or legal matter, overlooks decades of fleet-wide operating experience and established regulatory practice, and contravenes the NRC's Principles of Good Regulation.

[9] Proposed Rule, 88 Fed. Reg. at 13,332; Revised LR GEIS, Vol. 1 at 1-2.
(**19-1-4** [Uhle, Jennifer])

Comment: 3. Section 88FR13329, Page 13351, Comment/Recommendation: NEI suggests removing the restriction of this rule only extending to "one term of subsequent license renewal" and offer the following changes to the proposed rule language in Appendix B to Subpart A of 10 CFR Part 51"Environmental Effect of Renewing the Operating License of a Nuclear Power Plant. The specific change proposed for the Appendix B introductory paragraph is: "This assessment applies to applications for initial or ~~a first (i.e., one term)~~ subsequent license renewal (i.e., any number of renewal terms)." Additionally, the title of Table B-1 should be replaced with: "SUMMARY OF FINDINGS ON ENVIRONMENTAL ISSUES FOR INITIAL AND ~~ONE TERM OF~~ SUBSEQUENT LICENSE RENEWAL OF NUCLEAR POWER PLANTS." (**19-2-3** [Uhle, Jennifer])

Comment: The NRC specifically sought comment on "whether the proposed rule should be expanded beyond two license renewal terms." On this topic, Constellation agrees with NEI and Commissioner Caputo's comments in her vote on SECY-22-0024, when she stated that "[l]imiting the applicability of this draft proposed GEIS is wholly unjustified" because "every license renewal review, regardless of term, includes a site-specific environmental review" and therefore "[a]nything not resolved by the GEIS must be evaluated and discussed in the site-specific Supplemental Environmental Impact Statement" including an "evaluation of new and significant information regarding matters covered by the GEIS." Limiting the GEIS to one term of subsequent license renewal adds unnecessary uncertainty to the next phase of license renewal and is not an effective use of NRC and stakeholder resources. In any event, NRC's 10-year cycle of reviewing and updating the GEIS, as appropriate, fully mitigates the Commission's concerns. (**34-2** [Kaegi, Glen])

Comment: The LR GEIS should not be arbitrarily limited to the first term of SLR: it should be available so long as it is applicable. (**38-3** [LLoveras, Leigh Anne])

Response: *The NRC acknowledges the comments and appreciates the perspectives on an issue of specific interest to the Commission. The NRC disagrees with the comments requesting changes to the LR GEIS or rule to specify that they are applicable to more than one subsequent license renewal (SLR) term.*

As referenced in Section 1.0 of this LR GEIS, the NRC's generic environmental findings, which are described in this LR GEIS and support Table B-1 of Appendix B to Subpart A of 10 CFR Part 51, are applicable to the 20-year license renewal increment, either an initial license renewal (initial LR) term or the first SLR term, plus the number of years remaining on the current license, up to a maximum of 40 years. Therefore, as prescribed by the NRC's regulations in Appendix B to Subpart A of 10 CFR 51 and as directed by the Commission in SRM-SECY-22-0036 (NRC 2022i), the NRC will have the opportunity to assess any new information about the potential environmental impacts of continued nuclear power plant operations and any refurbishment

during a second SLR period during the next 10-year review and update of the LR GEIS. This review and update is currently scheduled to begin no earlier than 2031. No changes were made in LR GEIS, final rule, or guidance as a result of these comments.

A.2.30 Comments Concerning General Support: LR GEIS, Rulemaking, or License Renewal

Comment: First and foremost, our comment is to the staff. We know you've been under a very aggressive schedule and we appreciate the high prioritization that the Commission has placed on this activity to restore some stability and predictability to the second license renewal process. (**4-3-1** [Titus, Brett])
Comment: I appreciate the ability to comment and read expert opinions on a topic I know little about. After reading the proposed rule I am glad to see such an extensive process for nuclear renewal exists and that the primary changes since the 2013 revision are centered around environmental impacts. Our understanding of the environment and climate change has evolved greatly in the last decade, and undoubtedly the public demands a larger focus on environmental issues. (**5-1** [Anonymous, Anonymous])

Comment: I mean, this is a great presentation. Thank you so much. And I'd like to thank the NRC for allowing me the chance to, you know, speak about this important topic. As the Commission already knows, nuclear power is our largest source of carbon-free energy, and it's among the safest energy sources that we have available. Nuclear power provides countless jobs and economic benefits to communities across the country while stabilizing power grids around our nation. And importantly, it's critical to meeting key climate and energy security objectives now and for the future. All too often, however, nuclear power has been hamstrung by onerous and burdensome delays in our nation's permitting and licensing process. These delays have increased the costs of building and operating nuclear power, which have allowed fossil fuels to dominate the electricity market. While affordable energy is important, the build-out of these fossil fuels has had a demonstratively negative impact on air quality, contributing to many health problems and premature deaths, often in underserved and low-income communities. (**10-1-1** [Luse, Jeff])

Comment: Generation Atomic would like to thank the Nuclear Regulatory Commission for allowing public comment on this important topic.

As the Commission already knows, nuclear power is our largest source of carbon-free energy and is among the safest energy sources available. Nuclear power plants provide countless jobs and economic benefits to communities across the country while stabilizing power grids around our nation. Importantly, nuclear power is critical to meeting key climate and energy needs now and for the future. (**16-1** [Luse, Jeff])

Comment: Existing nuclear power plants promote our energy security and ability to meet key environmental objectives. We encourage all efforts at the NRC to ensure the existing fleet continues operation beyond initial license renewal terms and to do so in a manner that supports the sustainability of these key assets in the fight against climate change. (**16-3** [Luse, Jeff])

Comment: The Nuclear Energy Institute (NEI)[1] appreciates this opportunity to provide comments on the U.S. Nuclear Regulatory Commission's (NRC) proposed revisions to its Part 51 license renewal (LR) regulations,[2] draft Revision 2 to NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants" (revised LR GEIS), and related draft

guidance. NEI supports the NRC's efforts to provide a stable, predictable, and efficient environmental review process for initial and subsequent license renewal (SLR) applications for the nation's nuclear power reactors.

[1] The Nuclear Energy Institute (NEI) is the organization responsible for establishing unified industry policy on matters affecting the nuclear energy industry, including the regulatory aspects of generic operational and technical issues. NEI's members include entities licensed to operate commercial nuclear power plants in the United States, nuclear plant designers, major architect/engineering firms, fuel cycle facilities, nuclear materials licensees, and other organizations and entities involved in the nuclear energy industry.
[2] Renewing Nuclear Power Plant Operating Licenses - Environmental Review; Proposed Rule, 88 Fed. Reg. 13,329, 13,346 (Mar. 3, 2023). (**19-1-1** [Uhle, Jennifer])
Comment: We commend the NRC staff for their focused and diligent efforts in developing the proposed rulemaking package on an expedited basis. We believe the staff has produced a robust GEIS that, consistent with the National Environmental Policy Act's (NEPA) "hard look" standard,[3] thoroughly addresses the potential generic environmental impacts of continued plant operation and related refurbishment activities during any 20-year renewal term.

[3] Balt. Gas & Elec. Co. v. Natural Res. Defense Council, 462 U.S. 87, 97 (1983) (internal citation omitted) (NEPA does not require agencies to "elevate environmental concerns over other appropriate considerations. Rather it require[s] only that the agency take a 'hard look' at the environmental consequences before taking a major action."). (**19-1-2** [Uhle, Jennifer])

Comment: At the outset, NextEra appreciates the NRC Staff's efforts to update the GEIS in an expeditious manner. Following the unfortunate delay in the NRC's processing of SLR applications, NextEra is eager for the NRC's license renewal process to return to its standard of excellence and timeliness. (**22-1** [Strand, Dianne])

Comment: As a matter of policy, the NRC has utilized a generic approach to environmental reviews for reactor license renewals for nearly 30 years. This has proven successful in ensuring accurate environmental reviews, fully in compliance with the law, while focusing NRC Staff efforts and hearing opportunities on site-specific environmental issues. Completing the revision to the LR GEIS will enable the NRC to return to this tried-and-true path and help to preserve our nation's carbon-free nuclear generation assets for generations to come. We commend the NRC Staff for its timely and positive steps in this direction. (**22-2** [Strand, Dianne])

Comment: We also applaud the NRC staff for their focused and diligent efforts in developing the proposed rulemaking package on an expedited basis. As a public utility, we believe in both preserving and expanding nuclear generation. As a member of Nuclear Energy Institute (NEI), Duke Energy was an active participant in the development of the comments on the NRC Proposed Rule - Renewing Nuclear Power Plant Operating Licenses - Environmental Review (88 Federal Register 13329; Mar. 3, 2023) that were submitted to the NRC by NEI. Duke Energy concurs with the comments that were provided by the NEI letter. (**23-1** [Ray, Thomas])

Comment: Constellation agrees with the comments submitted by the Nuclear Energy Institute (NEI) on May 2, 2023. The importance of a stable and predictable process for the renewal of operating licenses cannot be overstated. There is widespread recognition that continued operation of the nation's fleet of nuclear power plants is essential to meeting emissions reductions targets reliably and affordably. Constellation appreciates that the NRC is taking steps to improve the license renewal process and commends the agency for ensuring the rulemaking process has adhered to an expedited schedule. (**34-1** [Kaegi, Glen])

Comment: *Although DCPP is not legally defined as a renewable energy resource, it does not contribute to green-house gases. So, its continued operation is essential to help us meet the State's climate goals while ensuring our energy needs are met.

*Diablo Canyon Power Plant is a safe, clean, and vital energy resource for our state and communities. Please join the CEC in support of continued safe operation of DCPP so we can all enjoy the clean energy it provides. (**39-8** [McCorry, Kathy])

Comment: Nuclear energy is becoming an increasingly viable source to maximize economic benefits while drastically limiting environmental impacts, such as greenhouse gases. More popular and supported forms of energy, such as fossil fuels, come with added issues. These issues include poor air and water quality, rising temperatures, and smog, which may create environmental injustice when not spread out fairly. (**40-2** [Cassiere, Daniel])

Comment: The agency is granted power through 42 U.S. Code § 2011 Section 111. Their mission goes beyond ensuring the environment's safety while managing nuclear power; they are tasked and strengthening free competition in private enterprise." The NRC was granted this power and these goals from the Atomic Energy Act of 1954. They have the autonomy to decide what protections they integrate as long as they protect the environment and fulfill their social and economic goals granted to their jurisdiction by Congress. Congress's acknowledgment of our impact on the environment and the continuation of said impact, as mentioned in 42 U.S. Code § 4331, makes the NRC fall under this obligation as well. These goals, as referenced, are not solely environmental but also social and economic. The NRC specifically is tasked with licensing and regulating nuclear power and activities in a manner consistent and receptive to environmental concerns, as described in 10 CFR §51.10. (**40-3** [Cassiere, Daniel])

Comment: Nuclear Energy presents many benefits, specifically in the economic and environmental sectors. Implementing nuclear energy into the modern American economy is economically plausible and will, over time, prove significantly beneficial to the economy. Although existing, the environmental detriments caused by nuclear energy are milder, especially at the smaller size of the sector compared to fossil fuels. Fossil fuels, as previously mentioned, lead to higher concentrations of greenhouse gases that are known to cause acid rain and physical health issues with improperly managed waste removal.

This is not to say there is no issue with nuclear energy, as radioactive waste and uranium costs present new factors not previously required to consider with other forms of energy. Nuclear energy is expensive upfront with building costs and gaining licensing to build a power plant. These expenses even out over time through cheaper maintenance than other methods, such as fossil fuel mining and combustion.

The key to these nuclear power plants' lower costs and maintenance lies in properly managing nuclear facilities and waste management. The public concern over nuclear failures and overheating is based on failures exemplified by previous technology not being up to par and a need for understanding how nuclear reactors and cooling work. (**40-4** [Cassiere, Daniel])

Comment: Nuclear energy is far safer than the rare examples of accidents and attempts at discrediting it. The two major nuclear reactor accidents were Fukushima in 2011 and Chernobyl in 1986. Fukushima was properly operating and functioning without issue. The reactor melting and spewing was not caused by the inherent dangers of nuclear power but by trembles and cooling issues caused by the Tohoku earthquake and tsunami. The power loss from the tremors caused the reactors to overheat and spew nuclear radiation. Japan is a victim of their

geography, where they are prone to regular earthquakes and tsunamis, which have far worse resulting damage than even the uncommon ones in the United States.

The Chernobyl accident in 1986 was caused by numerous factors, almost none of which should concern the public or the NRC as serious threats that should hinder leniency towards licensing or an increase to the number of nuclear energy permits granted. Chernobyl staff were warned and advised years before the initial reactor meltdown. There was a lack of safety culture and an unwarranted level of arrogance in the Soviet Union surrounding the Chernobyl reactor, preventing the necessary safety measures. The reaction failure also occurred over thirty-five years ago when our understanding of nuclear power was far smaller than it is today. The technology we possess today is also far more advanced. Water cooling technology has seriously advanced since then; we now understand how to prevent overheating throughout regular operations and maintain cooling and safety measures during blackouts or severe weather instances to avoid the events that occurred at Fukushima. (**40-5** [Cassiere, Daniel])

Comment: Nuclear energy is a zero-emission source of energy that provides an alternative to emitting harmful air pollutants into the air. Nuclear energy also requires far less land than other clean energy alternatives, such as wind turbines. The main waste of nuclear energy is reactor pieces and radioactive material. If adequately managed, handled, and stored, these materials can be separated from the environment and prevent all of the issues with radioactive waste associated with mutations, cancer, water pollution, and overall ecosystem degradation. (**40-6** [Cassiere, Daniel])

Comment: The NRC should promote nuclear energy and encourage more parties to work on obtaining a license. (**40-14** [Cassiere, Daniel])

Comment: Please continue to support the green revolution by keeping Nuclear power plants up and running safely. These nuclear power plants are the crown jewels of the energy sector, humming away and suppling great swaths of US with clean, reliable, cost-effective energy. (**41-1** [Devoe, Anthony])

Response: *The NRC acknowledges the comments. Several comments are supportive of nuclear power and/or the NRC's license renewal process. The comments are general in nature and, therefore, will not be evaluated further. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.*

A.2.31 Out of Scope: Energy Cost or Need for Power

Comment: And what would be the cost of transferring into a sustainable energy and what is the cost, the actual cost, of keeping up an old, brittle nuclear reactor that is corroding? And our reports have been that it is cracked because of some of the seismic problems in the area. So those are things that need to be checked. (**9-7-8** [Gosslee, Susybelle])

Comment: But we are concerned about the economy in the area. I mentioned it earlier. And you need to look at what would the cost be if they were able to convert over to sustainable energy. (**9-7-9** [Gosslee, Susybelle])

Comment: Finances have shut down some nuclear reactors already. Continuing to run reactors so long past their design life is a risky experiment that may result in accidents, shutdowns and huge rate hikes for electric utility customers. (**18-7** [Hadden, Karen])

Comment: *More importantly, DCPP produces about 18,000 gigawatt-hours of electricity annually, which is about 9 percent of California's in-state generation. Its baseload power sustains us through good and bad weather, especially through the hot summer months when energy usage is at its highest. (**39-3** [McCorry, Kathy])

Comment: *Recent extreme heat events and wildfires have highlighted the need to plan for additional risk to California's energy reliability. In 2020, a heat event resulted in rotating outages. In 2021, dry conditions resulted in a wildfire in Oregon that impacted transmission lines that California depends on for reliability. The fire resulted in a loss of 3,000 megawatts of imported electricity to California. In 2022, California experienced record-high temperatures, creating flex alerts and warning. On September 6, 2022, California experienced a new record peak load at 52,061 megawatts, nearly 2,000 megawatts higher than the previous record, despite significant efforts to reduce load during this peak period. (**39-4** [McCorry, Kathy])

Comment: *Electricity demand in California has also increased. This increase is due in no small part to the growing electrification of businesses, homes, and modes of transportation. Couple this change in electricity consumption with more frequent record-breaking high temperatures, and higher peaks in demand are the result. (**39-5** [McCorry, Kathy])

Comment: *At the same time, the State has become more and more reliant on renewable and zero-carbon generating resources. To reduce greenhouse gas emissions and help improve air quality and public health, the State's goal is to transition all energy generation to clean energy resources, primarily solar and energy storage at utility scale. Granted, California's ambitious target of increasing renewable generating sources has been unprecedented. However, the transition has not kept up with demand, putting grid reliability in jeopardy.
(**39-6** [McCorry, Kathy])

Comment: *In their resent study of this subject, the California Energy Commission determined that it is prudent to extend energy production at Diablo Canyon Power Plant to protect against energy supply shortfalls, while growth in renewable generation grows to ultimately supplant the DCPP's production. The CEC has determined that this is consistent with the state's emission reduction goals. (**39-7** [McCorry, Kathy])

Comment: The environment is one of many things that should be considered when discussing energy sources. How building and operating nuclear power plants and energy impacts the economy is just as important to consider. Many nations need help choosing a source of energy that is more expensive upfront but significantly more cost-effective over time. The United States, as a modernized economic powerhouse, does possess this luxury. Referring to Kuzents Curve, we find ourselves in a post-industrial economy.

According to the Kuznets curve, there are three stages to an economy: pre-industrial, industrial, and post-industrial economy. The pre-industrial stage is characterized by a nonindustrialized economy with a lower GDP and minimal negatives towards the environment. When an economy starts to grow and industrialize, its impact on the environment, GDP, and economic power skyrockets. The country enters a phase of massive economic growth, where they are unfocused on limiting their environmental impacts. The third and final stage is the post-industrial economy, in which the United States finds itself. The economy is now at a stage where their economic progress has leveled to a more calm speed of growth, and the population has enough economic surplus to fall back on; enough to focus on issues of the future and less immediate aspects of life, such as the environment. Kuznets curve is also affected by population and technology, which have grown alongside the economy. It would be unfair and unwise to our progress

exploiting the planet's resources at the expense of the environment, so we are in no place to restrict others because we put our economy on the backs of damaging the environment. Despite the expensive costs, countries with vastly different cultures, geographies, and economies are also starting to realize the potential and benefits of nuclear energy. Even a nation as different and far away as Nigeria is adopting nuclear energy and working to inform its public about the necessity to diversify its energy portfolio and the economic benefits that nuclear energy brings. Fossil Fuels are a resource we should not and cannot continue to rely on. Rising sea levels are a significant concern outside the previously mentioned and commonly understood water and air pollution issues. Areas like Chicago and New York are susceptible to damage and issues from rising sea levels and areas outside the United States. We should also take the necessary measures to prevent our contribution to rising sea levels as it affects nations outside our own. Fossil fuels are also a limited resource. Eventually, we will run out, and if we remain too dependent on them, our entire power infrastructure will collapse. Fortunately, the United States has started diversifying its energy profile with nuclear energy and other forms with more minor or less severe environmental impacts. This funding and support from the government for massive projects could cause unprecedented levels of harm, like the Keystone XL pipeline, if not used for alternative sources like nuclear energy. Shifting the focus from a deteriorating resource to one that can power the nation if we invest in it should be something the current administration and the public should support and work towards.

The NRC has an obligation to preserve the enjoyment and prosperity of the environment, and we are in the economic situation to do so. Another thing to consider is that protecting the environment and growing the economy are not mutually exclusive; having the best of both than fossil fuels. This was the case for Commonwealth Edison's power plants, with the technology and knowledge of over 50 years ago. As mentioned previously, in the modern day, nuclear power plants are significantly cheaper to maintain, and the operating and external costs are not any higher than energy made through fossil fuels, sometimes even cheaper. The primary expenses are from the capital costs, which mainly surround the licensing and agency fees and the litigation and administrative steps taken to meet the licensing and agency regulations. (**40-7** [Cassiere, Daniel])

Response: *The NRC acknowledges the comments. Several comments referenced issues and aspects related to the consideration of energy costs and need for power, including economic tradeoffs between nuclear and other energy sources. The economic costs and benefits of renewing an operating license are outside the scope of the LR GEIS and this rulemaking. The NRC regulation, 10 CFR 51.95(c)(2), states, in part,*

> *The supplemental environmental impact statement for license renewal is not required to include discussion of need for power or the economic costs and economic benefits of the proposed action or of alternatives to the proposed action except insofar as such benefits and costs are either essential for a determination regarding the inclusion of an alternative in the range of alternatives considered or relevant to mitigation.*

As stated in Section 1.3 of the LR GEIS, the purpose and need for the proposed action (issuance of a renewed license) is to provide an option that allows for baseload power generation capability beyond the term of the current nuclear power plant operating license to meet future system generating needs. Such needs may be determined by other energy-planning decisionmakers, such as the State, utility, and, where authorized, Federal agencies (other than the NRC). The NRC does not make license renewal decisions or recommendations regarding the impacts on tax and ratepayers. The regulatory authority over licensee economics falls within

the jurisdiction of the State and, to some extent, the Federal Energy Regulatory Commission. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.

A.2.32 Out of Scope: Emergency Preparedness

Comment: (xii) Socioeconomics
(55) Population and housing. - 1. Site specific (2). Populations change over time with changing patterns of residential development. Major roadways may not keep up. Both conditions have occurred over time adjacent to Turkey Point, which lies in a hurricane and storm surge zone. Turkey Point sit at the bottom of a peninsula with major roads suitable for evacuation of the growing population. These changes in land use make it impossible to evacuate the region effectively in the event of a radiological emergency and have already required a shift to "shelter-in-place" emergency procedures. Shelter-in-place could be lethal in the heat of summer with an electricity failure following a hurricane. (**7-12** [Stoddard, Philip])

Comment: (56) Transportation. - 1. Same issue as with Population and housing, regarding changing site-specific complications of emergency evacuation. (**7-13** [Stoddard, Philip])

Comment: Environmental impacts in the next twenty years will diverge from the previous twenty years.

Turkey Point is situated on the very edge of the bay on a low-lying coastal plain. The area is susceptible to catastrophic wind and storm surge events that are exacerbated by sea level rise and increasing storm intensity. For these reasons, the following issues must be re-examined by the NRC on a site-specific basis. (**31-17** [Silverstein, Rachel])

Comment: (56) Transportation

This issue must be modified from a "1" to a "2" and significance should be elevated from "small/moderate" up to "moderate/large". While the plant itself is elevated approximately 26 feet, surrounding roadways are not. This leaves access to the plant vulnerable during storms or due to sea level rise. Each plant will have a different access vulnerability, and therefore, should be treated in a site-specific manner. Turkey Point's unique location and cooling system create risks that are not generic or shared by other generating plants. (**31-18** [Silverstein, Rachel])

Comment: There are a number of things I want for you to be able to research. And I'm going to give those to you. I would like very much for you to check the emergency procedures at the reactor and in the surrounding area. The emergency procedures, of course have to be coordinated. And actually in this state, all of the emergency personnel are trained at Texas A&M. When I investigated Texas A&M, I learned that only the largest cities in this state have any capacity whatsoever to deal with nuclear. And if that their staff is trained somewhat. But you look at the procedures at the reactor and see that they're completely up to date. And that they continue to improve. And that county needs to have that also.

Everybody is lovely. Wants to be glad-handing each other. And you're doing a great job. But are they doing a good job? Find out if that's really true. And do they have the most up to date information?

I think that it's also, because of wind currents, it's also important to find out about the emergency processes, even in North Texas. I happen to try to escape one of the hurricanes out of Houston. It took us 38 drive hours to drive when normally it takes about four hours to get out of Houston.

So, if there is an accident, how will that, what will those people do? How will the people closest to the plant be able to get out when those roads are not completely adequate? I think that's one of the things you need to investigate. (**9-6-14** [Gosslee, Susybelle])

Comment: -Each of the above may also affect mitigation measures, such as the effectiveness of FLEX equipment, offsite security forces, and emergency response measures.
(**20-21** [Judson, Timothy])

Comment: -Examine mitigation measures, effectiveness of FLEX equipment, and failing emergency response measures, false alarms, inexcusable evacuations.
(**45-21** [Hutar, J Jeremy])

Response: *The NRC acknowledges the comments. The NRC understands these comments express concern regarding emergency preparedness and/or emergency response actions, such as transportation complications during an emergency evacuation, coordination of emergency procedures and security, or the adequacy of emergency plans. Emergency preparedness and security are applicable to the current operating licenses for each nuclear power plant and are subject to the NRC oversight of the existing or future renewed operating licenses. However, these issues are outside the scope of the NRC's license renewal environmental review process and, as such, this LR GEIS and rulemaking.*

The NRC staff has an ongoing program for determining the adequacy of offsite emergency plans and is supported in that role by the Federal Emergency Management Agency. Emergency preparedness and physical security plans are required at all nuclear power plants and require specified levels of protection from each licensee regardless of plant design, construction, or license date. Requirements related to emergency planning are set forth in the NRC's regulations in 10 CFR 50.47 and in Appendix E to 10 CFR Part 50. Requirements related to physical security are set forth in the NRC's regulations in 10 CFR Part 73, "Physical protection of plants and materials." These requirements apply to all operating licenses and will continue to apply to facilities with renewed licenses. The NRC has regulations in place to ensure that emergency preparedness and security plans are updated throughout the life of all nuclear plants. For example, under Appendix E to 10 CFR Part 50, nuclear power plant licensees are required to update their evacuation time estimates after every U.S. Census, or when changes in population would increase the estimate by either 25 percent or 30 minutes, whichever is less. Additionally, the NRC assesses the capabilities of the nuclear power plant licensee to protect the public by requiring the performance of a full-scale exercise, including the participation of various Federal, State, and local government agencies, at least once every 2 years. These exercises are performed to maintain the skills of the emergency responders and to identify and correct weaknesses. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.

A.2.33 Out of Scope: Nuclear Plant Safety

Comment: Such extensions threaten the safety and health of nearby residents due to the deterioration of fragile, old plants that were not built to operate this long. (**2-3** [Bilz, Reed])

Comment: Subsequent license renewal doubles the life span of nuclear power plants that were admittedly designed when nuclear power was an infant technology.

The fire at Browns Ferry, the meltdown at Three-Mile Island, and the accidents at Fukushima, exposed major design deficiencies, and operational vulnerabilities, that were neither considered

nor evaluated in the original safety designs of nuclear plants. These and lesser-known accidents also exposed inadequate regulations. Every plant involved in a nuclear accident was assumed to be safe before the accident occurred. Given the misguided comfort levels that continue to exist, the first consideration in subsequent license renewal should be the safety of people and the environment. (**8-2-1** [Magnuson, Brian])

Comment: How many of the NRC people here today flew in from Washington? Let me just get an idea. Show of hands.

Okay, how many of you flew in on a Douglas DC-3? The reason I ask is that it's an 80- or 90-year-old aircraft, and I suppose the case could be made if it's well-maintained, there should be no problem flying. But I see none of you took advantage of that.
And in a sense, that's how many of us feel about 60- to 80-year license extensions. Stuff fails. And it fails in unpredictable ways, even when we do our best. I think we've had incidents this year in Illinois already, which demonstrated that if you take their word for it, best-maintenance did not always work out well for the leaks that took place under Dresden for many years, the Braidwood leak of the 1990s, and now the Monticello leak up in Minnesota. Things fail. And it's a bathtub curve kind of thing. When they get older, they fail more at the end. So, you can maintain things as much as you want, but when I see a lot of you flying here on DC-3s, I'll have a lot more faith in the licensing process to have reactors operating for 80 years.
(**8-3-1** [Kraft, David])

Comment: Other than the fact that it's clear to me that what you want to do is give permission for old nuclear power plants that were made to have a certain life, to continue to operate past that life in a world that is no longer the same world that they were originally licensed in.
And they were licensed so that their materials and that their workings would last a certain period, but not past that. And we're asking dinosaurs to keep going into a world that's hotter and less, and more chaotic. Where there is more dangers just politically. And there is more dangers physically in terms of heat and drought. And perhaps even earthquakes, depending on what part of the country you're in and whether or not they're fracking close by. And sea level rise and all sort of things that we've never had to deal with before. And yet I don't see that reflected, honestly, in your materials. (**9-9-3** [Halpin, Beki])

Comment: We are very concerned about the possibility of license extensions allowing nuclear reactors to operate for up to 80 years. These reactors were designed and built to operate for 40 years. Pressure, high temperatures and neutron bombardment contribute to embrittlement inside of reactors. Experts say that previously intact metal can eventually shatter like glass due to embrittlement. (**18-1** [Hadden, Karen])

Comment: The extent of cracking and embrittlement is not fully known at the time of license extension decisions. This is a dangerous policy that the NRC must correct in order to protect public health, safety and security, and in order to prevent economic consequences of a potential accident. (**18-2** [Hadden, Karen])

Comment: #3 There should be clear requirements for thorough and updated embrittlement analyses to be completed and included in license applications. Otherwise, how does anyone know in a timely manner if a plant license should be extended? For Comanche Peak, the studies were not set to be concluded until just before the extension time period was to begin. This is years after the license extension would likely be approved. This is very backwards. No one would buy a house without an inspection. (**18-5** [Hadden, Karen])

Comment: 1. There is no precedent with operating reactors for anywhere close to 80 years. (**20-2** [Judson, Timothy])

Comment: -No commercial nuclear reactor in the world has operated for 60 years. (**20-3** [Judson, Timothy])

Comment: -The world's longest operating reactors have only now run for 54 years. (**20-4** [Judson, Timothy])

Comment: -Every reactor that began operating earlier shut down before 50 years of operation. (**20-5** [Judson, Timothy])

Comment: 6. NRC has failed to address the inherent dangers of operating reactors for up to 80 years. (**20-23** [Judson, Timothy])

Comment: -Aging, embrittlement, and degradation of reactor components, structures, and systems (CSS) are inherently site-specific. Similar components in different reactors are known to age at different rates. Aging-related degradation of CSS is affected by a complex combination of different factors, including operational and maintenance history, neutron fluence, water chemistry, hydrology, environmental and climatic conditions, construction, fabrication, and design of reactors. (**20-24** [Judson, Timothy])

Comment: -NRC has never adequately addressed the impact of aging-related degradation of reactors, and has no data on the material condition of reactors on which to evaluate the effectiveness of licensees' aging management programs (**20-25** [Judson, Timothy])

Comment: -NRC has granted exemptions and deferrals of inspections of reactor CSS on the basis of modeling and probabilistic risk calculations. This includes deferring 10-year inspections of reactor pressure vessels, because the reactor did not have enough metal "coupon" samples left for future inspections during renewed license periods out to 60 years. (**20-26** [Judson, Timothy])

Comment: - Ultimately, this is because reactors were originally designed, licensed, and expected to operate for only 40 years, or else more “coupons” would have been installed to ensure there would be enough samples available if reactors’ licenses were extended. (**20-27** [Judson, Timothy])

Comment: The NRC staff’s decision to update the review process is a good one; however, it should not be at the expense of a thorough review. All old and vulnerable equipment, flaws, equipment needing updating, and embrittled metal, and other costs should be evaluated, even assuming no further government subsidies for operations and repairs. The review process should have been updated years ago, because of all the changes in the industry, nuclear technology, and the changes in the creation of energy in the United States to sustainable energy. (**21-3** [Gosslee, Susybelle])

Comment: The NRC staff should gather all the information needed to be informed about the current status of every system throughout the reactor based on thorough recent inspections. If one-part breaks or dysfunctions, an accident could ensue or a criticality could follow that leads to disastrous consequences. Evaluate all the internal and external systems and write a complete report. Dealing with old systems, parts, metals, etc. is a liability and a risk, especially

when the proposal is to lengthen the life of the various parts during a time when so many climate factors are becoming more extreme. (**21-5** [Gosslee, Susybelle])

Comment: Identify and list all the risks. When a risk is identified, determine the costs to repair and replace and identify other alternatives with costs and the estimated length of time to repair or replace the old system. In addition, state the estimated length of time when the new system will be operational and state the impact of that particular part being out of operation. (**21-6** [Gosslee, Susybelle])

Comment: Evaluate the earlier steps. Determine what other unplanned issues need to be addressed and study them. Make a complete list of all the risks with costs to replace and a timeline to replace or repair. List the unplanned issues in a priority format using the best practices and standards, remembering that safety is the highest value in decision-making. (**21-8** [Gosslee, Susybelle])

Comment: Review the previous decisions to determine if they are still sound and relevant. (**21-9** [Gosslee, Susybelle])

Comment: To make a comparison, when a house is purchased, the buyer requests a home inspection be made by a well-trained professional with no conflict of interest. Every detail of the entire property will be evaluated and reported to the purchaser. In the case of nuclear reactors and the Nuclear Regulatory Commission, the public is the one to be protected and ensured of the safety of the plant. Full and accurate disclosure is necessary and the responsible way to proceed. (**21-11** [Gosslee, Susybelle])

Comment: Independent experts have identified critical reactor components for which the behavior and interaction of critical safety components during the SLR term are complex, poorly understood, and potentially dangerous to public health and safety and the environment. Yet, the NRC has failed to establish safety regulations to govern the use of these components in the SLR term. (**24-2-1** [Curran, Diane])

Comment: Decommissioning offers a trove of previous reactor operating experience data but NRC has a big problem with industry collaboration and lack of data retrieval
The collection of reactor operating experience makes up the bulk of developing and maintaining age management programs relating to license renewal. It is recognized as vitally important to maintain the collective analysis of the nuclear industry's operating experience to provide the "reasonable assurance" needed to support the license renewal program. However, as previously pointed out, there remain many significant uncertainties and technical knowledge gaps in deciphering that operating experience that must be addressed before extending "reasonable assurance" for safety and reliability to increasingly longer periods of operations. Simply put, there is yet much to be learned about the dozens of known age-related degradation mechanisms affecting in safety-related systems, structures and components; for example, how radiation assisted cracking initiates, crack growth rates are not necessarily going to be static as reactor operations are extended. There may yet be "late blooming" and new age-related degradation mechanisms. Neutron fluence, or bombardment, over time changes the chemistry of base metals and weld materials, influencing metal characteristics such as loss of ductility and the degrees of embrittlement. The internal mapping of existing, irreplaceable reactor components and structures from neutron fluence is not readily available to reliably project and manage safety margins as license extensions are advanced. Extreme heat, vibration and fatigue play critical parts in the synergy of the harsh operational environment of a nuclear power plant.

The collection and analysis of that same operating experience has a critical role to map out and guide the strategic harvesting effort at decommissioning nuclear power station to target the critical areas and find the most representative samples of concern for analysis and scientific findings. (**24-2-19** [Curran, Diane])

Comment: Beyond Nuclear submits the transcript of the October 6, 2022 NRC Advisory Committee on Reactor Safeguards (ACRS) meeting with the management and staff of the NRC Office of Research on the harvesting of aged materials from decommissioning nuclear power stations. The transcript raises significant concerns regarding the NRC staff's ongoing difficulty obtaining access to the previous operating experience at closed reactors. This does not mean that NRC has the industry's cooperation or access to facilitate the proposed license renewal approval research activity. But the operating experience data (principally the record of neutron fluence levels and operating temperatures over time) is necessary to develop strategic targets for harvesting activities to close priority knowledge gaps. Again, this is for developing the database for approving extended license renewals. In other words, in 2023, the NRC staff is still encountering industry roadblocks to providing the necessary reasonable assurance to qualify license renewal approvals.

The following sections excerpted from the ACRS transcript illuminate that the domestic nuclear industry is recalcitrant to collaborate with the NRC on retrieving operating experience data and harvesting aged material samples for scientific analysis.

"MR. POEHLER: And then the third challenge is, you know, the decommissioning versus harvesting. So, you know, a decommissioning company trying to decommission a plant has a different objective than a person that wants to harvest materials, and a decommissioning company trying to decommission a plant has a different objective than a person that wants to harvest materials, and sometimes those two things sort of conflict because the decommissioning schedules are often, you know, very tight and you have to fit harvesting in, and it definitely would impact decommissioning activities schedule, and also, you know, the storing and transporting of harvest materials can add to an already complicated process."

"... Now I'm going to talk about the elements of the NRC's proactive harvesting strategy. So the first element is to identify and prioritize harvesting interests. That process is going to focus on the unique value of harvesting relative to other sources of information, such as accelerated aging in a laboratory or test reactor, and use of operating experience. NRC Office of Research has been working on a spreadsheet to collect operating experience." [39]

[39] Meeting transcript of the Advisory Committee on Reactor Safeguards (ACRS) meeting with NRC Office of Research on status of decommissioning harvesting for license renewal, October 6, 2022, NRC ADAMS Accession # ML22297A041, pp.17-18, **Exhibit 10**, https://www.nrc.gov/docs/ML2229/ML22297A041.pdf

The transcript reveals that the collection of operating experience data for analysis is further complicated by the NRC Office of Research finding that the first stage of the industry's decommissioning activity is often to dispose of the data records of the reactor's previous operating experience.

"MR. TREGONING: Yeah, we had a question earlier about documentation. So this table [spreadsheet] was really developed, or we're developing it because it's a living table in conjunction with industry, try to not only identify the plant, the characteristics of the plants and materials that are out there now so we understand their attributes, but also to make the plant

owners aware, hey, this is the information that we want from a harvesting perspective, because I think what we found when they go into decommissioning, a lot of times it's the documentation that's the first thing that's disposed of. [Emphasis added]

So, getting that documentation, getting knowledge from the decommissioning companies and plant licensees of the types of information that we want, we tried to distill it down for this spreadsheet table that we've got so that we can be more sort of reactive when we find out a plant's closing down. You know, if we want to identify if there are any opportunities we could go to the licensee of the decommissioning company and say here are the things that we would like to understand if you have this information.

MR. HISER: Yeah, and I'll just add from a little more of a practical note, we have not had as much success being able to populate this spreadsheet. ...You know, you can get some from an FSR but you're not going to get all of this, especially on the environmental conditions, DPAs, temperatures, for specific components. So we've not had as much success but EPRI has continued to kind of push on industry, make this a priority with them. In fact, just in the last I'd say six months to a year, they said they're going to continue trying to press their members to provide input. [Emphasis added]

ACRS CHAIR REMPE: How willing are the decommissioning companies to provide the information? Because you said that's one of the first things they destroy. Are they willing to share?

MR. TREGONING: It depends on the decommissioning company. And I think Matt talked earlier, this is not their prime business objective. And so finding a willing partner that is engaged in harvesting, that's a very difficult challenge. [Emphasis added] ...

CHAIR REMPE: So when you said it's destroyed, my mind immediately thought that Holtec or some company like them would be the ones that would be first to destroy it. What you're saying is actually the plant before they sell to the decommissioning company might destroy it? [Emphasis added]

MR. TREGONING: And maybe destroy it. Let me amend my remarks. Maybe destroy is too strong a word there. It becomes unavailable for a variety of reasons." [40] [Emphasis added]

[40] Ibid.,ACRS harvesting transcript, pp. 37-39, **Exhibit 10**, https://www.nrc.gov/docs/ML2229/ML22297A041.pdf (**24-2-20** [Curran, Diane])

Comment: The safety review requires that the plant identify all physical structures and systems whose aging could affect safety. It must demonstrate that the structures which are considered "passive and long-lived", such as the coolant system piping or steam generators, can be maintained safely for twenty more years. Because the effects of aging on "active" components, such as motors, diesel generators, and batteries must be allayed through continuous surveillance and maintenance programs, these are not subject to review during the license renewal process. Despite the aging problems, relicensing rules prohibits any overall safety review of the entire operation. More conservative safety margins are not required in anticipation of higher failure rates in old plants. The approach has turned relicensing reviews into routine approvals.[1]

[1] https://www.riverkeeper.org/campaigns/stop-polluters/indian-point/relicensing/
(**25-2** [Evgeniadis, Ted])

Comment: License renewals, which began in 2000, essentially requires a government-approved plan to manage wear. These plans entail more inspection, testing and maintenance by the operator, but only of certain equipment viewed as subject to deterioration over time. The plans focus on large systems like reactor vessels. It is assumed that existing maintenance is good enough to keep critical smaller parts — cables, controls, pumps, motors — in good working order for decades more. But many potential improvements are limited by the government's so-called "backfit rule." The provision exempts existing units from safety improvements unless such upgrades bring "a substantial increase" in public protection. (**25-3** [Evgeniadis, Ted])

Comment: In addition, as indicated in a recent report from the Nuclear Information and Research Service, there is no way to predict the effects of deterioration of nuclear facilities over longer time periods, especially since this type of evidence is not available for nuclear power plants currently in operation or being decommissioned. (**28-3** [Ramsay, Rebecca])

Comment: To start, we emphasize the importance of the proposed rule and Draft GEIS to remind the NRC why it needs to invest more time and in-depth safety analysis in this process. (**32-1-1** [Reiser, Caroline])

Comment: The operation of a nuclear reactor beyond 60 years is unprecedented.[12] The NRC acknowledges on its website that "some systems, structures, and components may have been engineered on the basis of an expected 40-year service life,"[13] and there is an abundance of evidence that components break down even before 40 years of operation.[14] But the Draft GEIS ignores this reality. Aging nuclear power plants will face different and increasing operating challenges than plants operating within the planned-for operating lifetime.[15] We incorporate by reference Beyond Nuclear and Sierra Club's comments, focusing on the environmental impacts of aging and accidents.[16]

[12] See, U.S. Energy Information Administration, How old are U.S. nuclear power plants, and when was the newest one built? (Mar. 7, 2022) https://www.eia.gov/tools/faqs/faq.php?id=228&t=21#:~:text=The%20oldest%20operating%20reactor%20is,comm ercial%20service%20in%20December%201969.
[13] NRC, Backgrounder on Reactor License Renewal, https://www.nrc.gov/reading-rm/doc-collections/fact-sheets/fs- reactor-license-renewal.html.
[14] The NRC and industry (a) underestimated the durability of major components and (b) did not anticipate reactors operating long enough that major components would need to be replaced. See e.g. Lynn Connor, United States Nuclear Power Plant Steam Generator Replacement Experience (1997) https://www.osti.gov/etdeweb/servlets/purl/20147526 (necessary replacement of steam generators within original license period); NRC, Davis-Besse Reactor Vessel Head Degradation https://www.nrc.gov/reactors/operating/ops-experience/vessel-head-degradation.html (demonstrating how reactor vessel heads have been replaced due to corrosion from leaking control rod nozzles with less than 30 years of operation); NRC, Baffle-Former Bolts, https://www.nrc.gov/reactors/operating/ops-experience/baffle-former-bolts.html ("baffle-former bolts are more susceptible to degradation"); Nine Mile Point Unit 2, Docket No. 50-4 10, NPF-69, Core Shroud Reinspection Results (TA C No. MA 7284) (ADAMS Accession No. ML003712802) (Apr. 28, 2000) https://www.nrc.gov/docs/ML0037/ML003712802.pdf (cracks in the Nine Mile Point Unit 2 core shroud were documented in 2000, after only 12 years of operation); NRC, Information Notice No. 97-17: Cracking of Vertical Welds in the Core Shroud and Degraded Repair (Apr. 4, 1997) https://www.nrc.gov/reading-rm/doc-collections/gen- comm/info-notices/1997/in97017.html (cracked welds in the core shroud in Nine Mile Point Unit 1 after 25 years of operation).

[15] Union of Concerned Scientists, Dave Lochbaum, The Bathtub Curve, Nuclear Safety, and Run-to-Failure (Nov. 17, 2015) https://blog.ucsusa.org/dlochbaum/the-bathtub-curve-nuclear-safety-and-run-to-failure/.
[16] Comments by Beyond Nuclear and Sierra Club on Proposed Rule and Draft Generic Environmental Impact Statement for Renewing Nuclear Power Plant Licenses (May 2, 2023). (**32-2-4** [Reiser, Caroline])

Comment: . There is no precedent with operating reactors for anywhere close to 80 years. (**44-2** [Lee, Gary])

Comment: No commercial nuclear reactor in the world has operated for 60 years. (**44-3** [Lee, Gary])

Comment: The world's longest operating reactors have only now run for 54 years. (**44-4** [Lee, Gary])

Comment: Every reactor that began operating earlier shut down before 50 years of operation. (**44-5** [Lee, Gary])

Comment: 6. The NRC has failed to address the inherent dangers of operating reactors for up to 80 years. (**44-17** [Lee, Gary])

Comment: The NRC has never adequately addressed the impact of aging-related degradation of reactors, and has no data on the material condition of reactors on which to evaluate the effectiveness of licensees' aging management programs. (**44-18** [Lee, Gary])

Comment: 1. There is no precedent with operating reactors for anywhere close to 80 years. Grossly negligent idea! (**45-2** [Hutar, J Jeremy])

Comment: -No commercial nuclear reactor in the world has operated for 60 years and it is overdue. (**45-3** [Hutar, J Jeremy])

Comment: -The world's longest operating reactors have only now run for 54 years, just in time to decommission. (**45-4** [Hutar, J Jeremy])

Comment: -Every reactor that began operating earlier shut down before 50 years of operation, so the conservative principles of safety must be put in place. (**45-5** [Hutar, J Jeremy])

Comment: 6. NRC has failed to address the inherent dangers of operating reactors for up to 80 years. (**45-23** [Hutar, J Jeremy])

Comment: -Aging, embrittlement, and degradation of reactor components, structures, and systems (CSS) are inherently site-specific. Similar components in different reactors are known to age at different rates. Aging-related degradation of CSS is affected by a complex combination of different factors, including operational and maintenance history, neutron fluence, water chemistry, hydrology, environmental and climatic conditions, construction, fabrication, and design of reactors. (**45-24** [Hutar, J Jeremy])

Comment: -NRC has failed to adequately address the impact of aging-related degradation of reactors, and has no data on the material condition of reactors on which to evaluate the effectiveness of licensees' aging management, such as ASR. (**45-25** [Hutar, J Jeremy])

Comment: -NRC has granted exemptions and deferrals of inspections of reactor CSS on the basis of modeling and probabilistic risk calculations. This includes deferring 10-year inspections of reactor pressure vessels, because the reactor did not have enough metal "coupon" samples left for future inspections during renewed license periods out to 60 years. (**45-26** [Hutar, J Jeremy])

Comment: -Ultimately, this is because reactors were originally designed, licensed, and expected to operate for only 40 years, or else more "coupons" would have been installed to ensure there would be enough samples available if reactors' licenses were extended. (**45-27** [Hutar, J Jeremy])

Comment: Extending reactor lives to 80 years is dangerous and unprecedented. (**46-5** [Kirby, Laurence])

Comment: No commercial nuclear reactor in the world has operated for even as much as 60 years. (**46-6** [Kirby, Laurence])

Comment: Aging, embrittlement, and degradation of reactor components, structures, and systems (CSS) are inherently site-specific and have not been sufficiently considered by the NRC. Reactors were originally designed, licensed, and expected to operate for only 40 years. (**46-12** [Kirby, Laurence])

Response: *The NRC acknowledges the comments. Several comments expressed concerns related to safety issues and aging components, including gaps in knowledge related to operating experience to inform aging management programs. As detailed in Section 1.7 of this LR GEIS, the NRC's license renewal environmental review process, which is the focus of this LR GEIS and rulemaking, is confined to analyzing the effects (impacts) on the environment of continued operation of nuclear power plants through the period of extended operation (either initial license renewal [initial LR] or subsequent license renewal [SLR]). Nuclear power plant operational safety issues related to the management of aging systems, structures, and components are outside the scope of the NRC's environmental reviews conducted under 10 CFR Part 51 as well as this LR GEIS and rulemaking. Nonetheless, comments regarding aging as it relates to postulated accidents evaluated in Appendix E of this LR GEIS are addressed in Section A.2.13 of this appendix.*

The NRC staff conducts both an environmental review and a safety review of each license renewal application. The results of the NRC staff's environmental review are documented in a plant-specific supplement to the LR GEIS in accordance with the NRC's regulations set forth in 10 CFR Part 51. The NRC's safety review is conducted in accordance with 10 CFR Part 54, and the results of the staff's evaluation are documented in a safety evaluation report (SER).

To be granted renewed licenses, applicants must demonstrate that aging effects will be adequately managed such that the intended function(s) of the systems, structures, and components within the scope of license renewal will be maintained consistent with the current licensing basis for the period of extended operation. In accordance with 10 CFR Part 54, the staff will conduct a review of the applicant's aging management programs and document the results in the SER. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.

A.2.34 Out of Scope: Security and Terrorism

Comment: I think that you need to look at also the artificial intelligence. The systems and the technology is above my knowledge level, but there are experts in the private area, and I'm sure at the federal level in some of the agencies, that would be able to assist you in being more aware in having them help you, because you can't know it all. And so I advise you to bring in whatever experts you need to ensure that the system is, the artificial intelligence, is up to par. I also am very concerned, because just today the New York Times reported about Russia's findings of, or our government finding and documentation of Russia's interference in our technology. And that's literally today it was in the news. So please consider that seriously. All of us are under threat. There are many companies that have been already, banks, everything has already been. I know that it's most likely that the technology is a closed system, but goodness gracious, there is so many things that we don't even think about. Who would have thought of all those, what do you call those, things that come in and are bombing Ukraine? Oh, I forgot. (**9-6-15** [Gosslee, Susybelle])

Comment: I mean, to think about what a drone could do at that site. I think that the illustration of what's going on in Ukraine is a possibility of what could happen. When you're talking about an additional number of years, anything could happen. We already have people attacking the grid, for example. So that's a problem that we need to address. Also, we need to know about the economic impacts. Not only in the area of Glen Rose and the Somerville County, but also the whole region. What would happen with an accident? (**9-6-16** [Gosslee, Susybelle])

Comment: On the Lower Susquehanna River below Selinsgrove, PA there are 2 existing plants, Three Mile Island and Peach Bottom Atomic Power Station. In a recent attempt to amend a license, TMI-2 Solutions who owns TMI 2 failed to plan or study for airplane crashes, explosions, fires or intentional attacks, despite TMI's history of security vulnerabilities, and proximity to an international airport, major rail line, and two shorelines in three counties. Another accident could release radioactive emissions and leaks which may be directly harmful to the environment and water quality. These types of studies must be incorporated into the license renewal process. (**25-4** [Evgeniadis, Ted])

Response: *The NRC acknowledges the comments. Security-related issues are addressed as a current operating issue and are outside the scope of the LR GEIS and this rulemaking. As a result of the terrorist attacks of September 11, 2001, the NRC conducted a comprehensive review of the agency's security program and required further enhancements to security at a wide range of NRC-regulated facilities. These enhancements included significant reinforcement of the defense capabilities for nuclear facilities, better control of sensitive information, enhancements of emergency preparedness to further strengthen the agency's nuclear facility security program, and implementation of mitigating strategies to deal with postulated events that could potentially cause loss of large areas of the plant due to explosions or fires, including those that an aircraft impact, or similar strike, might create.*

The NRC routinely assesses threats and other information provided by a variety of Federal agencies and sources. The NRC also ensures that licensees meet appropriate security-level requirements. The staff will continue to address prevention of terrorist acts through the ongoing regulatory process as a current and generic regulatory issue that affects all nuclear facilities and many of the activities conducted at nuclear facilities. The issue of security and risk from malevolent acts at nuclear power facilities is not unique to facilities that have requested renewal of their operating licenses.

With regard to malevolent acts or sabotage resulting in a nuclear accident, it is the NRC's position that malevolent acts or sabotage are speculative and beyond the scope of a National Environmental Policy Act environmental review and, therefore, outside the scope of this LR GEIS and rulemaking. Nonetheless, the NRC has also considered the environmental impacts of severe accidents in this LR GEIS in Appendix E. Comments specific to the scope of the NRC's severe accident analysis are addressed in Section A.2.13 of this appendix. The NRC concludes that the consequences of events initiated by malevolent acts or sabotage would be comparable to or bounded by the severe accidents considered in Appendix E of this LR GEIS. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.

A.2.35 Out of Scope: Plant-Specific Issues

Comment: It's also interesting that the Pulunxy, am I pronouncing that right, Pulunxy? No, that's not right. Paluxy, I know that's right, River has this shell or fish in it that is only found around nuclear power plants. We may be, I may be mistaken about that, but in our reading we found something in that river has that. I'll check that out to be more accurate. I couldn't reach the person who brought that information to our attention. (**9-6-13** [Gosslee, Susybelle])

Comment: Then it gets into waste storage and transportation risks. The trains in Texas, the railroad tracks themselves are known to break. And we have had trains just blow over because of the wind in West Texas. We have, we'd have had head-on collisions, all of this in the last couple of years. It doesn't make the national news, but it happens. And that is something that you all need to evaluate because the waste is a major issue in this country. And it is all over the world. What are we going to do with the waste? And the proposal now is to transport 40,000 tons of it, it's going to come from the other reactors, to Texas to be stored in West Texas. 173,000 metric tons is going to be taken to New Mexico on train tracks that are old and crumbling, and on train cars that are not designed to carry the loads. And in casks that your website reports often leak. (**9-6-18** [Gosslee, Susybelle])

Comment: And that dam, I went out and looked at it myself, is it truly secure? It's very eroded just from my looking at it. (**9-7-4** [Gosslee, Susybelle])

Comment: We also are in tornado alley. So, what would be the impacts of a tornado on that reactor and how would the reactor respond if there were a tremendous tornado? (**9-7-6** [Gosslee, Susybelle])

Comment: d. Environmental implications of unresolved safety issues must be addressed with respect to Oconee Nuclear Power Plant

On September 21, 2021, Beyond Nuclear and the Sierra Club filed a Hearing Request regarding the SLR application filed by Duke Energy Corp. for the Oconee Nuclear Power Plant. The Hearing Request and all related pleadings and decisions are posted on the NRC's Electronic Hearing Docket. Beyond Nuclear hereby adopts and incorporates into these comments all pleadings demonstrating that the NRC's failure to resolve aformally identified dam safety issue constitutes an environmental concern that must be addressed in the EIS for Oconee. (**24-1-16** [Curran, Diane])

Comment: On January 15, 2021, Beyond Nuclear and the Sierra Club filed a Hearing Request regarding the SLR application filed by Virginia Electric Power Co. for the North Anna Nuclear Power Plant. The Hearing Request and all related pleadings and decisions are posted on the NRC's Electronic Hearing Docket. Beyond Nuclear hereby adopts and incorporates into these

comments all pleadings demonstrating that the occurrence of a beyond-design basis earthquake raises environmental risk issues that must be addressed in the SLR proceeding. (**24-1-17** [Curran, Diane])

Comment: Beyond Nuclear and the Sierra Club are participating in the NRC's adjudicatory proceedings regarding SLR applications for the North Anna and Oconee reactors. Beyond Nuclear is also participating in the adjudicatory proceeding regarding the SLR application for the Peach Bottom reactors. They seek to preserve a meaningful opportunity to participate under NEPA and the Atomic Energy Act. No meaningful opportunity to participate in that proceeding can be provided if the NRC relies on an inadequate GEIS to exclude significant environmental issues from the license renewal proceeding. (**24-1-22** [Curran, Diane])

Comment: Philadelphia Electric's ("PECO") applied for a license to operate the Peach Bottom Atomic Power Station in late-July, 1960. The application was approved by the Atomic Energy Commission. Peach Bottom was a 40 megawatt, High Temperature Graphite Moderated reactor that operated from 1966-1974. Peach Bottom 2 & 3 are 1,065 megawatt Boiling Water Reactor designed by General Electric and engineered by Bechtel. Both reactors began operation in July 1974, but had their licensees extended by the Nuclear Regulatory Commission (NRC) and are expected to operate through 2034.

The Nuclear Regulatory Commission ("NRC") and the Institute for Nuclear Power Operations ("INPO") have clearly demonstrated that Philadelphia Electric's ("PECO)", renamed Exelon in 2000, performance has historically been lackadaisical and sub-par. Exelon was "spun" into Constellation in 2022. In order to put Peach Bottom's operating history into perspective, it is necessary to review PECO's plant legacy.

According to Eric Epstein, Chairman, TMI-Alert: "Managerial problems further aggravate and compound the inherent flaws with Peach Bottom's reactor and containment structure." The reactors at Peach Bottom are General Electric("GE") Boiling Water Reactors ("BWR"). Epstein noted, "The GE-BWR is an obsolete design no longer built or constructed. Many in the industry feel it is inferior to Pressurized Water Reactors. Obviously, the age of the reactors, and the subsequent embrittlement that ensues, further erode the margin of safety."

Peach Bottom's Mark 1 containment structure has been demonstrated by Sandia Laboratories to be vulnerable during a core melt accident. Epstein explained: "The containment is likely to fail during a core melt accident [like Three Mile Island] allowing radiation to escape directly into the environment." Nuclear industry officials say the problem with the Mark 1 is that it is too small and wasn't designed to withstand the high pressure it is supposed to resist.[2]

[2] Epstein Petition for Leave to Intervene and Hearing Request (November 4, 2022)

The Susquehana River Basin (SRB) is spread over parts of New York, Pennsylvania, and Maryland. The river empties into the Chesapeake Bay and provides more than one-half of the freshwater flowing into it. The basin provides water resources for domestic & municipal uses, power production, agricultural & industrial activities, as well as for recreational & environmental uses. The basin also serves as a passage for several migratory fish species.

Water use and consumption as well as water supply and water chemistry have direct and indirect relationships with safety related components, plant cooling, and are intimately connected to the health and safety of the River and the local community. (**25-5** [Evgeniadis, Ted])

Comment: Power generation, cooling and safety are inherently connected. There is no separate imaginary fence between generation and safety. And there should be no regulatory moat created by artificial safety definitions erected by nuclear generators. Seasonal flow, Act 220, and the competing demands for limited water resources may make the amount of power for generation unreliable. Frequent power decreases and scrams show up as safety indicators and put stress on the nuclear generating stations. The NRC does not compile generation indicators, it analyzes safety indicators, like scrams and power reductions. The uprate clearly has the potential to create safety challenges by abruptly scramming the plant or forcing power reductions to accommodate a water use budget. Nuclear generating stations must also establish compliance milestones for EPA's Act 316 (a) or 316 (b). (**25-6** [Evgeniadis, Ted])

Comment: Enrico Fermi, unit 2

Fermi, unit 2 is the only operating reactor at the site it occupies with the retired unit 1 reactor, which has been defueled and awaits decommissioning since 1972. The site was licensed in 2015 for construction and operation of a third reactor, Fermi, unit 3, but the plant's owner, DTE Energy, announced at the time that it has no plans to begin construction. Fermi, unit 2 is located on the northwest shore of Lake Erie, in Monroe County, Michigan. Unit 2 is a General Electric Mark I BWR, which began operation in 1988, with a rated generation capacity of 1122 Mwe. At the time it was licensed, unit 2 was the largest Mark I reactor in the world.

Surface Water Impacts
Cooling System Type: Evaporative Draft Cooling Tower Cooling Water Source: Lake Erie
Ultimate Heat Sink: Lake Erie Surface Water Impacts: Harmful Algal Blooms
Thermal Pollution
Impingement and Entrainment of fish and aquatic life

Radioactive Releases
*Liquid effluents are discharged into Lake Erie and Swan River
*Over 1 million gallons of contaminated water from a 1993 accident were released into Lake Erie.

Nuclear Disasters/Accidents
In 1993, a turbine blade broke off and caused extensive damage to the plant and a fire.[1] Over 1 million gallons of water used to put out the fire became radioactively contaminated, and was eventually discharged into Lake Erie.
[1] Henry, Tom. "Fukushima plans stir memories for Fermi 2 water release." The Toledo Blade. April 18.2021. https://www.toledoblade.com/frontpage/2021/04/18/On-a-much-smaller-scale-Fermi-2-had-a-radioactive-waterrelease-in-1993-too/stories/20210417021 (**29-3** [Judson, Tim])

Comment: James A. FitzPatrick Nine Mile Point, units 1 and 2

The James A. FitzPatrick and Nine Mile Point nuclear power plants are physically adjacent to one another on the shore of Lake Ontario, in the town of Lycoming, Oswego County, New York. Historically, they were licensed and operated as two separate power plants, and had different owners. The plants came under common control and operation by a single corporation in 2017, when Exelon Corp. purchased FitzPatrick from Entergy Corp. As of 2023, they are now 100% owned and operated by Constellation Energy, under a series of corporate restructurings executed by Exelon from 2021-2023.

All three reactors are General Electric BWRs. Nine Mile Point, unit 1, and FitzPatrick are Mark I models, which began commercial operation in 1969 and 1975, respectively. Nine Mile Point, unit 2, is a Mark II, and began commercial operation in 1988. Nine Mile Point 1 is the oldest currently operating reactor in the U.S., and the fourth oldest globally. Lake Ontario is an international body of water, shared with Canada and overseen by the International Joint Commission on the Great Lakes (IJC). Under the Boundary Waters Treaty of 1909, the IJC has the authority to "approve projects that affect water levels and flows across the boundary and investigating transboundary issues and recommending solutions," including a number of matters that could be impacted by Nine Mile Point and FitzPatrick: drinking water, commercial shipping, hydroelectric power generation, agriculture, ecosystem health, industry, fishing, recreational boating and shoreline property. Among other concerns, a nuclear disaster at Nine Mile Point and/or FitzPatrick could have severe impacts on all of the above.

Furthermore, the Nine Mile Point and FitzPatrick sites are on unceded treaty lands of the Onondaga Nation. The Onondaga Nation has thoroughly documented concerns over the impacts of Nine Mile Point and FitzPatrick to its territory in a 2020 red paper.[2] In addition, the waters of Lake Ontario and its outlet, the St. Lawrence River, are part of the sovereign territories of several other Indigenous nations, including the Abinaki, Cayuga, Missisauga, Mohawk, and Seneca nations. The international dimensions of the impacts to Lake Ontario are inherently site-specific.

[2] Onondaga Nation, Haudenosaunee Environmental Tax Force, and American Indian Law Alliance. "Nuclear Reactors are Not Green'." January 30, 2020. https://storage.googleapis.com/wzukusers/user28491011/documents/3d6172a81ffc4c5ab8c805800face0e3/NukeRedPaper1-30-20-haudenosaunee.pdf

Surface Water Impacts
Cooling System Type: Nine Mile Point, unit 1 - Once-Through Cooling
Nine Mile Point, unit 2 - Evaporative Draft Cooling Tower
James A. FitzPatrick - Once-Through Cooling
Cooling Water Source: Lake Ontario
Ultimate Heat Sink: Lake Ontario
Surface Water Impacts: Thermal discharges (Nine Mile Point, unit 1, and FitzPatrick)
Entrainment and Impingement of Aquatic Species
Entrainment and Impingement of Avian Species (2000 event)
Endangered Species
Drinking Water Impacts: Lake Ontario is the drinking water source for 9 million people
Liquid effluent discharges (**29-4** [Judson, Tim])

Comment: 1991 release at FitzPatrick
Tritium leaks at Nine Mile Point and FitzPatrick
There four species of fish in Lake Ontario listed as threatened or endangered.[3]
[3] https://animals.mom.com/endangered-species-lake-ontario-8734.html
In January 2000, Nine Mile Point, unit 1, killed over 100 ducks when operators reversed the directional flow of the water intake system.[4]

[4] Gunter, Linda, Paul Gunter, Scott Cullen, Nancy Burton, Esq. "Licensed to Kill: How the nuclear power industry destroys endangered marine wildlife and ocean habitat to save money." Safe Energy Communication Council, Humane Society of the United States, Nuclear Information and Resource Service, and STAR Foundation. 2001. http://www.nirs.org/wp-content/uploads/reactorwatch/licensedtokill/LiscencedtoKill.pdf

Nine Mile Point 2: Legionnaire's disease from cooling tower infestation in 1989

Radioactive Releases
*All three reactors release liquid and gaseous radioactive effluents through their routine operations. In several instances, larger than normal and accidental releases have occurred.

*NRC effluent release reports documented over 3 million curies of noble gas releases from Nine Mile Point and FitzPatrick.

*Nine Mile Point,unit 1,spilled 40,000 gallons of radioactive water in the wastewater treatment facility in 1981,which was covered up and went unremediated for eight years.

*In March 1991,FitzPatrick released an unmonitored amount of radioactive materials from a vent in one of the radioactive waste concentrators, contaminating areas of the reactor site and discharging into Lake Ontario.[5]

[5] U.S. Nuclear Regulatory Commission. "Notice of Violation and Proposed Imposition of Civil Penalty." July 17, 1991.
https://adamswebsearch2.nrc.gov/webSearch2/main.jsp?AccessionNumber=ML20085A455

*Through the 1990s,both Nine Mile Point and FitzPatrick illegally sent dozens of shipments of radioactive sewage to Oswego County's wastewater treatment plant.

*Nine Mile Point and FitzPatrick have both had documented leaks of tritium.[6]

[6] Groom, Debra J. "Low levels of tritium found at FitzPatrick nuclear plant." The Post-Standard. Syracuse, NY. December 29,
2009. https://www.syracuse.com/news/2009/12/low_levels_of_tritium_found_ou.html
U.S. Nuclear Regulatory Commission. "List of Leaks and Spills at Operating U.S. Commercial Nuclear Power Plants October, 2020." https://www.nrc.gov/docs/ML2014/ML20141L500.pdf

Other Pollution and Environmental Health Impacts
The county has been suffered many environmental harms, including one of the largest coal plants in the state (now retired), and four superfund sites. The latter includes a hazardous waste incinerator, Pollution Abatement Services, which operated intermittently from 1970-1977. Nine Mile Point and FitzPatrick remain among the largest polluters in the area, their environmental impacts compound those of other polluting facilities and legacy environmental pollution from these and other sources.

Socioeconomic Impacts
Oswego County, where Nine Mile Point is located, has high rates of poverty unemployment. The local economy has long suffered from losses of well-paying jobs due to factory closures and deindustrialization, as well as declines in the agricultural sector. The nuclear power plants (Nine Mile Point and FitzPatrick, both owned by Constellation Energy) have been the largest private sector employer in the county for many years.

Nine Mile Point's continued operation has been based on out-of-market subsidies paid by New York consumers --subsidies much larger than the Nuclear Production Credits available under the Inflation Reduction Act. A second license extension for Nine Mile Point --especially unit 1 --is likely contingent on such subsidies continuing. The increased cost of electricity due to New York's nuclear subsidies is passed on to all consumers (residential, government, and

businesses). This means residential consumers have less income to pay for non-utility expenses, reducing their spending in local businesses. Local governments have less funds available for schools and other government services. Both large and small businesses have higher costs, and tend to raise prices and/or cut costs. The latter can include cutting labor costs by reducing the size of their workforce. Because renewable energy sources are both lower cost for energy and create more jobs/MWh of generation, the continued operation of Nine Mile Point will have a negative effect on jobs in New York State.

An analysis conducted in 2015 found that local jobs and economic development could be achieved by phasing out the FitzPatrick reactor, through a just transition for workers and the local community, at lower cost to New York electricity consumers, and lower greenhouse gas emissions.[7]

[7] Azulay, Jessica, and Tim Judson. "Replacing FitzPatrick: How the Closure of a Nuclear Reactor can Reduce Greenhouse Gasses and Radioactive Waste, while Creating Jobs and Supporting the Local Community." Alliance for a Green Economy and Nuclear Information and Resource Service. 2015. https://www.nirs.org/wp-content/uploads/neconomics/replacingthefitzpatricknuclearreactor.pdf (**29-5** [Judson, Tim])

Comment: Nuclear Disasters/Accidents

Nine Mile Point unit 1 is the oldest operating reactor in the US, beginning operation in 1969.
* Cracked welds in the core shroud have been known since at least 1994,the worst cracking of reactor internals in the industry at the time, after 25 years of operation. The reactor is over 53 years old. The core shroud was not repaired, but outfitted with spring-tensioned tie-rods to apply additional friction and pressure on the cracked welds. Tie-rods failed before the 1997 outage and inspection, and tie-rod repairs were made. NRC exempted the reactor's core shroud from further crack inspections in 1998,based on a disputed evaluation of inspection results.[8]

[8] Division of Engineering, U.S. Nuclear Regulatory Commission. "Status report: Intergranular stress corrosion cracking of BWR core shrouds and other internal components." March 1, 1996. https://www.osti.gov/servlets/purl/236061
U.S. Nuclear Regulatory Commission. "Information Notice No. 97-17: Cracking of Vertical Welds in the Core Shroud and Degraded Repair." April 4, 1997. https://www.nrc.gov/reading-rm/doc-collections/gen-comm/info-notices/1997/in97017.html
Associated Press. "Inspection Is Urged at a Nuclear Plant." The New York Times. September 26, 1998. https://www.nytimes.com/1998/09/26/nyregion/inspection-is-urged-at-a-nuclear-plant.html
U.S. Nuclear Regulatory Commission. "Niagara Mohawk Power Corporation, Nine Mile Point Nuclear Station, Unit No. 1; Issuance of Final Director's Decision Under 10 CFR 2.206." Federal Register. December 3, 1999.
https://www.govinfo.gov/content/pkg/FR-1999-12-03/pdf/99-31377.pdf

* Cracks in the Nine Mile Point unit 2 core shroud were documented in 2000, after only 12 years of operation. [9]
[9] Niagara Mohawk Power Corporation. *Core Shroud Reinspection Results (TAC No. MA 7284)." April 28, 2000. https://www.nrc.gov/docs/ML0037/ML003712802.pdf
Nine Mile Point, unit 2, underwent a 15% extended power uprate in 2012, increasing power output to 20% greater than the original license after a 4.3% stretch power uprate in 1996. The 2012 uprate was achieved by increasing fuel enrichment from 4.2% to 4.36%, and increasing the number of fuel assemblies in the core from 764 to 840. Average fuel burnup rate would be

48,000 MWD/tU. The reactor vessel has 15% more fissile material in the core, greater decay heat at higher burnup. There is also less volume of coolant water within the core shroud, due to the 10% increase in the number of fuel assemblies. The license amendment states that the power uprate will result in increased amounts of iodine fission products in the core.[10]
[10] U.S. Nuclear Regulatory Commission. "Nine Mile Point Nuclear Station, Unit No. 2 - Issuance of Amendment re: Extended Power (TAC NO. ME1476)." December 22, 2011. https://www.nrc.gov/docs/ML1133/ML113300041.pdf (PDF pp. 167, 175)
U.S. Nuclear Regulatory Commission. "Docket No. 50-410 - Nine Mile Point Nuclear Station, Unit 2: Renewed Facility Operating License https://www.nrc.gov/docs/ML0527/ML052720302.pdf (p. 377) (**29-6** [Judson, Tim])

Comment: Nine Mile Point 1 and FitzPatrick are both General Electric Mark I BWRs. Nine Mile Point unit 2 is a Mark II BWR. Both designs are known to have containment systems vulnerable to failure in a loss-of-coolant accident, as demonstrated by the meltdowns and hydrogen explosions at the three Mark I BWRs that were operating when the Tohoku earthquake and tsunami struck the Fukushima Dai-Ichi nuclear power plant.

*FitzPatrick is the only Mark I BWR in the country which operated for over 40 years without installing a hardened containment vent, and was the last to comply with NRC's post-Fukushima orders to retrofit the containment venting systems (in 2018).

*All three reactors have elevated fuel pools which are racked to maximum density, conditions that a National Academy of Sciences panel concluded makes the risk of fuel pool fires caused by acts of malice a national security risk that should be addressed by removing fuel to dry storage and low-density racking, per the original plant license.

o This risk would be mitigated if the reactors retired when their operating licenses expire. To date, licensees have only eliminated high-density fuel pool storage of irradiated fuel during decommissioning.

Nine Mile Point 2 experienced a station blackout event in 1991, declaring a site area emergency.[11]

[11] Time Magazine. "Nuclear Power: Down for the Count." August 26, 1991. https://archive.ph/20130204092426/http://www.time.com/time/archive/preview/0,10987,973670,00.html

Nine Mile Point and FitzPatrick are subject to extreme weather events that could be initiating events for a radiological disaster:

* Ice storms downed power lines and caused widespread power outages in 2003, which also knocked out most of the offsite emergency sirens and made road travel extremely hazardous,due to ice,downed trees, and downed power lines. A 2022 ice storm downed power lines and caused outages in several parts of Oswego County within the emergency planning zone.[12]
[12] U.S. NRC. "Daily Event Reports, Event Numbers 39729, 39730, 39731, and 39737." April 7, 2003. https://www.nrc.gov/reading-rm/doc-collections/event-status/event/2003/20030407en.html
Moyers Corners Fire Department. "Major Ice Storm Hits Central New York." April 7, 2003. http://www.mcfd.org/news/5435559c626163190e8c0000

Welytok, Kayla. "Check out the latest power outages." WSYR-TV. November 17, 2022. https://www.localsyr.com/news/local-news/oswego-county-slammed-with-power-outages-during-heavy-snow/
Hayes, Anne. "Ice buildup knocked out power for thousands in Oswego County, most restored." Syracuse.com. November 16, 2022. https://www.syracuse.com/crime/2022/11/ice-buildup-knocked-out-power-for-thousands-in-oswego-county-most-restored.html
*Severe lake-effect snowfalls can make roads impassable and potentially interfere with deployment of FLEX equipment. In 2005,Oswego experienced a 10-foot snowfall over 8 days,and nearby Fulton experienced two 8-foot snowfalls within two weeks of each other.[13]

[13] Fernandez, Manny. 8 Days, 10 Feet and the Snow Isn't Done Yet." The New York Times. February 12, 2007. https://www.nytimes.com/2007/02/12/nyregion/12snow.html

*The sites are subject to flooding risks from high lake water levels and/or storm surge. [14]

[14] Horning, Payne. "High Lake Ontario levels nearly pushed Nine Mile nuclear plant into emergency action." WRVO. July 14, 2017. https://www.wrvo.org/environment/2017-07-14/high-lake-ontario-levels-nearly-pushed-nine-milenuclear-plant-into-emergency-action

*Lake Ontario develops frazil ice during winter, which can cause clogging of cooling water intakes. [15]

[15] U.S. NRC. "Power Reactor Status Report for February 13, 2000." February 13, 2000. https://www.nrc.gov/readingrm/doc-collections/event-status/reactor-status/2000/20000213ps.html
Lochbaum, David. "Fission Stories #199: Frazzled at FitzPatrick." December 27, 2016. https://blog.ucsusa.org/dlochbaum/frazzled-at-fitzpatrick/ (**29-7** [Judson, Tim])

Comment: Millstone, units 2 and 3

Millstone units 2 and 3 are located on the coast of Long Island Sound, in Waterford, Connecticut. Both are pressurized water reactors of different designs. Unit 2 was designed by Combustion Engineering, has a licensed thermal capacity of 2700 MWt, and began commercial operation in 1975. Unit 3 was designed by Westinghouse, has a licensed thermal capacity of 3709 MWt, and began commercial operation in 1986. They share the site with Millstone, unit 1, a General Electric Mark I BWR, which retired in 1998 and awaits decommissioning. Under the commission's previous oversight process, Millstone was placed on NRC's Watch List and found guilt of falsifying environmental records and other serious violations.[16] Public beaches and recreational areas are near the plant, and can be affected by liquid and gaseous releases from the reactors.

[16] Allen, Mike. "A Record Fine at a Connecticut Nuclear Power Plant." The New York Times. September 28, 1999. https://www.nytimes.com/1999/09/28/nyregion/a-record-us-fine-at-a-connecticut-nuclear-plant.html

Surface Water Impacts
Cooling System Type: Once-Through Cooling (both units)
Cooling Water Source: Long Island Sound
Ultimate Heat Sink: Long Island Sound
Surface Water Impacts: Impingement and Entrainment of Aquatic Species
Significant impact on Niantic River winter flounder[17]

[17] Hartford Courant. "Flounder Kill: Which One is the Main Culprit?" February 11, 1999. https://www.courant.com/1999/02/11/flounder-kill-which-one-is-main-culprit/

Radioactive Releases
Millstone reactors' operations have released radioactive materials to the environment in several ways:
*Radioactive Water Discharges
*Radioactive Gas Discharges
*Known Leaks, Spills, Groundwater Contamination Requiring Clean-up
*Offsite Dumping/Disposal/Release of Radioactive Waste
The reactor site's proximity to public beaches and recreation areas make it possible for larger populations to be exposed than local residency demographic data would indicate.

Other Pollution and Environmental Health Impacts
Millstone was found to have feloniously discharged toxic waste in 1996.[18] The surrounding community suffers from a statistically high level of cancers and other diseases.[19]

[18] New York Times, 1999.
[19] Goranson, Susan. "94-R-0023." Office of Legislative Research, Connecticut General Assembly. February 1, 1994. https://cga.ct.gov/PS94/rpt%5Colr%5Chtm/94-R-0023.htm
(**29-8** [Judson, Tim])

Comment: <u>Peach Bottom, units 2 and 3</u>

Philadelphia Electric's ("PECO") applied for a license to operate the Peach Bottom Atomic Power Station in late-July, 1960. The application was approved by the Atomic Energy Commission. Peach Bottom, unit 1, was a 40-megawatt, High Temperature Graphite Moderated reactor that operated from 1966-1974. Peach Bottom 2 & 3, are 1,065 megawatt Boiling Water Reactor designed by General Electric and engineered by Bechtel. Both reactors began operation in July 1974.

The Nuclear Regulatory Commission ("NRC") and the Institute for Nuclear Power Operations ("INPO") have clearly demonstrated that Philadelphia Electric's ("PECO)", renamed Exelon in 2000, performance has historically been lackadaisical and sub-par. Exelon "spun off" Peach Bottom and all of its other nuclear power plants into Constellation in 2022. In order to put Peach Bottom's operating history into perspective, it is necessary to review PECO's plant legacy. According to Eric Epstein, Chairman, TMI-Alert: "Managerial problems further aggravate and compound the inherent flaws with Peach Bottom's reactor and containment structure." The reactors at Peach Bottom are General Electric ("GE") Boiling Water Reactors ("BWR"). Epstein noted, "The GE-BWR is an obsolete design no longer built or constructed. Many in the industry feel it is inferior to Pressurized Water Reactors. Obviously, the age of the reactors, and the subsequent embrittlement that ensues, further erode the margin of safety."
Peach Bottom's Mark I containment structure has been demonstrated by Sandia Laboratories to be vulnerable during a core melt accident. Epstein explained: "The containment is likely to fail during a core melt accident [like Three Mile Island] allowing radiation to escape directly into the environment." Nuclear industry officials say the problem with the Mark 1 is that it is too small and wasn't designed to withstand the high pressure it is supposed to resist.

February 18, 1987 -An NRC study said Peach Bottom's reactors were more likely to release radiation in the event of a core-melt accident.

March 31, 1987 -Peach Bottom was indefinitely shutdown. Operators were found sleeping on the job, playing video games, engaging in rubber band and paper ball fights, and reading unauthorized material.
January 11, 1988 -INPO President Zack Pate strongly criticized Philadelphia Electric's management and their revised reorganization plan.

Pate noted that, "The fundamental approach to nuclear operational management at Philadelphia Electric Company has not changed and is unlikely to change noticeably in the foreseeable future." He added, "success ultimately depends on the individual managers in key line positions. Since for the most part, the same managers who have been ineffective in this area for years are in the key line positions in the new organization, substantial improvement is unlikely." Pate concluded, "Major changes in the corporate culture at PECO are required. The recently announced reorganization plan will not achieve this."[20]

[20] Nuclear Information and Resource Service. The Nuclear Monitor. February 22, 1988. pp.1-2

Surface Water Impacts
Cooling System Type: Once-Through Cooling Cooling
Water Source: Susquehanna River
Ultimate Heat Sink: Susquehanna River
Surface Water Impacts: Harmful Algal Blooms
Thermal Pollution
Impingement and Entrainment of fish and aquatic life

During the 2002 drought nuclear power plants were exempted from water conservation efforts and participate in a "voluntary" program. In Pennsylvania, twenty-four counties were designated as "drought emergencies", and another thirty-one were on "drought watch." The Governor, the Secretary of the Department of Environmental Protection, and the Chairman of the Public Utility Commission, implored Pennsylvanians to conserve water. As the Patriot News astutely observed: "Warnings about the growing pressure on supplies are increasing, but much of the population continues to take the the availability of water for granted" (Editorial, September 24, 2002). Yet, no elected official approached the five "security conscious" nuclear power plants to coordinate operation of their assets in a manner that would conserve scarce water resources. Peach Bottom did not "conserve" water until the plant was forced to close to address a massive fish kill. On August 30, 2002, high differential pressures on the circulating water intake screens forced the manual shut down of Peach Bottom. "The problem was caused by a sudden surge in the amount of fish (Gizzard Shad) that entered the intake canal and clogged the screens. Unit 3 power was returned to 100 percent following cleaning of the circulating water screens and restating of the 3'A' circulating water pump" (Source: Nuclear Regulatory Commission, IR-50-277/02-05; 50-278/02-05).

"Whether the kills are legal or not, a former southern Lancaster County worker at the Peach Bottom nuclear plant said he was "sickened' by the large numbers of sport fish he saw sucked out of the Susquehanna. "When the water comes in, fish would swim in through tunnels and swim into wire baskets," said the man who lives in southern Lancaster County and asked that his name not be used. "There were hundreds and hundreds of fish killed each day. Stripers and bass and walleye and gizzard shad and all kinds of fish. It took a forklift to carry them out. "Every species in the river comes in there when they turn those big intakes on." ("Intelligencer Journal," January 15, 2005)

"Two electric utilities, PPL Corp. and Exelon Corp., have paid large sums of money to settle disputes with the Susquehanna River Basin Commission over the amount of water they use to operate their nuclear power plants. PPL last week agreed to pay $500,000 to the commission to settle a claim that it did not get permission six years ago to increase the water it takes from the river. Last December, Exelon Nuclear paid $640,000 to settle a similar claim related to its Peach Bottom plant in York County."[21]

[21] Patriot News. September 19, 2007.
In 2007, Peach Bottom, units 2 and 3, were documented returning water to the River at temperatures in excess of 110 degrees.

Radioactive Releases
September 15, 1989 -The Pennsylvania Superior Court reversed a lower court's decision dismissing charges by George Field against the Philadelphia Electric Company. Field, a health-physics technician, alleged that PECO directly released radiation on him to avoid shutting the plant down. The three judge panel concluded: We can visualize no conduct more outrageous in character, so extreme in degree, that went beyond all possible bounds of decency and to be regarded as atrocious and utterly intolerable in a civilized community, than to vent highly radioactive steam upon an employee. Furthermore, this was an intentional act. They elected to do this to him and then attempted to conceal the resulting situation The three judge panel remanded the case back to York County Common Pleas Court. Field is seeking $5.2 million in damages.[22]

[22] The Philadelphia Inquirer. September 15, 1989. Page 3-B. (**29-9** [Judson, Tim])

Comment: Nuclear Disasters/Accidents

There have been several safety and security vulnerabilities at Peach Bottom over the course of its operational history.

March 3, 2008: NRC Annual Assessment called for *additional regulatory oversight" of Peach Bottom's performance, as a result of security officer inattentiveness revealed in the last quarter of 2007. The inspection covered all of 2007 and the plant was found to have performed satisfactorily in areas related to reactor and radiation safety. Enhanced oversight will include additional inspections in the areas of security force performance monitoring, corrective actions, safety conscious work environment (SCWE) and completion of commitments. The Nuclear Regulatory Commission's report on the annual inspection told Exelon that *behaviors and interactions within the security organization did not encourage the free flow of information related to raising safety issues." This presumably was a reference to media reports that the Wackenhut Corp. security officer who videotaped his fellow officers sleeping on the job, claimed he had tried to report the problem within the work environment and was met with no action, before he gave the recording to local media. Peach Bottom received a White rating for the violations, through the Reactor Oversight Process.

Officials of the Nuclear Regulatory Commission met with Exelon Generation Co. representatives to discuss the results of an NRC inspection that focused on "safety conscious work environment" (SCWE). The inspection and the meeting were in response to incidents related to Wackenhut Corp. security officers, who were found sleeping on the job and the related issue of why incidents were not reported before a worker took a videotape to the media.

The NRC requires that license holders, like Exelon, "maintain an environment in which safety issues are promptly identified and effectively resolved and employees feel free to raise safety concerns," according to an NRC announcement of the April 15 meeting.
November, 1987: The Federal Bureau of Investigations discovered a drug distribution ring at Peach Bottom.[23]

[23] Associated Press. "Six Arrested on Charges Of Drug Dealing at Nuclear Power Plant." November 18, 1987. https://apnews.com/article/9f14835943af0c9f86446af8c79a3abe
February 18, 1987: An NRC study said Peach Bottom's reactors were more likely to release radiation in the event of a core-melt accident. (**29-10** [Judson, Tim])

Comment: Point Beach, units 1 and 2

Point Beach, units 1 and 2, are located in Two Rivers, Wisconsin, on the shore of Lake Michigan, the source of drinking water for 10 million people. Both reactors are PWRs designed by Westinghouse, with a licensed thermal capacity of 1,800 MWt. Unit 1 began commercial operation in 1971, making it one of the oldest currently operating reactors in the U.S. Unit 2 began commercial operation in 1973; it is known to have one of the most severely embrittled reactor vessels in the U.S. Point Beach is known to have a historically poor operational safety record.[24] Originally owned and operated by Wisconsin Electric Power, NextEra Energy Resources purchased it in 2007 under utility restructuring. While it has since operated as a merchant power plant, NextEra sells 90% of its electricity output to We Energies at fixed prices, which escalate annually.

[24] Nukewatch. "Point Beach Nuclear Reactors." February 16, 2021. https://www.closepointbeachnuclear.org/_files/ugd/242ced_25488a610ff8439d8483f3a894a111ae.pdf

Surface Water Impacts
Cooling System Type: Once-Through Cooling
Cooling Water Source: Lake Michigan
Ultimate Heat Sink: Lake Michigan
Surface Water Impacts: Impingement and Entrainment of Aquatic Life
Thermal Effluents

Built just before the National Environmental Policy Act (NEPA) mandated cooling towers for many new power plants, Point Beach, units 1 and 2, require 85-95% more water than would be necessary for nuclear plants with cooling towers. The reactors intake and then discharge an average of 915 million gallons of Lake Michigan water each day.

This once through cooling system has high volume flow rates for intake and discharge systems that damage or destroy fish larvae and phytoplankton and delivers excess thermal heat to the natural aquatic ecosystem of Lake Michigan.

The water is returned to the lake up to 24.3 degrees Fahrenheit hotter than the seasonal lake temperature.

Radioactive Releases
If NextEra's request to operate Point Beach for an additional 20 years (to 2050/53) is granted, the reactors will generate an additional 504 metric tons of high-level nuclear wastes in that timespan. The operation of the reactors from 1970-2017 created an estimated 965 metric tons

of waste and by the end of the current licenses in 2030/2033 there will be a total of 1,342 metric tons of waste that will remain in dry cask storage on the shore of Lake Michigan*an environmental risk to local communities for generations to come.

Socioeconomic Impacts
Based on a report from Mark Cooper, the Purchased Power Agreement (PPA) between NextEra (owners of PBNP) and We Energies from 2007, means ratepayers are paying 1.8 times the market price of electricity today and will see rates more than double over the next decade. For We Energies customers this will total about $5 billion by the end of this current licensing in 2030-2033. We understand that energy burden is a real environmental justice issue facing financially struggling Wisconsin families.

Erosion and Climate Change
Changing lake levels have caused significant erosion around the shores of Point Beach. The site itself is imperiled due to the many impacts of climate change. For example, there is great volatility in lake levels with the lowest level recorded in history for Lake Michigan in 2013 and the historically highest level recorded in 2020.

The increasing number of extreme weather events in the Midwest add significant vulnerability to the safe operation of nuclear reactors. For instance, the derecho which struck the Duane Arnold reactor in Iowa in August 2020 destroyed its cooling towers and backup generators. Several derechos have impacted Wisconsin, including the August 2020 derecho. This century, those include the June 2001 Central Wisconsin Derecho, the July 2011 Upper Midwest-Great Lakes Derecho, and the December 2021 Midwest Derecho and tornado outbreak.

Nuclear Disasters/Accidents
Point Beach Nuclear Plant Unit 2 was cited by the NRC in 2013 as one of the most embrittled reactor pressure vessels (RPV) in the United States. Embrittlement is the loss of strength, ductility and resistance to cracking, and markedly increases the risk that the reactor pressure vessel could crack open if the reactor would need to be suddenly flooded with cold water during an emergency shutdown. This would lead rapidly to a loss-of-coolant accident and reactor meltdown, and release radioactivity into the air, water and soil surrounding Point Beach, contaminating the drinking water source for 10 million people. (**29-11** [Judson, Tim])

Comment: <u>Seabrook</u>

Seabrook is a PWR designed by Westinghouse, located in Seabrook, New Hampshire, near Hampton Harbor and the saltwater marsh estuary to the Atlantic Ocean, 40 miles north of Boston, Massachusetts. It has a rated generation capacity of 1244 Mwe, and began commercial operation in 1990, after 14 years of construction. Long construction time and financial mismanagement led to many whistleblower reports of construction deficiencies. Seabrook is the only nuclear plant in U.S. known to be experiencing alkali-salt reaction (ASR) micro-cracking in concrete foundations and other structures. Tritium leakage (and subsurface flooding) began before the reactor was ten years old, necessitating pumping of contaminated groundwater into cooling water outfall pipes offshore. In early operation, cooling water inflow killed dozens of seals, until excluder devices were installed on the intakes (in response to complaints from environmental organizations). Originally built and operated by Public Service of New Hampshire, it has been owned and operated by NextEra energy

Surface Water Impacts
Cooling System Type: Once-Through Cooling
Cooling Water Source: Atlantic Ocean
Ultimate Heat Sink: Atlantic Ocean
Surface Water Impacts: Impingement and Entrainment of Aquatic Life
Groundwater Contamination (tritium)

The license renewal EIS in 2015 documented impingement/entrainment (death) to hundreds of thousands of fish species and many millions of mollusk/fish larvae and fish eggs over the life of plant. Two fish species of commercial value in particular were identified as having "large" impacts from continued operations. NMFS reportedly expressed concern over this situation, though re-licensing moved forward. Groundwater degradation from tritium leakage (described above) was also documented in the 2015 license renewal EIS.

Radioactive Releases
Tritium releases as described above.

Other Pollution and Environmental Health Impacts
A cancer cluster for two rare childhood cancers was identified in downwind NH Seacoast communities by New Hampshire Public Health Services in 2017, though no conclusions were ever made as to a possible source. A previous analysis of CDC data by the Radiation and Public Health Project found that there was an increase in childhood cancer incidence in the region in the decade after Seabrook began operations, versus the decade prior to reactor startup.

Nuclear Disasters/Accidents
Climate/extreme weather impacts could lead to increased risk of a nuclear disaster. The "Lessons Learned" report in 2018 found that likely extreme precipitation and storm surge (using old sea level rise estimates) would cause "beyond design basis" impacts, risking flooding of reactor building and other facilities. NextEra's principal mitigation measure is to stockpile sandbags, as a voluntary measure.

Progression of ASR degradation of concrete structures could lead to increased seismic risk, as well as the potential for containment failure.

Seabrook's proximity to Boston and busy summer recreation areas puts a great number of people at risk. Large numbers of people visiting beaches and parks in the summer months lead to severe traffic congestion within the emergency planning zone, which could make both prompt evacuation and sheltering-in-place impossible. (**29-12** [Judson, Tim])

Comment: In April of 2023, Nuclear Information and Resource Service collected survey responses on site-specific environmental impacts of several nuclear reactor sites. Data was compiled by questionnaires completed by members of local, regional, and national environmental organizations with specific historical knowledge of the reactor sites on which they provided information. The sites include both boiling water reactors and pressurized water reactors, located near different types of water sources (lakes, oceans, and rivers). Summaries of the data collected on the following reactors are included below, with documentation to the extent available. Because many of the reactors' operations began in the 1970s, documentation of many incidents must only be accessed from NRC's Public Document Room via microfiche records. (**29-13** [Judson, Tim])

Comment: Turkey Point Power Plant's present-day environmental impacts will persist into the future:

Given the numerous environmental issues outlined above, the undersigned assert that the following environmental issues must be addressed for site-specific review, and/or elevated in significance. (**31-9** [Silverstein, Rachel])

Comment: Thank you for the opportunity to comment. Because the NRC denied our request for additional time to prepare comments on the proposal, Miami Waterkeeper will send an addendum to this letter after May 16, 2023, which is the date of the 5-year midpoint of recovery well operation. At this time, it should be known if the plant operator is required to revise the hypersaline groundwater remediation plan. A modification to the plan could include additional recovery wells and/or alternate sources of water, such as a reverse osmosis plant. Changes to the remediation plan could incur environmental impacts - beneficial or otherwise-that the NRC should consider in any 20-year license extension. (**31-20** [Silverstein, Rachel])

Comment: The Turkey Point SEIS provides a stark example of the NRC's failure to take the hard look required by NEPA. NRDC, Friends of the Earth, and Miami Waterkeeper brought a contention arguing that the NRC failed to take a hard look at sea level rise for the Category 1 issue Termination of Plant Operations and Decommissioning. The NRC rejected this contention and never addressed sea level rise on this, or any other, Category 1 issue.[76] As we explained in our scoping comments on the Turkey Point SLR:

[T]he NRC should consider climate change impacts on the decommissioning process. Rising sea levels, and other climate impacts, are likely to interfere with the decommissioning process if left unmitigated. Notably, the decommissioning process will take longer than the 20-year license renewal period to complete; the power plant will be there until 2093 if the no-action alternative is taken and potentially to 2113 if the power plant is relicensed. Thus, the environmental impact statement must consider projections of sea level rise beyond the license renewal period. If, as predicted, sea level rise accelerates through the remainder of the century, it will have a dramatic impact on the east coast, including Turkey Point. FPL will need to adapt to the rising sea levels both during the proposed operational lifetime and the subsequent decommissioning. Related impacts must be addressed.[77]

[76] 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, at 2-3 (Oct. 2019) ("There are no site-specific issues related to decommissioning.").
[77] Friends of the Earth and NRDC, Comments on the Scope of the U.S. Nuclear Regulatory Commission's Environmental Impact Statement for Proposed Subsequent License Renewal of the Operating Licenses for Turkey Point Nuclear Plant Unit Nos. 3 and 4. Docket Nos. 50-250 and 50-251; NRC-2018-0101 (June 21, 2018). (**32-5-5** [Reiser, Caroline])

Response: *The NRC acknowledges the comments and the information provided. Several comments raised issues regarding specific nuclear power plants or raised concerns about plant-specific license renewal actions, without any clear nexus to the scope of the LR GEIS and associated rulemaking. As detailed in Section 1.7 of this LR GEIS, the NRC's license renewal environmental review process is the focus of this LR GEIS and rulemaking. The specific purpose of this LR GEIS and associated rulemaking is to identify and evaluate the environmental issues that could result in the same or similar impact (i.e., generic issues) on the environment at all nuclear power plants or a specific subset of plants and determine which*

issues could result in different levels of impact, thus requiring nuclear power plant-specific environmental analyses for impact determination.

This revised LR GEIS builds upon the lessons learned and knowledge gained by the NRC when evaluating the potential environmental effects of continued operations and refurbishment of nuclear power plants since the first LR GEIS was issued in 1996. Specifically, as discussed in Section 4.1.3 of this LR GEIS, the 2023 draft LR GEIS and proposed rule were informed by lessons learned and knowledge gained from conducting initial license renewal (initial LR) and subsequent license renewal (SLR) environmental reviews since development of the 2013 LR GEIS.

To the extent that these comments request that the NRC modify the LR GEIS and its characterization of environmental issues as either Category 1 (generic) or Category 2 (plant-specific) issues, the categories are used to avoid duplication and allow the NRC to focus specifically on those issues that are important for a particular plant. Category 1 issues are termed "generic" issues because the conclusions related to their environmental impacts were found to be common to all nuclear plants or a specific subset of plants. For Category 1 issues, a single level of significance is common to all plants, mitigation was considered, and the NRC determined that mitigation was not likely to result in a benefit. Issues that were resolved generically are not reevaluated in the plant-specific supplement to the LR GEIS because the conclusions reached would be the same as those reached in the LR GEIS, unless new and significant information is identified that would lead the NRC to reevaluate the LR GEIS's conclusions.

Category 2 issues are those that require a plant-specific review. For each of the Category 2 issues applicable to the specific site under review, the NRC evaluates site-specific data provided by the applicant, other Federal and State agencies, and Tribal and local governments, as well as publicly available scientific information.

Within the context of the NRC's license renewal environmental process, plant- or site-specific environmental issues and concerns associated with operating nuclear power plants, such as those raised in the comments, are considered in a plant-specific supplement to the LR GEIS in accordance with the NRC's regulations set forth in 10 CFR Part 51. In addition, the NRC will also consider relevant environmental issues and concerns as part of National Environmental Policy Act (NEPA) reviews of license amendment applications for operating nuclear plants.

Nuclear power plant operational safety and security issues are outside the scope of the NRC's environmental reviews conducted under 10 CFR Part 51. Nonetheless, the NRC provides continuous oversight for the safe operation of nuclear power plants through its ongoing reactor oversight process to verify that the nuclear plants are being operated and maintained in accordance with NRC regulations. This oversight includes having full-time NRC inspectors located at the plant and periodic safety inspections conducted by NRC inspectors based in an NRC Regional Office. The inspections look at a licensee's compliance with NRC's regulations, which include the following established practices for plant safety (routine and accident scenarios): radiation protection of plant workers and members of the public, radioactive effluent releases, radiological environmental monitoring, emergency preparedness, radioactive waste storage and transportation, quality assurance, and training. If the NRC discovers an unsafe condition, or that a licensee is not complying with its licensing basis, the NRC has the authority to take whatever action is necessary to protect public health and safety.

Issues identified in comments related to hearing requests and intervention petitions are considered separately in the appropriate adjudicatory proceeding and are outside the scope of this LR GEIS and rulemaking. The NRC's hearing process, governed by 10 CFR Part 2, is an adjudicatory process that is separate and distinct from the NRC's license renewal environmental review that is conducted in accordance with NEPA and the NRC's regulations for implementing NEPA. Any person whose interest may be affected by a license renewal proceeding and who desires to participate as a party in that proceeding may petition to intervene by filing a petition in accordance with 10 CFR 2.309. Similarly, in accordance with 10 CFR 2.802, any interested person may petition the NRC to issue, amend, or rescind any NRC regulation. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.

Comment: It is the understanding of the South County Chambers of Commerce that both Governor Gavin Newsom and the State Legislature asked PG&E to extend energy production at Diablo Canyon Power Plant by passing SB 846 into law. This bill provides PG&E with the state roadmap to achieve extension of operations through the myriad of state agencies and permitting authorities. However, the state bill's passage is not a final determination. Federal NRC authorization for extended operation of the nuclear reactors at the plant is also necessary. (**39-1** [McCorry, Kathy])

Response: *The NRC acknowledges the comment. The decision of whether to seek license renewal rests entirely with the owners of the nuclear power reactor and is outside the scope of the LR GEIS and associated rulemaking. Nevertheless, owners typically base such decisions on the plant's economic viability and whether it can continue to meet NRC safety and environmental requirements. Pacific Gas and Electric submitted a license renewal application for Diablo Canyon in November 2023. As a result, the NRC will conduct an environmental review leading to the preparation of a plant-specific supplement to the LR GEIS. In addition to the environmental review, the NRC staff will conduct a safety review in accordance with 10 CFR Part 54, and the results will be documented in a safety evaluation report. The NRC will base its license renewal decision on whether the facility will continue to meet the requirements for safe operation and whether the protection of the environment can be assured. No changes were made in the LR GEIS, final rule, or guidance as a result of this comment.*

A.2.36 Out of Scope: Other

Comment: Okay, so, let's see where -there needs to be clarification in what happens if there actually an accident at the plant. Who is going to pay for it? We have brownfields all over and many places that need cleaning up. That needs to be clarified on who is going to pay if the community, the county, this area of the state, if there is actually an accident. And I know that the assurances that are paid to the State of Texas are not adequate. So, I don't know how that process works, but you need to look at that and make sure that it is adequate. There is a history in our country of having that funding inadequate. (**9-7-1** [Gosslee, Susybelle])

Comment: The NRC's mission is: "to regulate the nation's civilian use of byproduct, source, and special nuclear materials to ensure adequate protection of public health and safety, to promote the common defense and security, and to protect the environment."

In order to make the best decisions to ensure the health, safety, and protection of the public and the environment, the NRC must also consider protecting the economy which is affected by the final decision, especially if there is an accident. An accident could have extreme and expensive consequences and must be avoided. Operational, repair, and accident costs should be considered throughout the evaluation process. (**21-2** [Gosslee, Susybelle])

Comment: Evaluate the total costs of an accident to the public, health, and infrastructure near and far from the reactor, on the economy, and local, state, and national governments. (**21-10** [Gosslee, Susybelle])

Response: *The NRC acknowledges the comments related to the economic costs associated with a nuclear power plant accident. The consideration of economic costs associated with a hypothetical nuclear accident is outside the scope of the LR GEIS and rulemaking. However, costs associated with nuclear incidents are governed by the Price-Anderson Nuclear Industries Indemnity Act (42 U.S.C. 2210 et seq.). Comments specific to the scope of the NRC's severe accidents analysis in Appendix E of this LR GEIS are addressed in Section A.2.13 of this appendix. In accordance with the Price-Anderson Nuclear Industries Indemnity Act, the NRC requires that all nuclear power reactors have and maintain financial protection, or insurance, to cover the liability claims of members of the public for personal injury and property damage caused by a commercial nuclear power plant accident. No changes were made in the LR GEIS, the final rule, or guidance as a result of these comments.*

Comment: I'm concerned about the rules even. The company has spent a great deal. I think my last analysis was that $1.3 million was spent by Vistra to lobby congress just like a year or two ago. And there was no major legislation. The industry has spent a tremendous amount of money on lobbying. So, the question rises in my mind is, are we really getting the best laws? (**9-7-10** [Gosslee, Susybelle])

Comment: You keep referring back to these old laws, you know, that protect animal life and so forth, but are the laws, are you advising the legislative system to develop more secure laws because almost all of your slides say protect public health. How are you actually doing that? What are you actually doing to protect public health and the environment? So, it's a two-way street. You are supposed to be the experts. What do you do to inform our legislative session each year, and our state legislature? Legislatures of congress and the state legislature, how we can protect ourselves? (**9-7-11** [Gosslee, Susybelle])

Response: *The NRC acknowledges the comments. The NRC licenses and regulates the Nation's civilian use of radioactive materials to provide reasonable assurance of adequate protection of public health and safety and to promote the common defense and security and to protect the environment. Concerns about the statutory laws passed by Congress and signed by the President that govern the NRC's regulatory activities are outside the scope of the LR GEIS and rulemaking. However, to the extent that those laws require implementing regulations, those regulations are promulgated by the NRC pursuant to the requirements of the Administrative Procedure Act (5 U.S.C. § 551 et seq.) and at the direction of the Commission. In each case, interested members of the public have opportunities to express concerns and provide comments, such as on this LR GEIS and associated rulemaking regarding the NRC's environmental protection regulations in 10 CFR Part 51. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.*

Comment: Suppression of independent opinion on significant aging issue
This evidence included a 2017 technical report by Pacific Northwest National Laboratory ("PNNL"), which described "technical gaps" in the understanding of the effects of reactor equipment aged beyond 60 years, and presented a plan for obtaining the necessary information.[2] As summarized in the "Abstract" section of the Report:

[2] Lochbaum Expert Report at 18 (citing Ramuhalli, et al.,"Criteria and Planning Guidance for Ex-Plant Harvesting to Support Subsequent License Renewal" at iii (PNNL-27120, December 2017)

("Ramuhalli 2017")). NRC retained PNNL in 2015 to fulfill three objectives: (1) "Develop a long-range strategy for obtaining information from decommissioning NPPS as well as providing the flexibility to get ex-plant components from operating plants;" (2) Construct a strategic plan and specifications for obtaining unique and significant materials aging degradation information from diverse sources . . . that will inform NRC's age-related regulatory oversight in the future;" and (3) Update NRC's proactive management of material degradation ("PMMD") information tool "so that it can be better used to inform prioritization in the ex-plant material strategic plan." Interagency Agreement NRC-HQ-60-15-T-0023, Statement of Work at 1 (Sept. 4, 2015) (ADAMS Accession No. ML19129A323). In setting forth these objectives, the contract noted that "[u]nderstanding and managing material and component degradation is a key need for the continued safe and reliable operation of NPPs, but has significant uncertainties." Id.

As U.S. nuclear power plants look to subsequent license renewal (SLR) to operate for a 20-year period beyond 60 years, the U.S. Nuclear Regulatory Commission and the industry will be addressing technical issues around the capability of long-lived passive components to meet their functionality objectives. A key challenge will be to better understand likely materials degradation mechanisms in these components and their impacts on component functionality and safety margins. Research addressing many of the remaining technical gaps in these areas for SLR may greatly benefit from materials sampled from plants (decommissioned or operating). Because of the cost and inefficiency of piecemeal sampling, there is a need for a strategic and systematic approach to sampling materials from structures, systems, and components (SSC) in both operating and decommissioned plants. This document describes a potential approach for sampling (harvesting) materials that focuses on prioritizing materials for sampling using a number of criteria. These criteria are based on an evaluation of technical gaps identified in the literature, research needs to address these technical gaps, and lessons learned from previous harvesting campaigns. The document also describes a process for planning future harvesting campaigns; such a plan would include an understanding of the harvesting priorities, available materials, and the planned use of the materials to address the technical gaps.
Id. at iii (emphasis added). (**24-1-12** [Curran, Diane])

Comment: Consistent with Ramuhalli 2017, Mr. Lochbaum's Expert Report advocated harvesting of components from shutdown reactors as a reasonable and potentially necessary means of obtaining external operating experience. Id at 34-41. But he also noted Ramuhalli 2017's conclusion that harvesting "can be expensive," and therefore a top priority should be "[c]learly identifying the need for harvesting the material." Id. at 40 (citing Ramuhalli 2017 Report at 24).

At the time of its issuance, Ramuhalli 2017 was posted on the websites of PNNL, the U.S. Department of Energy's Office of Scientific and Technical Information ("OSTI"), and the International Atomic Energy Agency's International Nuclear Information System ("IAEA INIS").[3] Subsequently, however the report was removed from all three websites. In an oral argument before the Atomic Safety and Licensing Board ("ASLB") on March 27, 2019, NRC Staff counsel described Ramuhalli 2017 as a "draft" document that had been created by PNNL under contract with the NRC, but was "predecisional" because it had not yet been approved by the NRC. Tr. at 116-17 (Gamin) (ADAMS Accession No. ML19088A340). According to NRC Staff counsel, the document was posted on these government and international nuclear information websites "by mistake." Tr. at 117. Yet, the Ramuhalli 2017 Report contained not a single marking indicating it was a draft, and appeared for all intents and purposes to be the authors' final product.

[3] See https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-27120.pdf PNNL), https://www.osti.gov/biblio/1413395-criteria-planning-guidance-ex-plant-harvestingsupport-subsequent-license-renewal (OSTI), (https://inis.iaea.org/search/search.aspx?orig_q=RN:49074900) (IAEA INIS).

By letter dated April 2, 2019, the NRC Staff notified the Board and parties of the issuance of a revised version of Ramuhalli 2017: PNNL-27120, Rev. 1, Criteria and Planning Guidance to Ex-Plant Harvesting to Support Subsequent License Renewal (March 31, 2019) (ADAMS Accession No. ML19081A006) ("Ramuhalli Rev. 1"). None of the factual information reviewed by the researchers who prepared Ramuhalli 2017 appeared to be changed in Ramuhalli Rev. 1. But Rev. 1 systematically eliminated language used in Ramuhalli 2017 to describe knowledge deficits or the need to address them. For example, while the phrases "technical gap" and "knowledge gap" were used a total of 27 times in Ramuhalli 2017, the word "gap" appears only three times in Ramuhalli Rev. 1. And the Abstract quoted above at page 3, which had described "*research needs" for addressing these technical gaps, disappeared completely.

A tabular comparison of statements in Ramuhalli 2017 with similar statements in Rev. 1 illustrates how thoroughly Ramuhalli 2017 was sanitized to eliminate conclusions that information significant to the safety of reactors was missing and needed to be obtained to ensure the safety of reactors operating beyond 60 years:

Ramuhalli 2017
"This document describes a potential approach for prioritizing sampling (harvesting) materials using a number of criteria that incorporate knowledge about the *specific technical gaps* closed through the sampling process. *At the highest level*, the major criteria are..."

Ramuhalli Rev. 1
"This document describes a potential approach for prioritizing sampling (harvesting) materials using a number of criteria that incorporate knowledge about the *specific technical issues that could benefit most significantly* from harvesting. Beyond the implications to safe operation of NPPs [nuclear power plants], the basic criteria to assess specific harvesting opportunities should include . . ." (p. ii) (emphasis added) (**24-1-13** [Curran, Diane])

Comment: Ramuhalli 2017
"The decommissioning of some nuclear power plants (NPPs) in the United States after extended operation *provides* an opportunity to *address* a number of materials degradation questions that add to confidence in the aging management system used by the nuclear industry." (p. v) (emphasis added)

Ramuhalli Rev. 1
"The decommissioning of some nuclear power plants (NPPs) in the United States after extended operation may provide an opportunity to increase knowledge about materials aging and degradation, through the harvesting of, and subsequent research on, service-aged materials." (p. ii) (emphasis added)

Ramuhalli 2017
"Many of the remaining questions regarding degradation of materials will likely require a combination of laboratory studies as well as other research conducted on materials sampled from plants (decommissioned or operating)." (p. v) (emphasis added)

Ramuhalli Rev. 1
"Insights into degradation mechanisms from studies on harvested materials can provide confirmation of the effectiveness of aging management approaches used by the nuclear industry." (p. ii) (emphasis added)

Ramuhalli 2017
Addressing [materials degradation] questions is expected to provide reasonable assurance that systems, structures, and components (SSCs) are able to meet their safety functions. (p. v) (emphasis added)

Ramuhalli Rev. 1
In addition, evaluation of material properties of systems, structures, and components (SSCs) from operating or decommissioned NPPs may provide insights into the actual safety margins, and increase confidence that long-lived passive components will be capable of meeting their functional requirements during extended operations.

Ramuhalli 2017
"Addressing many of the remaining technical gaps for SLR may require a combination of laboratory studies and other research conducted on materials sampled from plants (decommissioned or operating). Evaluation of materials properties of SSCs from decommissioned NPPs will provide a basis for comparison with results of laboratory studies and calculations to determine if long-lived passive components will be capable of meeting their safety functions during operation beyond 60 years. Because of the cost and inefficiency of piecemeal sampling (i.e., harvesting materials on an ad-hoc basis), there is a need for a strategic and systematic approach to sampling materials from SSCs in both operating and decommissioned plants." (p. 1) (emphasis added)

Ramuhalli Rev. 1
"[B]enchmarking of laboratory tests may be achieved by harvesting materials from reactors. The resulting insights into material aging mechanisms can add to confirmatory evidence of the effectiveness of aging management approaches used by the nuclear industry, as well as insights into the operating margins while maintaining confidence that long-lived passive components will be capable of continuing to meet their functional requirements during extended operations. (pp. 1-2) (emphasis added)

Ramuhalli 2017
"Over the past several years, a number NPPs (both within the United States and elsewhere) have either permanently ceased operation or have indicated that they will shut down in the next few years. These shutdown plants provide an opportunity to extract materials that have real-world aging and provide an avenue for benchmarking laboratory-scale studies on materials aging. The resulting insights into material aging mechanisms and precise margins to failure will be essential to provide reasonable assurance that the materials/components will continue to perform their safety function throughout the plant licensing period." (p. 2) (emphasis added)

Ramuhalli Rev. 1
"While many plants are continuing to operate and some have begun applying for continued operation through the SLR period, other plants in recent years have shut down or decided to cease operations in the near future. As these plants enter decommissioning, there are expected to be several opportunities for accessing and harvesting service-aged materials for use in materials degradation research activities. In addition, it is likely that opportunities to sample materials from operating plants will also arise as plants consider replacing specific components

that may have shown degradation. Given the significant opportunities for materials harvesting from decommissioning and operating NPPs, it is beneficial to have a strategic and systematic approach to materials harvesting." (p. 1) (emphasis added) (**24-1-14** [Curran, Diane])

Comment: Ramuhalli 2017
"Where available, benchmarking can be performed using surveillance specimens. In most cases, however, benchmarking of laboratory tests will require harvesting materials from reactors." (p. 2) (emphasis added)

Ramuhalli Rev. 1
"Where available, such benchmarking can be performed using surveillance specimens exposed to field conditions during the course of operation of the reactor. However, surveillance specimens are often limited to critical components such as the RPV, and do not exist for components in other locations in a plant. In such cases, benchmarking of laboratory tests may be achieved by harvesting materials from reactors." (p. 1-2) (emphasis added)

Thus, while Ramuhalli Rev. 1 bears the cover of a scientific report by an independent federal research agency, NRC management's interference with its content has completely deprived it of either independence or scientific integrity.[4] And NRC management watered down --to the point of complete negation - the authors' qualitative conclusions regarding the imperative of gathering additional information about aging reactor equipment in order to minimize the risk to public health and safety and the environment.

[4] Under the circumstances, it is not surprising that the only agency to publish Ramuhalli Rev. 1 on its website is NRC. The document cannot be found on the websites for PNNL, OSTI, or IAEA INIS - where Ramuhalli 2017 previously was posted until it was withdrawn, apparently at the behest of NRC. (**24-1-15** [Curran, Diane])

Comment: In addition, under contract to the NRC, experts at Pacific Northwest National Laboratory have advised the NRC that it is necessary to harvest aging components of operating reactors in order to gain sufficient understanding of these phenomena. Yet, the NRC has taken no regulatory action to ensure that harvesting will be accomplished and has even attempted to hide or sanitize the opinions of the PNNL experts.

This failure to regulate and attempt to hide significant safety issues is a matter of great concern, given that the NRC has published a Proposed Rule and Draft Environmental Impact Statement that would codify findings that the environmental impacts of operating nuclear reactors during an extended license term are insignificant. See Proposed Rule, Renewing Nuclear Power Plant Operating Licenses, 88 Fed. Reg. 13,329 (Mar. 3, 2023). These comments also address the draft environmental impact statement ("EIS") that underlies the Proposed Rule, Draft Generic Environmental Impact Statement for License Renewal of Nuclear Plants (NUREG-1437, Rev. 2, Feb. 2023) ("Draft GEIS"). (**24-2-2** [Curran, Diane])

Comment: Furthermore, the NRC has made a concerted effort to suppress public knowledge of technical documents and findings of a government contracted Technical Letter Report as well as public stakeholder attendance at related technical workshops that contradict these invalid assumptions.

In particular, the NRC has not addressed significant alterations and critical omissions made by the agency to Technical Letter Report (PNNL-27120) as contracted by the NRC Office of Research (RES) with the Department of Energy's (DOE) Pacific Northwest National Laboratory

(PNNL) and publicly published on December 7, 2017 as a scientific document to the three government websites of PNNL, the DOE Office of Scientific and Technical Information (OSTI) and the International Atomic Energy Agency's (IAEA) International Nuclear Information System (INIS). It is important to note that the IAEAINIS web page lists PNNL-27120 as a "Publication." After approximately ten months in the public venue, the PNNL technical report was abruptly deleted from the public record by NRC. The subsequent NRC revision, posted to NRCADAMS on March 31, 2019---but to date not reposted by PNNL, DOE or IAEA---effectively sanitizes and reframes the character of the PNNL findings as originally published from "essential" to optional industry activities for achieving "reasonable assurance" of age management programs projected for the subsequent license renewal period (60-to 80-years). Beyond Nuclear therefore contends that the identified NRC alterations and omissions do not support the above stated assumptions for "completed license renewals" where "environmental impacts can be reasonably predicted. (**24-2-4** [Curran, Diane])

Comment: Decommissioning is critically linked to operating license renewals but the NRC and industry have failed to reasonably close related "technical knowledge gaps"
The US Nuclear Regulatory Commission (NRC) Office of Research (RES) has recognized that, in fact, there are many critical technical knowledge gaps and technical issues in the age management programs for the subsequent license renewal period with potentially adverse safety and environmental impacts. NRC RES contracted with the Department of Energy's (DOE) Pacific Northwest National Laboratory (PNNL) on September 4, 2015 in request of research on the agency's commercial power reactor subsequent license renewal program to support industry closure of those gaps and technical issues in age-management programs per requirement of 10 CFR 54.31(d). The NRC contract identifies, "the biggest challenges for the NRC and the industry will be addressing the major technical issues for the 'subsequent' license renewal (SLR) beyond 60 years." [1]

[1] "Strategic Approach for Obtaining Material and Component Aging Information," US NRC Statement Of Work (SOW) with the US Department of Energy's Pacific Northwest National Laboratory, September 4, 2015, p. 1, (NRC FOIA2018-000831), **Exhibit 1**,ADAMSAccession #ML19129A329,
https://beyondnuclear.org/wp-content/uploads/2023/04/EXHIBIT_20150904_res-pnnl_sow__IR11_pp100-120_PNNLcontract.pdf

The federal contract states:
"Understanding and managing material and component degradation is a key need for the continued safe and reliable operation of NPPs (nuclear power stations), but has significant uncertainties. In many cases, the scientific basis for understanding and predicting long-term environmental degradation behavior of metals in NPPs is incomplete. A strategic approach to examination and testing of materials and components from decommissioning reactors can dramatically increase our knowledge-acquisition rate in this very important area." [2]

[2] Ibid., p. 2-3
The RES's principal objective for this work is to develop a long-range strategy for obtaining technical information on age-related degradation from decommissioning NPPs as well as ex-plant components from operating plants. Key to the contract's objective was for PNNL to develop guidance and criteria for the equivalent of a medical "autopsy" by strategically harvesting aged material specimens (base metals, weld materials, electrical cable, reactor internals, concrete, etc.) from the harshest operational environments in decommissioning nuclear power stations, as well as those units that remain operation (without compromising safety and reliability) for laboratory analysis of a host of critical aged-related degradation

mechanisms. Specifically, the focus was determined to be on the "timely acquisition of experiential real-world aging-degradation information that can significantly improve the agency's risk-informed and performance-based regulatory approach, but has been difficult or impossible to obtain from the operating fleet." [3] [Emphasis added]

[3] Ibid., p.4 (**24-2-5** [Curran, Diane])

Comment: As summarized in SECY 2014-0016, the NRC has determined that the most significant technical issues challenging safe and reliable nuclear power operations beyond 60-years focus on reactor pressure vessel neutron embrittlement at high fluence, irradiation assisted degradation of reactor internals and primary system components, concrete and containment degradation, and electrical cable qualification and condition assessment. Timely scientific research is deemed essential to gain critical insights on reactor materials degradation and gather information addressing a significant number of technical knowledge gaps needed to support the "reasonable assurance" of NRC regulatory needs for granting subsequent license renewal. Most importantly, the "current piecemeal approach" needs to be replaced with a comprehensive proactive approach to strategically gather the observable and measurable science of the material degradation of safety-related systems, structures and components (SSC). According to the NRC work order, this is necessary to address critical knowledge gaps with reasonable assurance to better understand the modes of material degradation for the validation and verification of aging modeling and simulation tools in safety-significant SSC for the projected license renewal period. (**24-2-6** [Curran, Diane])

Comment: The work order's language tasked PNNL to conduct a scoping study and a review of the technical information to identify those technical knowledge gaps and make recommendations for NRC research needs and develop analysis tools. The RES contract provides that the PNNL staff "shall not restrict their activities solely to these descriptions and shall be flexible in using their technical knowledge and experience in proposing additions, deletions, or deviations from the prescribed requirements as research progresses." [4]

[4] Ibid., text and Figure 3, p.6

[Refer to pg.164 of PDF for Figure 3: Schematic of the Overall Research]

The RES work order designated a number of "specific tasks" for the national laboratory to perform including as part of Task I that PNNL "shall" work with the NRC staff to conduct "one or two public workshops" on the prioritization of strategic material sample harvesting opportunities at decommissioning nuclear power stations as key to the analysis and reliable modeling for the subsequent license renewal review process. [5]

[5] Ibid., p.7

However the NRC public meeting/workshop that PNNL contributed to was abandoned by NRC staff. Instead, the NRC staff chose to close the NRC-hosted meeting and harvesting workshop to the invitation-only of representatives selected from the US and international nuclear power industry, the DOE, national labs and international regulators. The subsequent secret meeting was convened at NRC Headquarters in Rockville, Maryland on March 7-8, 2017 and made virtually available through a GoToMeeting webcast only by invitation. When the closed meeting was finally disclosed along including PowerPoint slides by a FOIA request filed by counsel on the behalf of Beyond Nuclear (NRC-FOIA-2018-000831), the event was publicly revealed as a breach of the agency's own policy and procedures, specifically, NRC Management Directive 3.5,

"Attendance at NRC Staff Sponsored Meetings." [6] In fact, Management Directive 3.5(d) specifies circumstances where public meetings are warranted to be open to "Previous Public Interest" expressly in license renewal and decommissioning" activities. Nowhere in the Management Directive does it provide for the NRC to keep the public out of open meetings involving issues and controversies potentially affecting public safety and environmental quality. In this case, in an apparent error of NRC policy, procedures and the law, the NRC clearly demonstrated its intent to keep safety-related technical discussions away from the public interest community that is tracking the NRC's verification and validation process for license renewal reviews.[7 & 8]

[6] NRC Management Directive 3.5, "Attendance at NRC Staff Sponsored Meetings," Handbook, ADAMS Accession #ML071220010 (Revised: April 10, 2007), **Exhibit 2**, https://www.nrc.gov/docs/ML0712/ML071220010.pdf
[7] Letter of David Lochbaum to Margaret Doane, NRC Office of Executive Director, "*Subject: SLR Workshop - 'Stealth' License Renewal?", November 9, 2020, **Exhibit 2**, https://beyondnuclear.org/wp-content/uploads/2023/04/EXHIBIT_20201109-lochbaum-edo-secret-harvest.pdf
[8] Reply of the NRC Office of the Inspector General to David Lochbaum, November 24, 2020, **Exhibit 3**, https://beyondnuclear.org/wp-content/uploads/2023/04/EXHIBIT_20201124-oig-lochbaum-receipt-secret-meeting-concerns.pdf (**24-2-7** [Curran, Diane])

Comment: The NRC work order additionally determined that if PNNL identifies significant technical data gaps from the execution of Task I, the national lab could proceed to Task 2 for "Gap Identification" and "Determine the Significance and Disposition of Technical Gaps." PNNL could also determine whether or not further research was warranted and even make recommendations to include the termination of the research if no significant '*gaps" were found.

It is abundantly clear to Beyond Nuclear that the September 4, 2015 Statement of Work and the contract's authors at the Office of Research were seeking a better understanding of the "technical knowledge gaps" affecting the safety and environmental impacts of age-related degradation for subsequent license renewal. Beyond Nuclear shares these concerns and goals in the public interest. These concerns include a more complete understanding of accelerating embrittlement in the base metals and weld materials of large, irreplaceable components like the reactor pressure vessel and expansive, inaccessible safety-related systems including buried pipe and electrical cable deemed too costly to assess and replace as a whole. But if left unchecked, these same systems, structures and component can adversely affect the safe and reliable operations of an aging nuclear power fleet at unpredictable points during the projected subsequent license renewal period. Decommissioning provides not only the unique opportunity to strategically harvest and analyze the modes of material degradation but represents an essential activity to scientifically interrogate *reasonable assurance" of safety and reliability claims for the license renewal period. (**24-2-8** [Curran, Diane])

Comment: NRC pulled and sanitized PNNL Technical Letter Report of references to relicensing "knowledge gaps" and the necessity for completing the laboratory analysis of harvested samples

The contracted findings of the federal laboratory researchers at PNNL were publicly released as a Technical Letter Report (TLR) per Department of Energy (DOE) Contract DE-AC05-76RL01830 on December 7, 2017. Entitled "Criteria and Planning Guidance for Ex-plant Harvesting to Support Subsequent License Renewal," (PNNL-27120), the TLR was posted to the public website of PNNL. [9] The International Atomic Energy Agency's (IAEA) International

Nuclear Information Service (INIS) website documents not just the public posting of the research paper but the scientific publication of PNNL-27120 to the PNNL website as well as the websites of the US Department of Energy's Office of Scientific and Technical Information (OSTI) and the IAEA INIS website. [10] The INIS repository lists the research paper's "Publication Year" as 2017, the "Publication Year Range" as 2016-2020 and the "Country of publication" as the United States.[11]

[9] "Criteria and Planning Guidance for Ex-plant Harvesting to Support Subsequent License Renewal," Ramuhalli et al, Pacific Northwest National Laboratory, Operated by Battelle for the Department of Energy and prepared for the US Nuclear Regulatory Commission under Contract DE-AC05-76RL01830, (PNNL-27120), December 7, 2017, **Exhibit 4**, https://beyondnuclear.org/wp-content/uploads/2023/04/Criteria_and_Planning_Guidance_for_Ex-Plant_Harvesting_to_Support_Subsequent_License_Renewal_PNNL_20171207.pdf
[10] International Atomic Energy Agency International Nuclear Information Service (INIS) website repository, **Exhibit 5**, https://inis.iaea.org/search/search.aspx?orig_q=RN:49074900
[11] Ibid., INIS

PNNL-27120 confirms the vital role that age management programs play in demonstrating "reasonable assurance" maintaining nuclear safety margins for the license renewal period:

"Understanding the causes and control of degradation mechanisms forms the basis for developing aging management programs (AMP) to ensure the continued functionality of and maintenance of safety margins NPP [nuclear power plants] SSCs [systems, structures and components]. The AMPs, along with the appropriate technical basis, are used to demonstrate reasonable assurance of safe operation of the SSCs during the SLR (subsequent license renewal)." [12]

[12] Ibid., PNNL-27120, 2017, p.1 (**24-2-9** [Curran, Diane])

Comment: Per contract language, the laboratory promptly prioritizes addressing the issue of "technical knowledge gaps" in the TLR Abstract:

"This document describes a potential approach for sampling (harvesting) materials that focuses on prioritizing materials for sampling using a number of criteria. These criteria are based on an evaluation of technical gaps identified in the literature, research needs to address these technical gaps, and lessons learned from previous harvesting campaigns.

"The document also describes a process for planning future harvesting campaigns; such a plan would include an understanding of the harvesting priorities, available materials, and the planned use of the materials to address the technical gaps." [13]

[13] Ibid., PNNL-27120, 2017, Abstract p. iii (**24-2-10** [Curran, Diane])

Comment: Additional references reenforce the need for strategic harvesting with laboratory analyses to gain the knowledge needed to close technical knowledge gaps projected for the license renewal period:

"This document describes a potential approach for sampling (harvesting) that focuses on prioritizing materials using a number of criteria. These criteria also help define the specific problems that will be addressed and the knowledge gained/technical gaps closed through the

sampling process. Using a number of lessons learned from previous harvesting campaigns, a harvesting process is defined that includes many of the criteria that should be taken into account during any harvesting campaign."[14]

[14] Ibid., PNNL-27120, 2017, **Exhibit 4**, p.1

As such, PNNL-27120 as published in 2017 includes 60 references to "gaps" and 19 references to "technical gaps."

PNNL-27120 goes further to establish the necessity, rather than an option, to perform strategic material harvesting of real-world aged materials for laboratory analysis to acquire the requested "reasonable assurance" for regulatory approval.
In PNNL's expert judgment, as the NRC contract stipulated that PNNL should exercise, the laboratory identified systems, structures and components that may even "require" material harvesting and laboratory analysis to deliver that "reasonable assurance" for safety and functionality of systems, structures and components into the subsequent license renewal period.

In particular, PNNL-27120 identifies that strategic harvesting and laboratory analysis real-world material samples are "essential" to obtaining necessary "reasonable assurance" of license renewal operational safety and reliability:
"Addressing many of the remaining technical gaps for SLR may require a combination of laboratory studies and other research conducted on materials sampled from plants (decommissioned or operating). [Emphasis added]

"Addressing these questions is expected to provide reasonable assurance that systems, structures, and components (SSCs) are able to meet their safety functions. Many of the remaining questions regarding degradation of materials will likely require a combination of laboratory studies as well as other research conducted on materials sampled from plants (decommissioned or operating)."[15] [Emphasis added]

[15] Ibid., PNNL-27120, 2017, **Exhibit 4**, Summary, p. v

"Evaluation of materials properties of SSCs from decommissioned NPPs will provide a basis for comparison with results of laboratory studies and calculations to determine if long-lived passive components will be capable of meeting their safety functions during operation beyond 60 years."[16]

[16] Ibid., PNNL-27120, 2017, **Exhibit 4**, p.1 (**24-2-11** [Curran, Diane])

Comment: "A key challenge to addressing the gaps in materials aging and degradation through 80 years of operation is the ability to perform tests that mimic the aging process in operating plants. Often, such tests are performed (and materials performance data obtained) through accelerated aging experiments, where the material under test is subjected to higher stresses (mechanical, thermal, and/or radiation) than those seen in operation. Such tests enable the experiments to be completed in a reasonable timeframe but need to be benchmarked with performance data from materials that have seen more representative service aging.

"Where available, benchmarking can be performed using surveillance specimens. In most cases, however, benchmarking of laboratory tests will require harvesting materials from reactors." [17] [Emphasis added]

[17] Ibid., PNNL-27120, 2017, **Exhibit 4**, pp.1-2
"These shutdown plants provide an opportunity to extract materials that have real-world aging and provide an avenue for benchmarking laboratory-scale studies on materials aging. The resulting insights into material aging mechanisms and precise margins to failure will be essential to provide reasonable assurance that the materials/components will continue to perform their safety function throughout the plant licensing period." [Emphasis added]
"The extracted materials could also help in determining specific methods for condition assessment or nondestructive evaluation (NDE) that may be applied to these components in the field to assess component aging." [18]

[18] Ibid., PNNL-27120, 2017, **Exhibit 4**, p.2 (**24-2-12** [Curran, Diane])

Comment: A review by Beyond Nuclear of PNNL-27120 prompted a number of questions in view of the report's findings and a potential public hearing request for a site-specific Subsequent License Renewal proceeding. Beyond Nuclear subsequently filed a Freedom of Information Act (FOIA) request on September 25, 2018 for all NRC communications regarding the PNNL Technical Letter Report. Roughly ten months after the December 7, 2017 release date, Beyond Nuclear attended a September 26, 2018 public meeting on the Subsequent License Renewal process at NRC Headquarters, Rockville, Maryland. Paul Gunter, staff member of Beyond Nuclear, took the opportunity during the public comment portion of the meeting to raise a question about the PNNL technical letter to NRC staff. [19] Gunter's question elicited surprise from NRC staff and the response that staff could not answer any questions on the technical report. Following the public meeting, NRC staff quickly removed PNNL-27120 from the three public government websites of PNNL, DOE OSTI and IAEA INIS.
[19] NRC FOIA2018-000831, Beyond Nuclear, NRC email 20180926 *RE: Gunter Question during today's meeting re: PNNL harvesting report," **Exhibit 6**, https://beyondnuclear.org/wp-content/uploads/2023/04/harvesting_09262018_email_gunter-question_pnnl-1.pdf

The NRC response to FOIA 2018-000831 took more than two years to finalize, yielding thousands of pages. In that time frame, the NRC revised the technical letter and republished as PNNL-27120 Rev. 1 and entered into the NRC Agencywide Document Access Management System (ADAMS) on March 31, 2019.[20] To date, the revision has not been publicly reposted to the websites of PNNL, DOE OSTI nor IAEA INIS.

[20] "Criteria and Planning Guidance for Ex-plant Harvesting to Support Subsequent License Renewal," Ramuhalli et al, Pacific Northwest National Laboratory, Operated by Battelle for the Department of Energy and prepared for the US Nuclear Regulatory Commission under Contract DE-AC05-76RL01830, (PNNL-27120 Rev.1), March 31, 2019, NRC ADAMS Accession # ML19081A006, **Exhibit 7**, https://beyondnuclear.org/wp-content/uploads/2023/04/EXHIBIT_20190331_PNNL-27120-rv1_ML19081A006.pdf

A few examples of a side-by-side review of the two documents contrasts a significant rewrite in the NRC revision that deletes all references to "knowledge gaps" and reframes harvesting and analysis as optional and helpful rather than necessary and essential.

The 2017 PNNL publication states, "Further, there are many instances where the formulations of cable insulation material (polymers) in plants (vintage material) are different from what is available today. In these cases, harvested vintage cables can be used for studies to provide the necessary data and plug the knowledge gaps."[21] [Emphasis added]
[21] Ibid., PNNL-27120, 2017, **Exhibit 4**, p.8

The 2019 NRC revision restates, "Further, there are many instances where the formulations of cable insulation material (polymers) in plants (material) are different from what is available today. In these cases, harvested cables can be used for studies to provide representative material for testing." [22] [Emphasis added]
[22] Ibid., PNNL-27120 Rev.1, 2019, **Exhibit 7**, p. 6 (**24-2-13** [Curran, Diane])

Comment: The 2017 publication states, "The resulting insights into material aging mechanisms and precise margins to failure will be essential to provide reasonable assurance that the materials/components will continue to perform their safety function throughout the plant licensing period. The extracted materials could also help in determining specific methods for condition assessment or nondestructive evaluation (NDE) that may be applied to these components in the field to assess component aging." [23] [Emphasis added]
[23] Ibid., PNNL-27120, 2017, **Exhibit 4**, p.2

The 2019 NRC revision restates as, "The resulting insights into material aging mechanisms can add to confirmatory evidence of the effectiveness of aging management approaches used by the nuclear industry, as well as insights into the operating margins while maintaining confidence that long-lived passive components will be capable of continuing to meet their functional requirements during extended operations. The results from testing of harvested materials could also help in assessing the reliability of specific methods for condition assessment or nondestructive evaluation (NDE) that may be applied to assess aging of these components in the field." [24] [Emphasis added]
[24] Ibid., PNNL-27120 Rev.1, 2019, **Exhibit 7**, p.2

The 2017 publication states, "4. Critical gaps in knowledge include the specifics of irradiation-assisted degradation mechanisms--factors contributing to initiation and growth. A number of microstructural changes are possible in the presence of radiation, including void swelling, segregation, and precipitation. Gaps exist in understanding the factors that contribute to these mechanisms and their impact on the material functional performance." [25] [Emphasis added]
[25] Ibid., PNNL-27120, 2017, **Exhibit 4**, p.17

The 2019 NRC revision restates as, "4. Some open questions exist as far as the specifics of irradiation-assisted degradation mechanisms and the factors contributing to initiation and growth. A number of microstructural changes are possible in the presence of radiation, including void swelling, segregation, and precipitation. Additional understanding of the factors that contribute to these mechanisms can reduce uncertainties in assessing their impact on the material functional performance." [26] [Emphasis added]
[26] Ibid., PNNL-27120 Rev.1, 2019, **Exhibit 7**, p.16 (**24-2-14** [Curran, Diane])

Comment: The NRC failed to address the how and why PNNL-27120 Rev.1 (2019) deleted the 2017 national laboratory technical report's references to achieving "reasonable assurance" for the subsequent license renewal "may", "will likely" and "will require" strategic harvesting of real-world aged samples from decommissioning reactors for laboratory analysis. NRC has never offered analysis justifying the deletions.

Instead, PNNL-27120 Rev. 1 (2019) reframes harvesting samples for laboratory analysis as "may be useful" or optional rather than "will require":

"Limited harvesting may be useful for benchmarking purposes if simulating "realistic" degradation for laboratory studies is required." [27]
[27] Ibid., PNNL-27120 Rev.1, 2019, **Exhibit 7**, p. 4 (**24-2-15** [Curran, Diane])

Comment: Similarly, the NRC has never clarified how the deletions and reframing of "knowledge gaps" in the original PNNL report have been addressed as directed by the agency's original contract. Neither has the NRC publicly explained how the PNNL-27120 (2017) was scientifically published and publicly posted to the government research websites in error nor why the NRC revision has not been reposted on these websites to date.

However, Beyond Nuclear's Freedom of Information Request (FOIA2018-000831) has provided some insight into the opposition generated within the agency by internal distribution of PNNL-27120 (2017) apparently originating within the NRC Office of Nuclear Reactor Regulation (NRR) Division of Materials for License Renewal (DMLR).

The following excerpts are from an email dated March 20, 2018, from Bennett Brady, NRR/DMLR and an anonymous assembled NRR/DMLR technical review team to Pat Purtscher, NRC Office of Research (RES) ---Note [(b)(5)] references a FOIA exemption from disclosure under "deliberative process":

"Pat,
Following your request, I asked eight of our technical review staff to review and provide comments on PNNL's technical letter report on harvesting materials. Attached are general comments on the report and specific comments that I have compiled in redline/strikeout version of the report itself... In spite of the rather negative comments on this report, we continue to believe that the Materials Harvesting Project will be in valuable in the future as the NRC deals with aging plants and needs an organized approach for selecting materials for harvesting withe the increased availability of sources." [28]

[28] NRC FOIA2018-00083, NRC email, "MDLR comments on PNLL(sic) Guidelines for Harvesting materials SLR", Bennett Brady, NRR/DMLR, March 20, 2018, p. 1 of 399, ADAMS Accession # ML20254A055, **Exhibit 8**, https://www.nrc.gov/docs/ML2025/ML20254A055.pdf

Anonymous NRC technical review commentators state:

"I get what the authors are trying to state. However, if I was an intervener, I would use this document to shutdown SLRAs. I did not see any 'robust' text in the following pages that tempered the following words or put them into a context that we are confident in the means of managing aging effects for the four classes of SSCs of concern eg. ... concrete, cables. For [(b)(5)]. If this is our basis for why the GALL-SLR [Generic Aging Lessons Learned-Subsequent License Renewal] Report is adequate, it's pretty weak compared to the below underlined sentences. Further, the same paragraph goes on to state [(b)(5)]." [29]

[29] Ibid., FOIA2018-000831, p. 237 of 399, **Exhibit 8**, https://www.nrc.gov/docs/ML2025/ML20254A055.pdf

"Big picture, I think that the entire report needs to be scrubbed for text that points to gaps and if issued we need a stronger basis for why we will grant renewed licenses before the harvesting and testing is completed."[30] [Emphasis added]

[30] Ibid., FOIA2018-000831, p. 237 of 399, **Exhibit 8**, https://www.nrc.gov/docs/ML2025/ML20254A055.pdf (**24-2-16** [Curran, Diane])

Comment: "How did we issue the GALL-SLR Report with technical gaps and how are we going to be able to issue a renewed license if there are technical gaps to reaching a reasonable assurance conclusion? [31]

[31] Ibid., FOIA2018-000831, p. 237 of 399, **Exhibit 8**, https://www.nrc.gov/docs/ML2025/ML20254A055.pdf

"For the first underlined sentence does this mean that we won't have [(b)(5)]. In that case, how can we issue a renewed license for [(b)(5)] years before the testing is completed? Will we generate license conditions to restrict how far into the SPEO a licensee can operate before the testing is complete? This statement is too broad. For the second underlined sentence, should I infer that [(b)(5)]" [32]

[32] Ibid., FOIA2018-000831, p. 237 of 399, **Exhibit 8**, https://www.nrc.gov/docs/ML2025/ML20254A055.pdf

Additional emails within the NRC Office of Research question the PNNL references to the choice of the word "gap" in response to the contract request. This August 23, 2018 NRC email internal to the Office of Research in response to NRR licensing division criticism of the overuse of the word.

"Matt,
I was reviewing the document and was struck by the continued used of "gap" (90 times). The combination "technical gaps" is used 24 times. This does seem excessive and it would seem to be a good idea to find different words to use. I would suggest "topic" as a sub in many of these places, probably not all.

The main concern of the NRR reviewers is that the document makes SLR look like it is dependent on harvesting. Pradeep suggested in his response to one of the comments that 'Perhaps there needs to be a context setting statement up front'. I don't see that he has proposed anything in this draft, but I think that is true and we should provide a specific recommendation like 'For many years now, harvesting and evaluation of ex-plant materials has been a critical part of the technical basis behind the regulatory framework used at the NRC, but the process was always limited by the availability of representative materials. Now with multiple plants announcing that they are or will be closing, many new potential opportunities will become available.' I hope that by starting with this, we can reduce the concern of the NRR reviewers. What do you think?
Pat" [33] [Emphasis added]

[33] Ibid., FOIA2018-000831, p. 243 of 399, **Exhibit 8**, https://www.nrc.gov/docs/ML2025/ML20254A055.pdf

"Hi Pat,
Yeah, I agree that the use of "gap" needs to be scaled back even more. In a few places I've been replacing "gap" with 'issue.' I like what you've written -I think it's pretty similar to this text in the Abstract (my tracked changes marked there), but that may need to be pulled into the Intro section as well. [(b)(5)] I've started working through with a clean version of what Pradeep sent to make my suggested edits (attached). I'm hoping to get all the way through it today if possible and share with you.
Matt" [34]

[34] Ibid., FOIA2018-000831, p. 246 of 399, **Exhibit 8**, https://www.nrc.gov/docs/ML2025/ML20254A055.pdf

The final version of PNNL-27120 Rev. 1 as revised by NRC and reposted only to the NRC website's ADAMS in 2019 references "gaps" in the technical report's text a total of three times. All references to "technical knowledge gaps" are deleted in the revision.

"In addition, concrete structures and electrical cables are long-lived components that would require a significant investment if replacement is necessary. As a result, recent assessments such as the expanded materials degradation assessment (EMDA) have included knowledge gaps related to these long-lived nonmetallic components (Bernstein et al. 2014; Graves et al. 2014)." [35] [Emphasis added]
[35] Ibid., PNNL-27120 Rev. 1, 2019, p.3, **Exhibit 7,** https://beyondnuclear.org/wp-content/uploads/2023/04/EXHIBIT_20190331_PNNL-27120-rv1_ML19081A006.pdf

"However, other factors (such as fabrication irregularities or cold work) may contribute to increasing the susceptibility to SCC (Byun and Busby 2012). There is also active research to address potential gaps related to thermal embrittlement during SLR (for instance, Byun et al. 2016)." [36] [Emphasis added]
[36] Ibid., PNNL-27120 Rev. 1, p.10, **Exhibit 7**, https://beyondnuclear.org/wp-content/uploads/2023/04/EXHIBIT_20190331_PNNL-27120-rv1_ML19081A006.pdf

"One way to efficiently use this information is an integrated tool set that will enable rapid assessment of technical gaps and well-informed decisions on harvesting."[37] [Emphasis added]
[37] Ibid., PNNL-27120 Rev. 1, p.22, **Exhibit 7**, https://beyondnuclear.org/wp-content/uploads/2023/04/EXHIBIT_20190331_PNNL-27120-rv1_ML19081A006.pdf
(**24-2-17** [Curran, Diane])

Comment: NRC FOIA 2018-000831 gives insight into the drastic scaling back of PNNL's references to "gaps" and "knowledge gaps." The NRC rewrite of the technical letter report to address criticism of the NRC Materials Division of License Renewal, agency staff made the decision to not provide transparency or any analysis behind the revision language.

"I'd suggest reworking the first sentence to avoid commenting on whether and how technical gaps are addressed by the GALL-SLR [Generic Aging Lessons Learned-Subsequent License Renewal]. Here is my suggestion, which is has similarities to what I had on track changes on Friday...[(b-5)]" [38] [Emphasis added]
[38] FOIA2018-000831, NRC email, internal to Office of Research, August 27, 2018, p. 2 of 6, **Exhibit 9**, https://beyondnuclear.org/wp-content/uploads/2023/04/EXHIBIT_20180817_scale-back-gaps_avoid-cmt_GALL-SLR.pdf (**24-2-18** [Curran, Diane])

Comment: 4. Evidence of the NRC's dereliction of its regulatory duty include the NRC's attempt to hide and then sanitize independent expert opinion by the scientists at the Pacific Northwest National Laboratories (PNNL) that strategic material harvesting of realworld aged materials in nuclear plants for laboratory analysis is essential for "reasonable assurance" in the regulation of the safety of nuclear reactors. The report, entitled "Criteria and Planning Guidance for Ex-plant Harvesting to Support Subsequent License Renewal" (PNNL-27120) (Dec.7, 2017) (PNNL Report), was published by PNNL on its website in 2017 and subsequently removed approximately ten months later by NRC without explanation. Subsequently, a revised version was posted by NRC staff only on the NRC website in the Agencywide Document Access Management System (ADAMS) with altered conclusions that harvesting of aged material is merely helpful or optional for establishing reasonable assurance in the Subsequent License Renewal review process.

5. The information provided in my expert report is based on the downloading of the PNNL Report from the PNNL public website as well as finding it publicly posted on the websites of the Department of Energy's Office of Scientific and Technical Information (OSTI) and the International Atomic Energy Agency's International Nuclear Information Service (INIS). I subsequently participated in an NRC public meeting on September 26, 2018 regarding the Subsequent License Renewal review process where I queried the NRC staff on the related federal laboratory report. I was told by NRC staff that they would not answer any questions on the report. I subsequently discovered that the report was immediately removed from all three scientific websites. In addition, I was subsequently notified by NRC that a significantly reframed and revised report was publicly posted to the NRC website on April 2, 2019. The report that I originally reviewed had been thoroughly sanitized with all references to the need for harvesting aging reactor equipment removed and changed to statements that harvesting was merely desirable but not necessary.

6. I also determined, through a FOIA request, that high-level management officials of the NRC Staff were involved in altering language in the 2017 PNNL report to effectively render its revision meaningless for regulatory purposes.

7. In my expert opinion, the NRC's effort to silence or expunge independent scientific expert opinion that it had contracted for violates the requirement of the National Environmental Policy Act for consideration of all relevant opinions on the significance of adverse environmental impacts. It also violates the NRC's obligation under the Atomic Energy Act to put protection of public health and ahead and above any cost considerations or practical concerns of reactor licensees.
(**24-6-28** [Curran, Diane])

Response*: The NRC disagrees with these comments. The NRC has established a license renewal process with clear requirements, which are codified in 10 CFR Part 51 and 10 CFR Part 54. The regulations in 10 CFR Part 54 require applicants to perform safety evaluations and assessments of nuclear power plants and provide the NRC with sufficient information to analyze the impacts of continued operation for the requested license renewal term. Applicants are required to assess the effects of aging on passive and long-lived systems, structures, and components and to consider plant-specific and industry operating experience concerning age-related degradation. The report cited in these comments was a draft, contractor-prepared report that was inadvertently made public while still undergoing development as discussed in the final report, Criteria and Planning Guidance for Ex-Plant Harvesting to Support Subsequent License Renewal, PNNL-27120, Rev. 1, March 2019, Agencywide Documents Access and Management System (ADAMS) No. ML19081A006 (Ramuhalli et al. 2019). That draft information is not used as the basis for license renewal regulations or activities.*

Within the context of the NRC's license renewal environmental review process, the purpose of this LR GEIS and associated rulemaking is to identify and evaluate the environmental issues that could result in the same or similar impacts (i.e., generic issues) on the environment at all nuclear power plants or a specific subset of plants and determine which issues could result in different levels of impact during the license renewal term, thus requiring nuclear power plant-specific environmental analyses for impact determination. As stated in the NRC's responses to similar comments in this appendix, nuclear power plant operational safety issues related to the management of aging systems, structures, and components are outside the scope of the NRC's environmental reviews conducted under 10 CFR Part 51 as well as this LR GEIS and rulemaking.

Any member of the public may raise potential health and safety issues in a petition to the NRC about safety at a specific plant by using the 10 CFR 2.206 process. The petition process described in 10 CFR 2.206 is the primary mechanism for the public to request enforcement action by NRC in a public process. This process permits anyone to petition the NRC to take enforcement action related to NRC licensees or NRC-regulated activities. More information on requesting enforcement actions and reporting safety concerns can be found in the NRC's brochures on the Public Petition Process and Reporting Safety Concerns to the NRC. Information on how to request enforcement actions is available on the NRC's website at https://www.nrc.gov/about-nrc/regulatory/enforcement/petition.html.

Members of the public can also submit petitions for rulemaking to request that the NRC develop, change, or rescind any of its regulations. Section 2.802 of 10 CFR (10 CFR 2.802) describes the petition for rulemaking process. Information about submitting a petition for rulemaking is available on the NRC's website at https://www.nrc.gov/about-nrc/regulatory/rulemaking/rules-petitions.html. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments.

Comment: The biggest complaint from businesses and their executives comes from agency costs and dealing with the possibly necessary but overwhelming amount of litigation and contracting required to get and keep licenses. Companies are for-profit, and their main goal is to make a profit, so, unfortunately, they will not invest in nuclear energy out of the care and kindness for the environment in their heart. For private companies to obtain permits for nuclear power plants and reactors, there must be a significant amount of money in the nuclear energy business. A major roadblock in the profitability of nuclear energy falls under the insane amount of money dollars on lawyers to draft documents like an environmental impact statement. Those costs cannot be helped; documents and impact statements are required, and they work to improve transparency when it comes to environmental harm. The average nuclear plant pays around $60 million annually in regulatory liabilities and over $20 million in fees to the NRC. Fees at a certain amount are necessary to maintain operations; the specific amount is unknown.

The NRC should lower fees and regulatory costs to allow more room for profit for the companies to incentivize more American investment into nuclear energy. The best way to do this is to limit unnecessary or overcharged regulatory fees, control the amount of money required to go through the licensing process and keep up with the licensing and regulatory obligations. This is possible because of the increasing government focus on nuclear energy.
(**40-13** [Cassiere, Daniel])

***Response**: The NRC disagrees with this comment. The NRC's primary mission is to protect the public health and safety from the effects of radiation from nuclear reactors, materials, and waste facilities by conducting its licensing functions in a manner that is receptive to environmental concerns. While the NRC is responsible for the regulation of radioactive materials in licensed facilities, it does not promote their use. The National Environmental Policy Act (NEPA) requires Federal agencies to assess the environmental effects of their proposed actions prior to making decisions, and the NRC's environmental protection regulations in 10 CFR Part 51 implement Section 102(2) of NEPA. When the NRC collects fees from licensees, including for environmental review activities, it does so consistent with statutory authority and requirements. Most notably, under the Nuclear Energy Innovation and Modernization Act, the NRC is required to recover, to the maximum extent practicable, approximately 100 percent of its annual budget less the budget authority for excluded activities. Additional information on licensing fees is available at https://www.nrc.gov/about-nrc/regulatory/licensing/fees.html. However, the costs*

associated with the regulatory process are outside the scope of this LR GEIS and associated rulemaking. No changes were made in the LR GEIS, final rule, or guidance as a result of this comment.

A.2.37 Miscellaneous Issues

Comment: In support of its position, SLOMFP hereby adopts and incorporates the comments of Beyond Nuclear, Inc. and the Sierra Club, Inc. that have also been filed today in this rulemaking docket. SLOMFP also adopts and incorporates by reference the comments of Natural Resources Defense Council. (**27-2** [Curran, Diane])

Comment: We hereby adopt and incorporate as our own, the comments on the above-referenced matters submitted by, respectively, Beyond Nuclear and the Sierra Club; Natural Resources Defense Council; and San Luis Obispo Mothers for Peace. In addition, we supplement those comments with the enclosed document, "Survey of Site-Specific Impacts of Subsequent License Renewal for Representative Nuclear Reactors." (**29-2** [Judson, Tim])

Response: *The NRC acknowledges the adoption and incorporation by reference of other comment documents submitted by other organizations. The NRC has considered the comments submitted by the referenced organizations and responded to them elsewhere in this appendix. No changes were made in the LR GEIS, final rule, or guidance as a result of these comments adopting and incorporating other comments.*

A.3 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.”

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

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

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

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

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

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

10 CFR Part 73. *Code of Federal Regulations*, Title 10, *Energy*, Part 73, “Physical Protection of Plants and Materials.”

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

40 CFR Part 51. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 51, "Requirements for Preparation, Adoption, and Submittal of Implementation Plans."

40 CFR Part 70. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 70, "State Operating Permit Programs."

40 CFR Part 71. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 71, "Federal Operating Permit Programs."

40 CFR Part 93. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 93, "Determining Conformity of Federal Actions to State or Federal Implementation Plans."

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

40 CFR Part 1508. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 1508, "Definitions."

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

42 FR 26951. May 25, 1977. "Executive Order 11988 of May 24, 1977: Floodplain Management." *Federal Register,* Office of the President.

56 FR 64943. December 13, 1991. "Nuclear Power Plant License Renewal." *Federal Register*. NRC (Nuclear Regulatory Commission).

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.

60 FR 22461. May 8, 1995. "Nuclear Power Plant License Renewal; Revisions." *Federal Register*, Nuclear Regulatory Commission.

61 FR 28467. June 5, 1996. "Environmental Review for Renewal of Nuclear Power Plant Operating Licenses." *Federal Register*, Nuclear Regulatory Commission.

65 FR 67249. November 9, 2000. "Executive Order 13175 of November 6, 2000—Consultation and Coordination with Indian Tribal Governments." *Federal Register*, Office of the President.

67 FR 61695. October 1, 2002. "NRC Information Quality Guidelines." *Federal Register*, Nuclear Regulatory Commission.

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.

74 FR 13926. March 27, 2009. “Power Reactor Security Requirements.” Final Rule, *Federal Register*, Nuclear Regulatory Commission.

75 FR 17254. April 5, 2010. “Revisions to the General Conformity Regulations.” Final Rule, *Federal Register*, Environmental Protection Agency.

79 FR 56238. September 19, 2014. “Continued Storage of Spent Nuclear Fuel.” Final Rule, *Federal Register,* Nuclear Regulatory Commission.

82 FR 2402. January 9, 2017. “Tribal Policy Statement.” *Federal Register*, Nuclear Regulatory Commission.

84 FR 39684. August 9, 2019. “Mitigation of Beyond-Design-Basis Events.” Final Rule, *Federal Register*, Nuclear Regulatory Commission.

85 FR 47252. August 4, 2020. “Notice of Intent To Review and Update the Generic Environmental Impact Statement for License Renewal of Nuclear Plants.” *Federal Register*, Nuclear Regulatory Commission.

87 FR 24205. April 22, 2022. “Level 3 Probabilistic Risk Assessment Project Documentation (Volume 3x).” Draft report; request for comment. *Federal Register*, Nuclear Regulatory Commission.

87 FR 76219. December 13, 2022. “Notice of Intent To Conduct Scoping Process and Prepare Environmental Impact Statement; Vistra Operations Company LLC; Comanche Peak Nuclear Power Plant, Units 1 and 2.” *Federal Register*, Nuclear Regulatory Commission.

88 FR 1196. January 9, 2023. “National Environmental Policy Act Guidance on Consideration of Greenhouse Gas Emissions and Climate Change.” Notice of interim guidance; request for comments, *Federal Register*, Council on Environmental Quality.

88 FR 10940. February 22, 2023. “Notice of Intent to Conduct Scoping Process and Prepare Environmental Impact Statement; Vistra Operations Company LLC; Comanche Peak Nuclear Power Plant, Units 1 and 2.” Intent to conduct scoping process and prepare environmental impact statement; public scoping meeting, and request for comment, *Federal Register*, Nuclear Regulatory Commission.

88 FR 13329. March 3, 2023. “Renewing Nuclear Power Plant Operating Licenses-Environmental Review.” *Federal Register*, Nuclear Regulatory Commission.

88 FR 14958. March 10, 2023. “Proposed Rule; Public Meetings and Request for Comment.” *Federal Register*, Nuclear Regulatory Commission.

Administrative Procedure Act. 5 U.S.C. § 551 et seq.

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Appendix A

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11. ABSTRACT (200 words or less)

U.S. Nuclear Regulatory Commission (NRC) regulations allow for the renewal of commercial nuclear power plant operating licenses. There are no specific limitations in the Atomic Energy Act or the NRC's regulations restricting the number of times a license may be renewed. To support license renewal environmental reviews, the NRC published the first Generic Environmental Impact Statement for License Renewal of Nuclear Plants (LR GEIS) in 1996. Per NRC regulations, a review and update of the LR GEIS is conducted every 10 years, if necessary. The proposed action is the renewal of nuclear power plant operating licenses.

Since publication of the 1996 LR GEIS, 59 nuclear power plants (96 reactor units) have undergone license renewal environmental reviews and have received renewed licenses (either an initial license renewal [initial LR] or subsequent license renewal [SLR]), the results of which were published as supplements to the LR GEIS. This revision evaluates the issues and findings of the 2013 LR GEIS (Revision 1). Lessons learned and knowledge gained from initial LR and SLR environmental reviews provide major sources of new information for this assessment. In addition, new research, findings, public comments, changes in applicable laws and regulations, and other information were considered in evaluating the environmental impacts associated with license renewal. Additionally, this revision fully considers and evaluates the environmental impacts of initial LR and one term of SLR.

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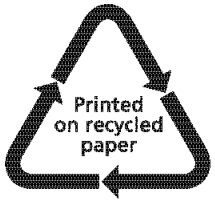

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