U.S. NUCLEAR REGULATORY COMMISSION

REGULATORY GUIDE 4.2, Revision 4

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PREPARATION OF ENVIRONMENTAL REPORTS FOR NUCLEAR POWER STATIONS

A. INTRODUCTION

Purpose

This Regulatory Guide (RG) provides guidance to applicants for the format and content of environmental reports (ERs) that are submitted as part of an application for a permit, license, or other authorization to site, construct, and/or operate a new nuclear power plant.

Applicability

This RG applies to applications for a permit, license, or other approval for a nuclear power plant subject to Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, "Domestic Licensing of Production and Utilization Facilities," 10 CFR Part 52 "Licenses, Certifications, and Approvals for Nuclear Power Plants," and the associated review under 10 CFR Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

Applicable Regulations

- The National Environmental Policy Act of 1969, as amended (NEPA; 42 United States Code (U.S.C.) 4321 et seq.) requires that Federal agencies prepare detailed environmental impact statements (EISs) on proposed major Federal actions significantly affecting the quality of the human environment. The principal objective of NEPA is to require a Federal agency to consider, in its decision-making process, the environmental impacts of each proposed major Federal action and alternative actions, including alternative sites.

- 10 CFR Part 50 governs the licensing of nuclear power plants. Applicable sections in 10 CFR Part 50 provide requirements for submittal of ERs in support of applications for early site permits (ESPs), combined licenses (COLs), limited work authorizations (LWAs), construction permits (CPs), and operating licenses (OLs).

- 10 CFR Part 51 provides requirements for NRC's preparation and processing of EIS and related documents under Section 102(2)(C) of NEPA.

Written suggestions regarding this guide may be submitted through the NRC's public website in the NRC Library at https://www.nrc.gov/reading-rm/doc-collections/reg-guides/index.html., under Document Collections, in Regulatory Guides, at https://www.nrc.gov/reading-rm/doc-collections/reg-guides/contactus.html, and will be considered in future updates and enhancements to the "Regulatory Guide" series. During the development process of new guides suggestions should be submitted within the comment period for immediate consideration. Suggestions received outside of the comment period will be considered if practical to do so or may be considered for future updates.

Electronic copies of this RG, and previous versions of DGs and RGs are available through the NRC's public website in the NRC Library at https://www.nrc.gov/reading-rm/doc-collections/reg-guides/index.html under Document Collections, in Regulatory Guides. This RG is also available through the NRC's Agencywide Documents Access and Management System (ADAMS) at https://www.nrc.gov/reading-rm/adams.html, under ADAMS Accession Number (No.) ML25043A345. The regulatory analysis is associated with a rulemaking and may be found in ADAMS under Accession No. ML25044A483. The associated draft guide DG-4032 may be found in ADAMS under Accession No. ML24176A218, and the staff responses to the public comments on DG-4032 may be found under ADAMS Accession No. ML25155B863.

- 10 CFR Part 52 governs the issuance of ESPs, design certifications (DCs), COLs, standard design approvals, and manufacturing licenses for nuclear power facilities licensed under Section 103 of the Atomic Energy Act of 1954, as amended (42 U.S.C. 2133), and Title II of the Energy Reorganization Act of 1974 (42 U.S.C. 5841-5853). Applicable sections in 10 CFR Part 52 describe requirements to include ERs for ESPs, DCs, COLs, standard design approvals, and manufacturing licenses.

Related Guidance

While the guidance provided in the related documents listed below may overlap with guidance in this RG, the purposes of the documents are different. Some of the related documents offer guidance in the development of reference sources that may be useful in the development of an ER, but, unlike this RG, none are specifically intended to offer guidance directly pertinent to preparing the ER itself.

- RG 1.206, "Applications for Nuclear Power Plants," identifies sources of information that can be used by applicants in the development of ERs for COL applications.

- RG 4.7, "General Site Suitability Criteria for Nuclear Power Stations," discusses the major site characteristics related to public health and safety and environmental issues that the NRC staff considers in determining the suitability of sites for light-water-cooled nuclear power stations.

- RG 4.11, "Terrestrial Environmental Studies for Nuclear Power Stations," provides technical guidance that the NRC staff considers acceptable for terrestrial environmental studies and analyses supporting licensing decisions for nuclear power reactors.

- RG 4.24, "Aquatic Environmental Studies for Nuclear Power Stations," provides technical guidance that the NRC staff considers acceptable for aquatic environmental studies and analyses supporting licensing decisions for nuclear power reactors.

- NUREG-1555, "Environmental Standard Review Plan: Standard Review Plans for Environmental Reviews for Nuclear Power Plants," provides the criteria used by the NRC staff for reviewing ERs submitted with nuclear power plant license applications.

- COL-ISG-030, "Environmental Considerations Associated with New Nuclear Reactor Applications that Reference the Generic Environmental Impact Statement for Licensing of New Nuclear Reactors (NUREG-2249), Interim Staff Guidance."

Purpose of Regulatory Guides

The NRC issues RGs to describe methods that are acceptable to the staff for implementing specific parts of the agency's regulations, to explain techniques that the staff uses in evaluating specific issues or postulated events, and to describe information that the staff needs in its review of applications for permits and licenses. Regulatory guides are not NRC regulations and compliance with them is not required. Methods and solutions that differ from those set forth in RGs are acceptable if the applicant provides sufficient basis and information for the NRC staff to verify that the alternative methods comply with the applicable NRC regulations.

Paperwork Reduction Act

This RG provides voluntary guidance for implementing the mandatory information collections in 10 CFR Part 51 that are subject to the Paperwork Reduction Act of 1995 (44 U.S.C. 3501 et seq.). These

information collections were approved by the Office of Management and Budget (OMB), approval number 3150-0021. Send comments regarding this information collection to the FOIA, Library, and Information Collections Branch (T6-A10M), U.S. Nuclear Regulatory Commission, Washington, DC 20555 0001, or by email to Infocollects.Resource@nrc.gov, and to the OMB reviewer at: OMB Office of Information and Regulatory Affairs (3150-0021), Attn: Desk Officer for the Nuclear Regulatory Commission, 725 17th Street, NW Washington, DC 20503.

Public Protection Notification

The NRC may not conduct or sponsor, and a person is not required to respond to, a collection of information unless the document requesting or requiring the collection displays a currently valid OMB control number.

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Abbreviations/Acronyms

ACHP	Advisory Council on Historic Preservation
ACS	American Community Survey
ADAMS	Agencywide Documents Access and Management System
APE	area of potential effect
BMP	best management practice
CBG	Census block group
CDF	core damage frequency
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CO_2	carbon dioxide
CO_2(e)	carbon dioxide equivalent
COL	combined license
CP	construction permit
CWA	Clean Water Act (aka Federal Water Pollution Control Act)
dBA	decibel(s) on the A-weighted scale
DBA	design-basis accident
DC	design certification
DCD	design control document
DOE	U.S. Department of Energy
D/Q	atmospheric deposition factor(s)
DSM	demand-side management
EA	environmental assessment
EAB	exclusion area boundary
EE	energy efficiency
EFH	essential fish habitat
EIS	environmental impact statement
ELF-EMF	extremely low frequency-electromagnetic field
EMF	electromagnetic field
EPA	U.S. Environmental Protection Agency
ER	environmental report
ESA	Endangered Species Act of 1973, as amended
ESP	early site permit
FAST	Fixing America's Surface Transportation
FR	*Federal Register*

FSAR	final safety analysis report
FWS	U.S. Fish and Wildlife Service
gal	gallon(s)
GASPAR	gaseous and particulate (code)
GEIS	Generic Environmental Impact Statement
GHG	greenhouse gas
GIS	geographic information system
gpm	gallon(s) per minute
GWd	gigawatt day(s)
GWP	global warming potential
Hz	hertz
IAEA	International Atomic Energy Agency
ISFSI	independent spent fuel storage installation
ISG	interim staff guidance
ISO	independent system operator
kg/ha/mo	kilogram(s)/hectare/month
km	kilometer(s)
kWh	kilowatt-hour(s)
LADTAP	Liquid Annual Dose to All Persons (code)
LEDPA	least environmentally damaging practicable alternative
LLW	low-level solid waste
LPZ	low-population zone
LWA	limited work authorization
LWR	light-water reactor
m^3	cubic meter(s)
m^3/yr	cubic meters per year
MACCS	MELCOR Accident Consequence Code System
MEI	maximally exposed individual
Mgd	million gallon(s) per day
mi	mile(s)
mrad	millirad
mrad/d	millirad/day
mrem	millirem
mrem/yr	millirem per year
MSA	Magnuson–Stevens Fishery Conservation and Management Act of 1996

MTU	metric ton(s) of uranium
MWd/MTU	megawatt-days per metric ton of uranium
MW	megawatt
MW(e)	megawatt(s) electric
MW(t)	megawatt(s) thermal
MWh	megawatt hour(s)
MWh/yr	megawatt hour(s) per year
NAAQS	National Ambient Air Quality Standard
NCRP	National Council on Radiation Protection and Measurements
NEI	Nuclear Energy Institute
NEIMA	Nuclear Energy Innovation and Modernization Act
NEPA	National Environmental Policy Act of 1969, as amended
NHPA	National Historic Preservation Act of 1966, as amended
NIEHS	National Institute of Environmental Health Sciences
non-LWR	non-light-water reactor
NOAA	National Oceanographic and Atmospheric Administration
NO_x	nitrogen oxide
NMFS	National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
NRHP	National Register of Historic Places
NWS	National Weather Service
NUREG	U.S. Nuclear Regulatory Commission technical document
O_3	ozone
OL	operating license
OMB	Office of Management and Budget
PPE	plant parameter envelope
PRA	probabilistic risk assessment
rem	roentgen equivalent man
REMP	radiological environmental monitoring program
RG	regulatory guide
ROI	region of interest
RTO	regional transmission organization
SAMA	severe accident mitigation alternative
SAMDA	severe accident mitigation design alternative
SAR	safety analysis report

SEIS	supplemental environmental impact statement
SHPO	State Historic Preservation Office (or Officer)
SPE	site parameter envelope
SME	subject matter expert
SMR	small modular reactor
SRP	Standard Review Plan
SSC	structure, system, and component
THPO	Tribal Historic Preservation Officer
TRAGIS	Transportation Routing Analysis Geographic Information System
U.S.	United States
USACE	U.S. Army Corps of Engineers
U.S.C.	United States Code
χ/Q	atmospheric dispersion factor(s)
yr	year

B. DISCUSSION

Reason for Revision

This revision of the guide adds guidance for ERs for new nuclear reactor applications. Specifically, in Appendix C, Reactor Applications that Reference the Generic Environmental Impact Statement for the Licensing of New Nuclear Reactors, guidance is provided on the use of the NR GEIS including microreactors.

Background

In recent years, interest in developing and licensing nuclear reactors in the United States using new technologies has increased. The increased interest is demonstrated by the Nuclear Energy Innovation Capabilities Act of 2017 (Public Law 115-248) and Nuclear Energy Innovation and Modernization Act of 2019 (NEIMA, Public Law 115-439). In February 2020, the NRC issued COL-ISG-029, "Environmental Considerations Associated with Micro-reactors," which provided supplemental guidance to assist the NRC staff in determining the scope and scale of environmental reviews of micro-reactor applications.

Applicants for reactor license renewal should use RG 4.2, Supplement 1, "Preparation of Environmental Reports for Nuclear Power Plant License Renewal Applications," for developing ERs submitted as part of an application in accordance with 10 CFR Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants."

Consideration of International Standards

The International Atomic Energy Agency (IAEA) works with member states and other partners to promote the safe, secure, and peaceful use of nuclear technologies. The IAEA develops Safety Requirements and Safety Guides for protecting people and the environment from harmful effects of ionizing radiation. This system of safety fundamentals, safety requirements, safety guides, and other relevant reports reflects an international perspective of what constitutes a high level of safety. To inform its development of this RG, the NRC considered IAEA Safety Requirements and Safety Guides pursuant to the Commission's International Policy Statement and Management Directive and Handbook 6.6, "Regulatory Guides."

Similar to this RG, IAEA Nuclear Energy Series No. NG-T-3.11, "Managing Environmental Impact Assessment for Construction and Operation in New Nuclear Power Programmes," addresses the basic concepts of environmental impact assessment and a methodological approach for estimating health and environmental impacts. IAEA Safety Guide NS-R-3, "Site Evaluation for Nuclear Installations," contains recommendations for the collection of information to assess the safety and environmental suitability of a site for a nuclear installation. Use of this RG would, in general, be consistent with the principles and basic aspects of environmental impact assessment described in the IAEA Technical Report NG-T-3.11 and Safety Guide NS-R-3 on health and environmental impacts and site evaluation.

Documents Discussed in Staff Regulatory Guidance

This RG endorses the use of one or more third-party guidance documents. These third-party guidance documents may contain references to other codes, standards or third-party guidance documents ("secondary references"). If a secondary reference has itself been incorporated by reference into NRC regulations as a requirement, then licensees and applicants must comply with that standard as set forth in the regulation. If the secondary reference has been endorsed in an RG as an acceptable approach for meeting an NRC requirement, then the standard constitutes a method acceptable to the NRC staff for

meeting that regulatory requirement as described in the specific RG. If the secondary reference has neither been incorporated by reference into NRC regulations nor endorsed in an RG, then the secondary reference is neither a legally binding requirement nor a "generic" NRC-approved acceptable approach for meeting an NRC requirement. However, licensees and applicants may consider and use the information in the secondary reference, if appropriately justified, consistent with current regulatory practice, and consistent with applicable NRC requirements.

C. STAFF REGULATORY GUIDANCE

General Guidance to Applicants

I. Summary

This section summarizes general guidance for developing the format and content of ERs under 10 CFR Part 51 for applications for licenses, permits, and authorizations for new reactors pursuant to 10 CFR Parts 50 and 52. The following chapters outline the format and content of a prospective ER. Applicants may use the same chapters and sections/subsections in their ER.

The information provided in Section C is applicable to ERs for large light-water reactor COL applications not referencing an ESP. Appendix A provides supplemental guidance for the development of ERs for other authorizations and licenses that can be granted by the NRC under 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," and 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants," such as ESPs, COLs referencing an ESP, CPs, OLs, LWAs, standard design certifications (DCs), and manufacturing licenses. Appendix B describes the requirements for the NRC to consult with other Federal agencies under other environmental statutes and the information the NRC staff needs to complete those consultations.

Appendix C provides additional guidance on the preparation of ERs under 10 CFR Part 51 for applications that reference the Generic Environmental Impact Statement for the Licensing of New Nuclear Reactors (NR GEIS, NUREG-2249). New nuclear reactors can include small modular reactors (SMRs), microreactors, and other reactors using nontraditional technologies, and may be classified either as light-water reactors (LWRs) or non-light--water reactors (non-LWRs). The amount of information needed for a new nuclear reactor would depend on application-specific factors such as the size of the reactor, its footprint, and the amount of resources it uses (e.g., water). A potential applicant for a new nuclear reactor should engage with the NRC staff in pre-application accordance with 10 CFR 51.40, "Consultation with NRC Staff" to discuss the appropriate level of environmental studies or information that should be provided for a new nuclear reactor design (e.g., additional information about the fuel cycle, radiological effluents, and accidents should be provided). The guidance in Appendix C may however refer an applicant to the guidance in Section C for some issues for proposed new reactor projects.

General guidance in this section includes information related to consultations, non-NRC permits and approvals, impact findings, mitigation of adverse impacts, and issues related to the definition of construction in 10 CFR 50.10(a). General guidance related to the presentation of referenced material or other information in the ER sufficient to support the NRC's development of the EIS is also provided in this section.

Applicants should be cognizant of the NRC's current environmental review process and practices through the review of:

- applicable NRC regulations in Section A of this RG;
- the most recent versions of regulatory guidance, particularly the documents in the Related Guidance section in Section A of this RG;
- The staff's NR GEIS (NUREG-2249);
- recent EISs prepared by NRC staff; and

- the staff's "Environmental Standard Review Plan: Standard Review Plans for Environmental Reviews for Nuclear Power Plants" (NUREG-1555).

In addition, applicants are encouraged to confer with the NRC staff as early as possible in the planning process before submitting environmental information or filing an application in accordance with 10 CFR 51.40, "Consultation with NRC staff," and as discussed in RG 1.206. If an applicant is a Federal agency, then the applicant should inform the staff of its NEPA and regulatory responsibilities during the pre-application review. Furthermore, applicants should be aware that they should assess environmental impacts in proportion to their significance as described in 10 CFR 51.45(b)(1).

The NRC staff in its NEPA documents generally follows the terminology used by the applicant in its ER to describe commonly used terms such as station, plant, unit, facility, or project. The applicant should define the terms that it uses and be clear and consistent throughout its ER.

II. Consultations and Coordinations

The NRC is responsible for conducting consultations under certain Federal laws, as appropriate, such as the Endangered Species Act of 1973 (16 United States Code (U.S.C.) 1531 et seq.), the Magnuson-Stevens Fishery Conservation and Management Act of 1996, Section 305 (16 U.S.C. 1855), and the National Historic Preservation Act of 1966, as amended (NHPA) (54 U.S.C. 300101 et seq.). As discussed throughout this RG, the information that the NRC suggests an applicant provide as part of their ER will help the NRC meet its responsibilities to consult with other Federal, State, and Tribal agencies under these Federal laws. The applicant should provide sufficient information in the ER to enable the NRC to complete the consultation processes. Additional information related to consultations is found in Appendix B of this RG.

In addition, there are laws and Executive Orders that may require coordination between the NRC and other Federal and State agencies before granting a license or a permit. One example is the Fish and Wildlife Coordination Act, enacted in 1934 to ensure that water-resource development projects do not conflict with the conservation of fish and wildlife resources. Under the Fish and Wildlife Coordination Act, Federal agencies must consult with the U.S. Fish and Wildlife Service (FWS) and the National Marine Fisheries Service (NMFS), as well as the State agency exercising administration over fish and wildlife resources when any body of water is proposed, authorized, permitted or licensed to be modified by any public or private agency under a Federal permit or license. Although coordination with other Federal agencies is the responsibility of the NRC, the proponent of the action (the applicant) should provide sufficient information to enable the NRC to complete the coordination process.

III. Non-NRC Environmental Permits and Approvals

In many cases, the NRC cannot issue a license or permit until the appropriate State or other Federal agencies have granted licenses or permits to the applicant. Applicants are required to comply with applicable Federal and State environmental statutes.[1] The exact license or permit requirements will be dependent on factors such as water sources, proposed activities, as well as State permitting requirements, which can vary between States. Examples include the following:

- The Clean Water Act of 1972 (CWA) (33 U.S.C. 1251 et seq.), was enacted to preserve and restore the quality of the Nation's surface waters. Section 401 of the CWA requires that an

[1] An additional source for permits that an applicant may need can be found in Appendix A of EPA's "§309 Reviewers Guidance for New Nuclear Power Plant Environmental Impact Statements."

applicant for a Federal license or permit that may result in a discharge of regulated pollutants into waters of the United States obtain, and provide to the Federal licensing agency (i.e., the NRC), a Section 401 water-quality certification from the State, interstate agency, or authorized Indian Tribe with jurisdiction over the discharge. The NRC cannot issue a license or permit until the appropriate jurisdiction has granted or waived the Section 401 certification. Conditions in the 401 certification become conditions of the license in accordance with 10 CFR 50.54(aa). Additionally, the NRC cannot issue a license or permit if certification has been denied by the State, an interstate agency, or the U.S. Environmental Protection Agency (EPA) Administrator.

- Section 402 of the CWA establishes the National Pollutant Discharge Elimination System (NPDES) permit program to regulate point source discharges of pollutants into waters of the United States. An NPDES permit sets specific discharge limits for point sources discharging pollutants into waters of the United States and establishes monitoring and reporting requirements, as well as special conditions. The EPA is charged with administering the NPDES permit program, but can authorize states to assume many of the permitting, administrative, and enforcement responsibilities of the NPDES permit program. Authorized states are prohibited from adopting standards that are less stringent than those established under the Federal NPDES permit program, but may adopt or enforce standards that are more stringent than the Federal standards if allowed under State law.

- Section 404 of the CWA requires a 404 permit for discharge of dredged or fill material into wetlands and waters of the United States. The U.S. Army Corps of Engineers (USACE) and the EPA are responsible for administering and enforcing Section 404. States and Indian Tribes can administrate the 404 permit program in certain non-navigable waters that are within their jurisdiction.

- The Clean Air Act, Section 176 (42 U.S.C. 7401 et seq.), prohibits Federal agencies from undertaking, licensing, permitting, approving, or supporting any action in a maintenance or nonattainment area that does not conform to the applicable State Implementation Plan. The General Conformity Rule requires that Federal agencies demonstrate conformity to the applicable State Implementation Plan. If required, the conformity determination must be completed before the license or permit is issued.

- The Coastal Zone Management Act of 1972 (16 U.S.C. 1451 et seq.), requires that activities of Federal agencies that are reasonably likely to affect coastal zones be consistent with any applicable State-approved Coastal Management Program to the maximum extent practicable. Applicants must submit to both the NRC and to the State a certification that the proposed activity complies with the enforceable policies of the State's program. If the Coastal Zone Management Act applies to the project, the NRC cannot issue its license or permit until the State has concurred with the applicant's certification of a coastal consistency determination.

These examples are illustrative, not all-inclusive. An applicant should understand the permitting requirements, processes, and schedules of applicable agencies when planning to apply for a license and construct a nuclear power plant. This guide does not contain guidance for preparing permit applications for submission to other agencies, including the USACE. Such guidance should be obtained from the applicable agencies. The Nuclear Energy Institute (NEI) prepared NEI 10-07, Revision 1, "Industry Guideline for Effective Interactions with Agencies Other Than NRC during the Early Site Permit Process," to provide guidance to applicants about interactions with other agencies. NEI 10-07 is endorsed in this RG for ESP, COL, CP, and OL applications. In addition, applicants for an NRC permit or license should be aware that the USACE may be a cooperating agency with NRC for preparation of an EIS related to a proposed nuclear power plant. NEPA allows for agencies to cooperate on EISs so that one EIS

can satisfy the NEPA requirements for both agencies. This cooperation improves the efficiency of the process. However, the applicant should engage with the USACE to ensure that their application to the USACE meets the USACE's requirements.

During pre-application interactions, applicants for a CP, OL or a COL should inform the staff if they plan to use Title 41 of the Fixing America's Surface Transportation (FAST) Act (42 U.S.C. 4370m).

IV. Impact Findings

Applicants should assess environmental impacts in proportion to their significance as described in 10 CFR 51.45(b)(1)

In assessing the significance of environmental impacts for new reactor applications, the NRC uses the same definitions of significance levels as codified in the footnotes to Table B-1 in Appendix B to Subpart A, "Environmental Effect of Renewing the Operating License of a Nuclear Power Plant," of 10 CFR Part 51:

- SMALL: For the issue, 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 small.

- MODERATE: For the issue, environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.

- LARGE: For the issue, environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

V. Mitigation of Adverse Effects

Applicants are required to consider alternatives available for reducing or avoiding adverse effects as described in 10 CFR 51.45(c). In addition, applicants should identify in their ERs any ongoing or planned mitigation for other permit-related activities and discuss the potential need for additional mitigation. Mitigation alternatives should be considered in proportion to the significance of the impact. There are five types of mitigative actions:

- avoiding the impact altogether by not taking a certain action or parts of an action;

- minimizing impacts by limiting the degree or magnitude of the action and its implementation;

- rectifying the impact by repairing, rehabilitating, or restoring the affected environment;

- reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; and

- compensating for the impact by replacing or providing substitute resources or environments.

An applicant should identify in the ER all relevant, reasonably foreseeable mitigation measures that could reduce or avoid adverse effects, even if they are outside the jurisdiction of the NRC. This approach is consistent with CEQ's response documented in Question 19b of its 40 questions (see 46 FR 18026).

The applicant should provide the reason why the mitigation measures are considered reasonably foreseeable. A mitigation measure can be considered reasonably foreseeable if, for example, it is (1) required by the NRC as a license condition (e.g., a requirement imposed pursuant to 10 CFR 50.54(aa)), (2) required or likely to be required by another regulatory agency (e.g., USACE), or (3) mitigation that the applicant intends to perform and identifies in the ER.

Where applicable, the applicant should specify what Federal, State, or local laws require the mitigation measures, or if there is (or is expected to be) a Federal, State, or local permit that requires the particular measures. The applicant should clearly explain the requirements that are being imposed by the regulatory agency that has authority over the resource and explain how it relied on the mitigation to determine the impact level by discussing how the mitigation will be accomplished and whether it is expected to lower the impact level. For example, for a project where a wetlands mitigation plan is required by a State permit issued to the applicant and/or by State laws and regulations, the applicant should consider this information in the ER.

VI. Implementation of the LWA Rule – Definition of Construction and Preconstruction

On October 9, 2007, the NRC issued revisions to its rules related to LWAs (72 FR 57416). Prior to this revision, the regulations had allowed for site preparation, excavation, and certain other onsite activities to proceed before a CP was issued, but only after NRC review and approval in the form of an LWA. With the revised regulations, NRC authorization would be required only before undertaking activities that have a reasonable nexus to radiological health and safety or common defense and security. The revised rule clarified which activities are defined as "construction" and which activities are not considered construction, as discussed below. In discussing the environmental impacts of the proposed action, activities defined by the LWA rule as not constituting "construction" are referred to in this RG as "preconstruction" activities. Preconstruction activities are not considered direct impacts of the NRC's Federal action because they may occur in the absence of an NRC license and are not part of the NRC's licensing action. This change has implications for how impacts are described within the NRC's EISs, even when the application does not include a request for an LWA.

According to 10 CFR 50.10(a), "construction" includes those activities such as driving of piles, subsurface preparation, placement of backfill, concrete, or permanent retaining walls within an excavation, installation of foundations, or in-place assembly, erection, fabrication, or testing, which are for:

- safety-related structures, systems, or components (SSCs) of a facility, as defined in 10 CFR 50.2, "Definitions;"
- SSCs relied upon to mitigate accidents or transients or used in plant emergency operating procedures;
- SSCs whose failure could prevent safety-related SSCs from fulfilling their safety-related function;
- SSCs whose failure could cause a reactor scram or actuation of a safety-related system;
- SSCs necessary to comply with 10 CFR Part 73, "Physical Protection of Plants and Materials;"
- SSCs necessary to comply with 10 CFR 50.48, "Fire protection," and Criterion 3 of 10 CFR Part 50, Appendix A; and

- onsite emergency facilities, that is, technical support and operations support centers, necessary to comply with 10 CFR 50.47, "Emergency plans," and 10 CFR Part 50, Appendix E.

Construction does not include:

- changes for temporary use of the land for public recreational purposes;

- site exploration, including necessary borings to determine foundation conditions or other preconstruction monitoring to establish background information related to the suitability of the site, the environmental impacts of construction or operation, or the protection of environmental values;

- preparation of a site for construction of a facility, including clearing of the site, grading, installation of drainage, erosion and other environmental mitigation measures, and construction of temporary roads and borrow areas;

- erection of fences and other access control measures;

- excavation;

- erection of support buildings (such as construction equipment storage sheds, warehouse and shop facilities, utilities, concrete mixing plants, docking and unloading facilities, and office buildings) for use in connection with the construction of the facility;

- building of service facilities, such as paved roads, parking lots, railroad spurs, exterior utility and lighting systems, potable water systems, sanitary sewerage treatment facilities, and transmission lines;

- procurement or fabrication of components or portions of the proposed facility occurring at locations other than the final, in-place location at the facility; and

- manufacture of a nuclear power reactor under a manufacturing license under Subpart F of 10 CFR Part 52 to be installed at the proposed site and to be part of the proposed facility.

The activities defined by 10 CFR 50.10, "License required; limited work authorization," as not being included in the definition of construction are considered to be "preconstruction" activities because they may occur in the absence of an NRC license and are not part of the NRC's licensing action.

Where this guide refers to "building," it includes all preconstruction and construction activities. Under the revised LWA rule, the applicant should separate the impacts of preconstruction and construction activities to address the latter, as they are the activities being authorized by the NRC. The applicant should also describe the impacts of the preconstruction activities, so they can be evaluated as part of the cumulative impacts related to the construction activities.

Generally, the estimates of the impact breakdown between preconstruction and construction activities do not need to be detailed. The applicant should provide sufficient information to allow the NRC staff to evaluate the impacts on each resource of NRC-authorized construction, in addition to the combined impacts of preconstruction and construction for the cumulative impacts analysis.

In a few areas, the level of impact may be so small that anything other than a ballpark estimate of the separation would not be warranted to adequately inform the NEPA decision-making process. As an

example and based on staff experience from other construction projects of similar size, an air quality impact may be assessed as being small during scoping, if the area is in attainment under EPA regulations. Under these circumstances, no effort beyond a very simple estimate of the preconstruction-construction impact separation, would be necessary to assess the impact of the construction activities.

In addition, the staff anticipates that the USACE will be a cooperating agency on the majority of EISs because it is likely to have permitting actions related to the preconstruction and construction activities and, in some cases, operational activities for the plant. The USACE views the impacts from preconstruction and construction activities as impacts of the proposed project based on USACE regulations. The NRC and the USACE will cooperate on the EISs in accordance with the Memorandum of Understanding signed on September 12, 2008, and published in the *Federal Register* (73 FR 55546), covering environmental reviews related to the issuance of authorizations to construct and operate nuclear power plants. The NRC and the USACE established the cooperative agreement because both agencies have concluded it is the most effective and efficient use of Federal resources to write one EIS that addresses both agencies' NEPA obligations. Other Federal agencies may also become cooperating agencies on an EIS.

VII. Storage of Spent Fuel

In 2014, the NRC issued a revised rule at 10 CFR 51.23, "Environmental impacts of continued storage of spent nuclear fuel beyond the licensed life for operation of a reactor," and published NUREG-2157, "Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel." As a result of the revised rule, the environmental impacts of the continued storage of spent fuel (beyond the licensed life of the plant) are deemed incorporated into an EIS for a new reactor review. As part of the basis for the analysis in NUREG-2157, the NRC staff assumed that an independent spent fuel storage installation of sufficient size to hold all of the spent fuel from operations would be built during the licensed life of the plant. The applicant should be cognizant of the analysis in NUREG-2157 and should provide a discussion of its plans for management of spent fuel during the licensed life of the plant.

VIII. Presentation of Applicant Information

Information and data should be provided in or with the application at a level sufficient for the NRC staff to comply with Section 102(2) of NEPA. The applicant should describe and provide the following data and information:

- geographic information and geospatial data used to support analyses, including appropriate description of the data formats and sources of the information;
- data formats used to create figures and maps; and
- description and documentation of computer modeling codes that are used to support analyses in sufficient detail to allow the NRC staff to conduct an independent evaluation.

This section provides methodologies for incorporating previous analyses by reference into environmental review documentation. Applicants are encouraged to incorporate by reference any relevant information from other publicly available documents (from the NRC, applicant documents submitted for the record, or any other reputable source, such as other governmental entities or academic institutions). The applicant can only incorporate by reference documents that are publicly available and must properly cite them in the ER reference list.

Incorporating by reference should adhere to the following three principles:

(1) Specificity: After ensuring that reference material is publicly available, identify the documents that are being incorporated by reference and specify the section or page range, or both, that is being incorporated.
(2) Summarize: Provide a summary of the information being incorporated by reference and why it is applicable to your project.
(3) Address new information: Identify and discuss any new information relevant to environmental concerns and bearing on the proposed action or its impacts that was not considered in the documents being incorporated by reference.

Example:

When applicants decide to use incorporation by reference for applicable documents, the ER should contain a clear statement to that effect. For example, at first usage in an ER, the applicant can accomplish incorporation by reference by using language similar to the following:

The following information has been summarized and incorporated by reference from [title of document]. At the first appearance of each document incorporated by reference, the text should fully spell out the title and the EIS reference list should properly cite each document mentioned.

In all cases, information derived from published results should be clearly distinguished from information derived from the applicant's field measurements and all references should be available for auditing in the applicant's records.

The information the applicant provides to support the conclusions in the NRC's EIS must be publicly available. Because the EIS relies on information from the ER, applicants should ensure that key information supporting the conclusions in the ER can be made publicly available. Publicly available information is information that can be accessed by the public; for example: (1) publicly available information in the NRC's Agencywide Documents Access and Management System (ADAMS) recordkeeping system or maintained in the NRC's Public Document Room, (2) copyrighted information with a proper citation, or (3) a publicly accessible website with a reference that allows the NRC and the public to find the information. The applicant may reference copyrighted information but must not submit copyrighted material as public information in support of an ER.

However, the copyrighted information should be properly referenced so that the NRC and the public can access it. Regarding sensitive information, a request for withholding such information from the public must meet the requirements of 10 CFR 2.390, "Public inspections, exemptions, requests for withholding," if the information satisfies those requirements and the Commission grants the request to withhold the information from the public, then the information would not be made publicly available. Applicants should also ensure the consistency of information presented in different sections of the ER, as well as between the ER and the safety analysis report.

If the NRC is not relying on the information to reach its conclusions in the EIS, applicants are not required to make references and other supporting information publicly available, but making them available for review in an audit setting is appropriate. If the NRC is relying on the information in its EIS, and the information is not otherwise publicly available as discussed above, then the information must be docketed so that it can be made publicly available.

Chapter 1

1.0 Introduction

This section of the RG was written for large LWRs. Applicants for a license for a new nuclear reactor that will reference the NR GEIS should reference Appendix C "Reactor Applications that Reference the Generic Environmental Impact Statement for the Licensing of New Nuclear Reactors" for specific guidance related to how to use the NR GEIS in their ER. The guidance in Appendix C may however refer an applicant to the guidance in this section for some issues for proposed new reactor projects.

1.1 Plant Owners and Reactor Type

The owner(s) and the applicant(s) for the proposed project must be specified. Other information that must be provided is specified in 10 CFR 50.33, "Contents of applications; general information." Information about reactor type shall be provided in the safety analysis report (see 10 CFR 52.17, "Contents of applications; technical information," and 10 CFR 52.79, "Contents of applications; technical information in final safety analysis report").

1.2 Description of the Proposed Action and the Purpose and Need

According to 10 CFR 51.45(b), "Environmental report," the ER, among other things, "shall contain a description of the proposed action" and "a statement of its purposes." The purpose and need statement is developed by the NRC staff, but is informed by the applicant's objectives, as stated in Chapter 1 of its ER.

In NRC licensing actions under 10 CFR Parts 50 and 52 for large LWRs, the purpose and need have typically been described in terms of providing a specific quantity of electricity (typically baseload) to a defined service area within a defined time period. However, neither NEPA nor NRC regulations require the purpose and need statement to be restricted to electricity generation. As discussed in Chapter 8.0 of this RG, an applicant may use different means than a baseload generating capacity analysis to demonstrate the need for the power to be provided by the proposed project.

The NRC staff's purpose and need statement is the basis for the evaluation of the need for the project and for establishing a reasonable set of alternatives to the proposed action. Reasonable alternatives include those that are practical or feasible from the technical and economic standpoint using common sense. A reasonable alternative may be outside an agency's regulatory authority, such as energy alternatives (e.g., coal, wind, solar, natural gas), and would need to be evaluated to determine if it meets the purpose and need statement for the project. However, if the purpose and need statement stated the proposed project was intended to demonstrate a certain new reactor technology to generate electricity, alternative energy, such as coal, wind, solar or natural gas would not be a reasonable alternative, because it does not meet the purpose and need statement. Alternatives that do not meet the purpose and need statement are not considered reasonable alternatives and are not analyzed in detail.

The applicant may request licensing for purposes or ancillary benefits other than or in addition to electric power production. Additional purposes or needs for the project may provide greater insight into the benefits of the proposed project and assist the NRC staff in defining reasonable alternatives to the proposed project. Additional purposes could include, but are not limited to, meeting greenhouse gas emission goals, replacing existing plants, or enhancing energy diversity. Consideration of such ancillary benefits should be included in the benefit-cost analysis in Chapter 10 of the EIS.

If the purpose and need statement for a specific project is different from statements that have been previously evaluated in other EISs, the alternatives and benefits also may be different. An applicant in such a case should consult with the NRC staff in accordance with 10 CFR 51.40 to discuss the information and analysis that should be provided in the ER to support the development of the purpose and need, and the evaluation of the need for the project and the alternatives.

1.3 Planned Activities and Schedules

The applicant should supply a schedule of planned activities, including dates for the start of building and full-power operation. These dates are used by staff in the EIS analyses for construction, operation, cumulative impacts, and need for power.

1.4 Status of Compliance

In accordance with 10 CFR 51.45(d), the ER shall:

- "list all Federal permits, licenses, approvals and other entitlements that must be obtained in connection with the proposed action";
- "describe the status of compliance with these requirements"; and
- "include a discussion of the status of compliance with applicable environmental quality standards and requirements including, but not limited to, applicable zoning and land use regulations, thermal and other water pollution limitations, or requirements which have been imposed by Federal, State, regional, and local agencies having responsibility for environmental protection."

Chapter 2

2.0 The Proposed Site and the Affected Environment

As specified by 10 CFR 51.45(b), the ER shall contain "a description of the environment affected" by the proposed action. The information in this chapter of the ER should present the relevant information concerning the physical, ecological, societal, and human characteristics of the environment in and around the proposed site that might be affected by building and operation of a proposed nuclear station. For each environmental resource, applicants should describe only the affected environment for those areas within which the resource could potentially be subject to direct or indirect impacts from the action. The NRC refers to this area as the "resource impact area." Table 7-1 in Chapter 7.0 of this RG provides examples of resource impact areas for each environmental resource area typically affected by building or operating a nuclear reactor. The applicant's resource impact area may be different from the examples in Table 7-1. The NRC does not expect applicants to precisely define resource impact areas for each environmental resource, but the area within which the applicant characterizes the affected environment should generally correspond to the potential spatial extent of direct and indirect impacts, i.e., to what the NRC will define as the resource impact area.

The applicant should provide proposed plant location information (e.g., state and county in which the site will be located), an aerial photograph of the site as it exists at the time of the application, and one or more maps showing the site location and plant arrangement within the site, including the extent (if any) to which the plant is co-located and/or interfaces with an existing power plant or other existing industrial facility. The applicant should provide coordinates for the proposed center point for the nuclear island for each proposed new unit and the total acreage of the proposed site. In addition, this section can be used to provide other descriptive information about the setting of the proposed project.

2.1 Land Use

The applicant should provide data and information about the site, local vicinity, and the wider region. For the purposes of this section, the site is defined as the immediate property effectively controlled by the applicant (e.g., within the site boundary), upon which the proposed project would be situated. The vicinity is the surrounding landscape encompassing the site, local access routes, nearby cities and towns, and other local resources with the potential to be affected by the proposed project. The region includes the vicinity and the wider surrounding area. The definition of vicinity and region is left to the discretion of the applicant; however, as a general suggestion for consideration of land use issues, a typical distance limit of a 6 mi. (9.6 km) radius from the site perimeter can be used for vicinity and a 50 mi. (80 km) radius from the site perimeter can be used for region. The vicinity should be large enough to encompass surrounding areas whose land uses could reasonably be influenced to a noticeable degree by the proposed project and associated facilities. The region should be large enough to encompass any areas encompassed by applicable regional land use or local economic-development plans. The guidance provided in this paragraph applies only to defining a vicinity and region for evaluation of land use impacts; geographic areas of other sizes and shapes may be appropriate for evaluation of other environmental impacts.

The vicinity should include any offsite areas upon which related project structures would be sited or routed as part of the action covered in the application. Examples include transmission facilities (e.g., switchyards, substations, and transmission-line towers), and access roads needed to connect the plant to the grid. Other examples include reservoirs, barge slips, water-intake facilities, blowdown or other discharge lines, and related infrastructure.

The applicant should identify and describe the land use characteristics of the site, vicinity, and region. These descriptions should provide reasonably foreseeable land use changes near the site, including commercial, residential, and industrial developments and the anticipated effects of land use or related regional-development plans.

2.1.1 Site, Vicinity, and Region

The ER should include the following land use information related to the proposed site, vicinity, and region, as necessary to assess potential land use impacts:

- A site area map prepared according to RG 1.206;
- Zoning information for the proposed site including any existing or proposed land use plans and any regional economic-development plans that include the proposed site or vicinity within their scope;
- Maps and summary tabulation of areas occupied by the principal land uses for the site, vicinity, and region;
- Map showing existing topography of the site and vicinity;
- Maps showing highways, railroad lines, waterways, and utility corridors located on, or that cross, the site, vicinity, and region;
- Special land uses (e.g., recreation areas, parks, Tribal lands, designated wild and scenic rivers, or areas of other special designation) that could be affected by building the proposed project;
- Raw material resources (e.g., timber, sand and gravel, coal, oil, natural gas, ores, groundwater, and geothermal resources) and the owners thereof on or adjacent to the site that are presently being extracted or are of known commercial value;
- Principal agricultural and forest products of the vicinity and region, if agriculture or forestry is a predominant land use;
- Maps showing major public and trust land areas in the region;
- Discussion of whether any land at the proposed site or any affected offsite lands would be subject to requirements in the Coastal Zone Management Act (16 *United States Code* (U.S.C.) 1451 et seq.);
- Discussion of whether any land at the proposed site or any affected offsite lands constitute prime or unique farmlands (7 CFR Part 657, “Prime and Unique Farmlands”);
- Maps and discussion of any floodplains or wetlands on the site (can cross-reference other ER sections);
- Discussion of whether the applicant intends to acquire additional land to expand the proposed site;
- All associated geographic information system (GIS) coverages used to produce the map products in the ER; and

- Brief discussion of the major geological aspects of the site that could influence land use, including brief descriptions of soil and rock types, and unique geologic features (e.g., karst; geothermal resources; paleontological resources; unique formations, outcrops, or exposures of special interest (e.g., glacial erratics); and water supplies). Reference the final safety analysis report for detailed geologic, seismologic, and geotechnical information.

2.1.2 Transmission-Line Corridors and Other Offsite Areas

Building or upgrading of electric power transmission lines to serve a nuclear power plant does not require NRC approval (10 CFR 50.10(a)(2)(vii)). The NRC recognizes that new transmission lines and corridors may not necessarily be built, operated, or owned by an applicant seeking a permit or license from the NRC. However, the impacts of new transmission lines and corridors, or changes to existing lines or corridors, are relevant to the NRC's analysis of cumulative impacts in an EIS (10 CFR 51.45(c)).

To the extent that the indicated information is readily available, the ER should present the best available land use information related to (1) offsite corridors or areas that would be affected by building and operating electric power transmission lines or other offsite project elements, (2) new transmission corridors, and (3) building activities that would occur in existing transmission corridors, including the following:

- description of new transmission-related facilities (e.g., transmission lines and substations) that would be needed, including voltage specifications and the name of the entity that would build and own any new transmission-related facilities and the associated process for obtaining approved rights-of-way;

- map showing the potential or planned routing (i.e., the specific route or a band encompassing the route) of any new or existing (affected by the proposed project) transmission corridor(s) and location of transmission-related facilities;

- tabular summarization of the dimensions (length and width) of affected transmission corridors by each specific corridor segment or right-of-way;

- tabular summarization of existing land use and land cover within affected transmission corridors and other offsite areas (e.g., pipeline corridors);

- highways, railroad lines, and utility corridors crossed by new transmission lines or access corridors;

- special-use land areas that would serve as constraints in the selection of transmission-line routing or other offsite project activities (e.g., pipeline corridors);

- location of any project activities that would be in a floodplain, on wetlands, or on a waterbody;

- discussion of whether any land used for new transmission corridors or other offsite building activities would be subject to the Coastal Zone Management Act (16 U.S.C. 1451 et seq.);

- discussion of whether any land that would be used for new transmission corridors or other offsite building activities would constitute prime or unique farmlands (7 CFR Part 657);

- discussion of any expected private land access requirements;

- description of proposed routes of access corridors (e.g., roads and railroads) to serve the proposed project and any land use restrictions or land use plans affecting such corridors; and

- all associated GIS coverages used to produce the map products in the ER.

Information about the routing and design of transmission lines and other offsite facilities may be limited at the time a licensing application is submitted, especially for ESP applications or if a party other than the applicant will own or be responsible for all or some of the offsite facilities. The ER should present only information that can reasonably be obtained by the applicant at the time of submittal. The ER may explain when more detailed information may be available or that more detailed information may not be available until some unspecified time in the future. The ER should include the best available information about the possible transmission lines to support an analysis of the possible contribution of building and operating the transmission lines on the cumulative environmental impacts of the action.

2.2 Water Resources (Surface Water and Groundwater)

The applicant should provide sufficient information for the water-resource impact area to establish the baseline condition for evaluating the effects of station building and operation on water resources (surface water and groundwater) and its uses and users. For the purposes of this section, the resource impact area may be defined as the station and the surrounding area out to a distance sufficient to encompass those water resources that may affect or be reasonably assumed to be affected by the building or operation of the station. For groundwater resources, the resource impact area may generally be defined by the extent to which building or operating the plant affects the underlying aquifers. For reclaimed water, such as treated wastewater (if part of the proposed project), the resource impact area may generally be defined by the geographical extent of its prospective uses and users.

The applicant should describe, in quantitative terms, the hydrological and chemical characteristics of surface-water and groundwater bodies in the resource impact area. In addition, water use within the resource impact area should be described. The amount of data and information provided should be sufficient to evaluate the effects of station building and operation on water resources, and is anticipated to depend on the magnitude of the potential impacts. Greater potential impact will require more data and information to support the evaluation. Alternative interpretations of data and characteristics should be described when reasonable or when uncertainty in impacts exist. Characteristics should be substantially based on data obtained from a pre-application monitoring program and integrated with data from other studies conducted in the area and region (as applicable).

A statistical description should accompany all data. Average or median values, standard deviations or interquartile range, and the historical extremes should be described. Temporal trends in characteristics, including seasonal variation, should be identified and explained. Temporal variations of important characteristics (e.g., river flow rates) should be described in sufficient detail to provide accurate evaluation of impacts. For many characteristics, monthly variations may be sufficient, but daily or shorter increments should be provided (e.g., low river flows) when important for evaluating environmental impacts. Spatial variations of characteristics (e.g., aquifer hydraulic conductivity) should be described when they are important for evaluating environmental impacts radionuclide transport in groundwater.

All data for hydrologic characteristics, including water use, should be adjusted to both present-day conditions and to those that may reasonably be expected to occur over the proposed period of the license (e.g., future conditions). Where features of a proposed station (e.g., foundations, excavations, artificial lakes, and canals) modify the hydrologic conditions, the applicant should furnish sufficient site-specific detail for evaluation of the effects of building and operating the station on hydrologic characteristics, water use, and potential radionuclide transport for those water bodies and systems that

may receive radionuclides from the station. In addition, the applicant should describe reasonably foreseeable changes in the hydrologic environment (e.g., climate and land use).

When a mathematical model is used to support the evaluation of hydrologic characteristics, the applicant should describe the conceptual basis for the model, including the rationale for eliminating plausible alternative conceptualizations, the assumptions used in developing the model, the range of applicability of the model, the input data used, the resulting output, the basis for boundary conditions, parameter estimation and calibration procedures followed, and estimates of uncertainty in model forecasts. The applicant should provide in the ER sufficient descriptions of key models, assumptions, parameters, data used, and approaches to allow for an adequate NRC staff evaluation. If there is relevant information in other supporting documentation (i.e., Final Safety Analysis Report [FSAR], design control document [DCD] or other references), indicate where in those documents this information can be found.

2.2.1 Hydrology

The applicant should describe the hydrologic characteristics of surface waterbodies and groundwater aquifers that could be affected by station water use or be affected by building or operating the station. These characteristics collectively define the supply of water within the resource impact area, including the location, quantity, and temporal variability of that supply. The applicant should include the following information in the ER:

- discussion of rivers and streams including, but not limited to, drainage areas and gradients, discharge, bathymetry, wetlands and floodplain descriptions, flood and drought characteristics, flood control measures, and other hydrographic modifications;

- discussion of lakes and impoundments including, but not limited to, bathymetry, temperature, currents, inflows and outflows, evaporation, seepage, and a description of reservoir characteristics (e.g., elevation-area-capacity curves) and operations;

- discussion of estuaries and oceans including, but not limited to, bathymetry, tidal and nontidal currents, temperature, salinity, sedimentation rates, and sediment gradation and sorption characteristics;

- discussion of groundwater including, but not limited to, descriptions of aquifers and confining units, occurrence and extent of perched groundwater conditions, recharge and discharge areas and fluxes, groundwater head contour maps, hydraulic gradients, permeabilities, total and effective porosities, advective travel times, bulk density, and storage coefficients;

- groundwater transport characteristics (e.g., dispersion and adsorption coefficients), when necessary to evaluate impacts;

- data concerning use of groundwater including drawdown caused by withdrawals from neighboring major industrial and municipal wells; and

- maps or figures showing information requested above, as appropriate (e.g., areas affected by saltwater intrusion).

2.2.2 Water Use

The applicant should provide present and known future surface-water, groundwater, and reclaimed water uses (as applicable) that could affect or be affected by building or operation, including

for the following uses: public and self-supplied (or private) withdrawals for domestic, municipal, industrial, agricultural, mining, and power generation uses.

Data and information provided for each use should include, but not be limited to, the following:

- location and nature of water users and water-use areas;
- distance from the station;
- withdrawal rate by use category and return rate; and
- statutory or other legal restrictions on the water use or the water resource.

Additional information for groundwater use should include the following:

- identification of the aquifer from which withdrawal occurs;
- location and depth of wells;
- identification of any EPA-designated sole source aquifers that may be affected by station building or operation;
- characterization of consumptive and nonconsumptive water uses over the resource impact area;
- temporal variations in consumptive and nonconsumptive water uses; and
- existing capacities (including available capacities) of local and regional water and wastewater utilities.

Station water-use requirements are not addressed in this chapter; however, Chapter 3.0 of this RG addresses the information to be included in the ER related to station water-use requirements.

2.2.3 Water Quality

The applicant should describe the water-quality characteristics of surface waterbodies, groundwater aquifers, and reclaimed water (as applicable) that could be affected by station water use and effluent disposal. Data and information should include, but not be limited to, the following characteristics:

- physical (e.g., temperature);
- chemical (e.g., pH); and
- biological (e.g., biological oxygen demand).

The mean, range, and temporal and spatial variation of these water-quality characteristics should be provided. Data should be gathered for a sufficient period of time to understand long-term (annual) and short-term (seasonal or other) variations in both quality and availability of water (flow rates, water levels, etc.).

A description of existing aquatic environmental stressors, including a list of any CWA Section 303(d)-impaired waters, should be provided. The applicant should identify, to the extent possible,

the source and nature of existing impairments. The status of the permitting process for the CWA (33 U.S.C. 1251 et seq.) certifications should also be described.

2.2.4 Water Monitoring

The purpose of the pre-application water monitoring program is to establish a baseline for assessing subsequent environmental effects on water resources attributable to building and operating the proposed station. The applicant should describe the pre-application monitoring program used to assess the characteristics of the surface-water and groundwater resources in the resource impact area.

The ER should describe the pre-application monitoring program in sufficient detail to demonstrate a thorough and comprehensive approach to environmental assessment. The adequacy of the monitoring program with respect to both spatial coverage (i.e., surface area and depth), and temporal coverage (i.e., duration and sampling frequency) should be demonstrated. The description of this program should include the following:

- locations of monitoring stations;
- frequency and duration of monitoring;
- monitoring equipment used;
- sampling and analysis procedures followed;
- data analysis methods used; and
- documentation of any data-quality objectives.

2.3 Ecological Resources

The ER should describe the terrestrial, wetland and aquatic ecological resources existing at the proposed project site and in the vicinity and region. The applicant should provide sufficient details in the ER as a baseline for determining the impacts on terrestrial, wetland and aquatic species and habitats that might be affected by building and operating the proposed nuclear station.

2.3.1 Terrestrial Ecology

The ER should include a baseline description of potentially affected terrestrial resources. The description should also address offsite parcels and corridors needed for components such as reservoirs, barge docks, heavy-haul roads, access roads, laydown areas, electric transmission lines, water pipelines, and mitigation sites. When describing terrestrial resources, the applicant should use the same definitions of vicinity and region as used for the land and water use sections of the ER. The baseline description should focus on the anticipated footprint of land disturbance and may be less detailed for peripheral areas. Much of the needed information may be summarized from the background reports prepared using RG 4.11. Information should be updated to reflect recent land use changes and natural successional processes. Guidance on consultation under Section 7 of the Endangered Species Act is provided in Appendix B.

Terrestrial Habitats

Detailed guidance on identifying and describing terrestrial habitats is provided in RG 4.11. The ER should include the following information to characterize terrestrial habitats:

- Identification and description of each ecoregion (or equivalent) encompassing potentially affected areas using a widely recognized system such as that used by the EPA (EPA Ecoregion maps);

- Figures identifying and mapping each terrestrial habitat on, or adjacent to, the site (or offsite parcels or corridors);

- Description of each terrestrial habitat type using guidance provided in RG 4.11. Detailed field survey or quantification of vegetation characteristics may not be necessary. Descriptions based on recent site observations are typically more useful than older or regionalized descriptions. Studies would ideally show the condition of the ecological resources that exist no more than 5 to 10 years prior to NRC receiving the application. If older ecological baseline data is used, a discussion of the basis for determining that the data provides for an accurate and meaningful evaluation of potential impacts should also be included;

- Tables estimating the area of each habitat onsite (or offsite parcels or corridors);

- A table estimating the approximate area (or percentage) of each habitat type in the landscape surrounding the site and any offsite facilities; and

- A qualitative discussion of terrestrial habitat in the region.

Wetlands

Wetlands are specialized habitats with properties intermediate between terrestrial and aquatic. The Federal definition of wetlands is presented in 33 CFR Part 328, "Definitions of Waters of the United States," but not all areas meeting this definition are subject to Federal regulatory jurisdiction. Unregulated areas meeting the Federal definition are termed "non-jurisdictional wetlands." Some states and localities regulate wetlands independently using definitions that may vary from the Federal definition. Wetland information presented in the terrestrial ecology portions of the ER should be consistent with wetland information presented in the aquatic ecology portions. RG 4.11 provides additional guidance on wetlands. In general, the ER should include the following information with respect to characterizing wetlands:

- An indication of whether a wetland delineation has been completed for the site and offsite parcels, what areas were addressed, what wetland procedure(s) were used, and whether the delineation follows procedures required by applicable Federal and State agencies;

- A wetland delineation map and identification of each wetland using a classification system such as that used in the FWS National Wetlands Inventory, for those areas addressed by wetland delineation;

- A description and estimate of the area of each wetland falling under each National Wetlands Inventory classification;

- Wetland mapping data from a published source (e.g., the National Wetlands Inventory maps or State wetland maps) or identification of the terrestrial habitats on the site, if any, that may contain wetlands for those project areas where no wetland delineation was performed;

- A discussion of the functions and values of each wetland or cluster of interrelated wetlands (sometimes referred to as an "assessment area") on the site or offsite parcels;

- Citation and summary of any jurisdictional determination issued by the USACE or another applicable agency. For project areas lacking a jurisdictional determination, a description of the anticipated process for acquiring one;

- Identification, when practicable, of whether each wetland is under the jurisdiction of the CWA or applicable State or local wetland protection laws (note that a jurisdictional determination may not have been made at the time of an application);

- An estimate of the approximate extent of wetlands in the surrounding landscape using National Wetland Inventory maps or another source and a separate estimate for each National Wetland Inventory class or for each mapping unit used;

- An estimation of wetland losses in the context of their relative abundance in the surrounding landscape; and

- A qualitative discussion of wetlands in each relevant ecoregion, including the typical landscape positions commonly occupied by wetlands (e.g., stream valleys, estuarine or lacustrine fringes, and topographic depressions), and the history of wetland disturbance.

Wildlife

Guidance on identifying terrestrial wildlife is provided in RG 4.11. The ER should include the following:

- Tables of wildlife species observed in each habitat (upland or wetland) on the site (and each offsite parcel or corridor) based on a minimum of one year of observations, if available. See RG 4.11 for additional direction;

- A discussion of the potential value of each habitat to each major wildlife grouping: mammals, birds, reptiles, amphibians, and insects. The discussion can be qualitative and should have an ecological focus; discussions individualized to species are not usually necessary;

- A discussion of wildlife activities that have the potential to substantially alter the composition or distribution of terrestrial habitat (e.g., overbrowsing or burrowing);

- Presence of indicator organisms that could be used to gauge changes in habitat quality, biodiversity, and the distribution and abundance of species populations;

- A brief discussion of trophic interactions between predators and prey potentially occurring on or near project activities. This discussion may be generalized and qualitative;

- A discussion of possible wildlife movement and migration patterns. The discussion may be generalized and does not need to be based on field observations; and

- A discussion of wildlife used for subsistence or recreational hunting.

Important Species and Habitats

Guidance on important terrestrial species and habitats is provided in RG 4.11 and Table 2-1. Note that important species and habitats include, but are not limited to, threatened or endangered species and critical habitats. The ER should include the following information on important species and habitats:

- Each important terrestrial species or habitat known to occur or that has a reasonable likelihood of occurring in the area. Briefly indicate why each meets the criteria for importance in Table 2-1;
- A brief description of each important terrestrial habitat, which can cross-reference the habitat descriptions already provided;
- A brief paragraph for each important terrestrial species, which provides key data on habitat requirements and life history as necessary to support an assessment of potential effects from the project; and
- A discussion related to any correspondence that has been initiated with the FWS or State, local, or Tribal natural resource agencies on important species or habitats (Table 2-1) including endangered, threatened, or special status species. Briefly summarize and provide copies of key correspondence (e.g., letters, email, or phone call summaries).

Table 2-1. Important Species and Habitats to Be Considered in the ER[(a)]

Species	Habitat
Federally threatened or endangered and proposed species for listing by U.S. Fish and Wildlife Service (FWS) or National Marine Fisheries Service (NMFS) that occupy habitat or have an ecosystem function that may be affected by the proposed project Candidate species for Federal listing by the FWS or NMFS of particular interest to the review that occupy habitat or have an ecosystem function that may be affected by the proposed project Representative State status species of particular interest to the review Other species for which a Federal or State agency has established a monitoring requirement at or near the site Representative commercially or recreationally valuable species Potentially significant nuisance or invasive species Other species of known or indicated interest	Federally designated or proposed critical habitat or essential fish habitat. Protected areas such as sanctuaries, parks, refuges, or preserves, including marine protected areas Habitats identified by Federal or State agencies as unique, rare, or of priority for protection; e.g., areas that have been designated as habitat for an evolutionary significant unit, distinct population segment, critical habitat, or essential fish habitat Other habitats of known or indicated interest, e.g., known breeding, spawning, nesting, or nursery grounds

(a) The criteria presented in this RG represent updated guidance developed by the NRC subsequent to the publication of RG 4.11.

2.3.2 Aquatic Ecology

The ER should include a baseline description of the potentially affected aquatic resources. The description should also include any waterbodies that could reasonably be expected to exhibit detectable changes to aquatic resources from building and operating of the new facilities. This includes waterbodies associated with offsite transmission and pipeline corridors, large component transport routes, and any other affected offsite areas. The description should focus on the information that is needed for the evaluation of potential impacts on the aquatic environment that may result from building and operating the facilities. The extent of the description should extend to any potentially affected habitats, including rivers, perennial and intermittent streams, reservoirs and impoundments, estuaries, lakes, ponds, and ocean areas and should, when appropriate, consider effects on a watershed basis.

RG 4.24 provides guidance on designing and implementing aquatic environmental studies for baseline descriptions and for impact analysis. The subsections below address specific elements of characterizing baseline aquatic conditions, including aquatic habitats, organisms, and important species and habitats. Guidance on consultation under Section 7 of the Endangered Species Act or under the Magnuson-Stevens Fishery Conservation and Management Act is provided in Appendix B.

Aquatic Habitats

The ER should include the following information to characterize aquatic habitats:

- A description of the aquatic environment, including the relative significance of habitats in waterbodies onsite or in the landscape surrounding the site, including those that would be used for plant cooling or that could be affected by other activities;

- Maps or figures, including electronic layers, showing waterbodies and aquatic habitats on the proposed site and in the vicinity and region, including the natural structure of the benthic habitat (when readily available), the location and depth of any associated underwater structures in the vicinity of the site (e.g., submerged dams), and the proposed location of the intake and the discharge systems. Similar maps and figures of transmission and pipeline corridors that extend offsite or other affected offsite areas and their relationships to waterbodies and aquatic habitats;

- A discussion of the existing aquatic habitats in the landscape surrounding the proposed intake and discharge structures and associated systems;

- Bathymetry, substrate, and other habitat information, including maps or figures, for the affected aquatic habitats in the vicinity of plant structures including the discharge and intake facilities; and

- A description of any natural, anthropogenic, and pre-existing environmental stressors and the current ecological conditions indicative of such stresses.

Aquatic Organisms

The ER should include the following information to characterize the aquatic organisms:

- Distribution and abundance data for fish and macroinvertebrates found on the site and in other potentially affected waters. Data should be collected for a sufficient period of time and frequency and from locations that will provide an understanding of the long-term (annual) and short-term (seasonal or other) variations in distribution and abundance of species potentially affected by building and operation. Studies would ideally show the condition of the ecological resources that

existed no more than 5 to 10 years prior to NRC receiving the application. If older ecological baseline data is used, a discussion of the basis for determining that the data provides for an accurate and meaningful evaluation of potential impacts should also be included. Data collection should be consistent with the guidance on baseline studies presented in RG 4.24;

- Locations and values of local commercial, subsistence, and recreational fisheries and the historic and current seasonal distributions of harvest by species;

- List and description of species essential to the maintenance and survival of commercially or recreationally valuable species;

- Presence, distribution, and abundance of key aquatic indicator organisms (e.g., diatoms, benthic macroinvertebrates, submerged aquatic vegetation, and fish) that could be used to gauge changes in habitat quality, biodiversity, and the distribution and abundance of species populations. Key indicator organisms are those that would be particularly vulnerable to impacts on forage or habitat;

- A brief discussion of trophic interactions between predators and prey potentially occurring on or near project activities. This discussion may be generalized and qualitative;

- Presence of nuisance, invasive, and introduced species, including fish, aquatic vegetation, and benthic invertebrates (e.g., *Corbicula* spp. *or Mytilus* spp.) onsite or in the vicinity; and

- Presence of disease and parasite outbreaks (e.g., viral hemorrhagic septicemia affecting North American salmon and trout, the myxosporean parasite (*Myxobolus cerebralis*) that causes whirling disease, or the marine dinoflagellate responsible for red tide (*Karenia brevis*) that could potentially be affected by operations.

Important Species and Habitats

The ER should provide the following information to characterize important species and habitats as defined in Table 2-1:

- A description of important aquatic species or habitat using the guidelines in Table 2-1 and a brief description of why each meets the criteria in Table 2-1. Additional guidance on identifying important species and habitats is provided in RG 4.24;

- A brief discussion for each important species (or representative species as indicated in Table 2-1), which considers all life stages necessary to support an assessment of potential effects on the species from the project. Include a description of their temporal and spatial (including depth) distribution and abundance and any observed occurrence in relationship to the intake and discharge sites and frequency of observations, if appropriate; and

- A summary related to any correspondence or discussions with the FWS, NMFS, or State, local, or Tribal natural resource agencies on important species or habitats associated with the proposed project (Table 2-1) including endangered, threatened, or special status species and federally designated critical habitat. Briefly summarize and provide copies of key correspondence (e.g., letters, email, or phone call summaries).

When proposed new transmission corridors, pipeline corridors, or affected offsite areas would intersect or be adjacent to aquatic resources, the following information should be included in the ER to the extent the information is available to the applicant:

- A map or figure and description of the location of important aquatic species and habitats known or expected to be potentially affected by the transmission and pipeline corridors. Consideration should be given to affected offsite areas together with any specific habitat requirements or community interrelationships; e.g., areas that have been designated as an evolutionary significant unit, distinct population segment, critical habitat, or essential fish habitat.

2.4 Socioeconomics

The applicant should provide sufficient data and information in the ER to establish the environmental baseline for estimates of socioeconomic effects, including the economic region. The economic region is comprised of counties (or other geographic grouping) within the 50 mi (80 km) region where the majority (typically around 75 to 80 percent) of workers would reside. Socioeconomic assessments should include the following:

- Table providing historic and projected population data for the counties with summary totals for the counties in the economic region. Population values should include historic data for the previous two decennial censuses and extend forward to at least the decennial year after the expected license period of the proposed project;

- Population projections within the economic region for the time period of the proposed project, and a discussion of the methodologies used to develop projections;

- An overview map and accompanying tables identifying the counties and principal cities and towns in the economic region;

- Discussion of any current migrant workforce or other migrating population (see latest Census of Agriculture);

- A table and accompanying discussion of transient populations; and

- A table presenting the current income distribution, including household income by segments (e.g., by quartiles), Federal median household income level, and the number and percent of households below the Federal poverty level for each county in the economic region, and each State within the economic region. Discuss current trends affecting incomes within the economic region.

Detailed information about the economic characteristics of the proposed site and its surrounding economic impact region forms the baseline for estimating the economic impacts that might occur because of building- or operation-related activities at the proposed site. The ER should focus primarily on the community characteristics for the economic region surrounding the proposed site.

The ER should include community characteristics information including a table and/or chart illustrating the following:

- Current site labor force (if the proposed site is co-located at an existing power plant), including peak number of workers, a characterization of all temporary outage workers, and the county-level residential distribution of the current operations workforce and temporary outage workers;

- Housing information, including sales and rental markets in the economic region, the number and types of units available for rent or sale, vacancy rates, and trends. The applicant should only include habitable structures and the location of existing and projected housing developments; and

- The region's current and historic economic base, including important regional industries by category, employment, and size. Trend data should be of sufficient depth and scope to provide an accurate account of the changes in the region's economic history, and an indication as to where those changes are most likely to affect the region's economy. Describe the nature of the regional construction industry and construction labor force and total labor force, unemployment levels, and future economic outlook projected during the proposed license term.

The ER should identify local and regional planning and administrative organizations and discuss analyses and trends that may affect socioeconomic conditions, including:

- The current governmental structure including jurisdictions, school districts, and tax authorities (including those tax jurisdictions that would be most affected by the proposed project). Tax rate data should be included:

    - Federal, State, county, regional, school district, sales and use, and other applicable tax sources and their rates;

    - any current agreements for the proposed or existing site for special property tax rates;

    - payment-in-lieu-of-taxes; and

    - other in-kind payments to local jurisdictions.

- The current public educational system within the economic region (i.e., primary and secondary schools and higher education institutions) including capacity; student counts; present percentage of utilization; student-teacher ratios; and expected trends affecting these resources;

- A discussion of the local land use plans relevant to population growth, housing, and changes in land use patterns within the economic region and relevant trends that could affect the development of the economic region;

- A summary, in tabular form, of local social services and public facilities (e.g., water and sewer);

- The name and location of water- and sewer treatment facility, design capacity, current usage rate, and any information about future expansions or other changes, in each affected county and community in the economic region;

- A summary, in tabular form, detailing the site access routes including roads and highways, rail, and waterways. For each mode of transportation, provide a discussion of significant proposed and planned expansions, improvements, and upgrades;

    - Roads: A brief summary of roads that will be used for site access. Detailed information should be provided in Section 2.8.3.

    - Rail: Describe railroads with regard to quality, capacity, proximity, road crossings, and spurs to the proposed site.

- Waterways: Waterway infrastructure and barge facilities. Describe size and any limitations.

- Recreation venues, parks, protected lands, and other visitor attractions in the vicinity of the site. Describe the type of venue, capacity, occupation rate and seasonal characteristics; and

- Characteristics of distinctive communities (e.g., historic districts, tourist attractions, and other popular resources). Discuss any expected trends affecting these resources.

2.5 Historic and Cultural Resources

Historic and cultural resources are the remains of past human activities and include prehistoric and historic era archaeological sites, historic districts, and buildings, as well as any site structure or object that may be considered eligible for listing on the National Register of Historic Places (NRHP). Historic and cultural resources also include traditional cultural properties important to a living community of people for maintaining its culture. Historic and cultural resources are deemed to be historically significant if they have been determined eligible for or have been listed on the NRHP. A historic property is a historic or cultural resource that is eligible for or listed on the NRHP.[2]

NEPA (42 U.S.C. 4321 et seq.) requires Federal agencies to take into account the potential effects of their actions on the cultural environment. The National Historic Preservation Act of 1966 (NHPA) (54 U.S.C. 300101 et seq.) requires Federal agencies to consider the impacts of their undertakings on historic properties and consult with the appropriate State Historic Preservation Officer (SHPO), Tribal Historic Preservation Officer (THPO) or Indian Tribes on a government-to-government basis, and other parties with an interest in the effects of the undertaking, including local governments and the public, as applicable.

The applicant should use Section 106 of the NHPA, and implementing regulations at 36 CFR Part 800, "Protection of Historic Properties," as a guide for providing historic and cultural resource information in the ER. In accordance with 36 CFR Part 800, an applicant should engage with the SHPO, THPO, Indian Tribes, and interested parties for the purposes of gathering information in developing its ER. [3] Information gathering by an applicant is not considered consultation pursuant to 36 CFR Part 800. Consultation with the SHPO, THPO, Indian Tribes, and interested parties is the responsibility of the NRC.

The applicant should determine the boundaries of the proposed direct (e.g., physical) and indirect (e.g., visual and auditory) area of potential effects (APE)[4] to be recommended to the NRC. Once the proposed APE has been determined, the applicant should conduct cultural resource investigations to

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[2] As defined in 36 CFR 800.16(l)(1), "Historic property means any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places maintained by the Secretary of Interior. This term includes artifacts, records, and remains that are related to and located within such properties." As defined in 36 CFR 800.16(l)(2), "The term eligible for inclusion in the National Register includes both properties formally determined as such in accordance with regulations of the Secretary of the Interior and all other properties that meet National Register listing criteria." National Register criteria for listing are found in 36 CFR Part 60, "National Register of Historic Places."

[3] Pursuant to 36 CFR 800.2(c)(2)(ii), the NRC is responsible for consulting with Indian Tribes or Native Hawaiian organizations that attaches religious and cultural significance to historic properties that may be affected by an undertaking.

[4] As defined in 36 CFR 800.16(d), "Area of potential effects means the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist. The area of potential effects is influenced by the scale and nature of an undertaking and may be different for different kinds of effects caused by the undertaking."

identify historic and cultural resources located within the APE, determine if they are eligible for listing on the NRHP, assess affects, and develop avoidance or mitigation plans to resolve adverse effects. The NRC will use this information to support its Section 106 consultation and assessment of effects for the proposed project.

Consistent with 36 CFR 800.16(d), the NRC typically defines the APE as the area or areas at the power plant site and the immediate environs that may be directly or indirectly impacted by building and operating the proposed new unit(s). The applicant should describe the proposed project area and provide the following information in the ER:

- A U.S. Geological Survey Quadrangle map that identifies the direct and indirect APEs.
- Legal description of the APE appropriate for the proposed project area. Note that not all areas of the U.S. (i.e., the original 13 colonies) use the Public Land Survey System (e.g., township, range, and section information).
- Aerial photos of the proposed project site before any land disturbing activities commence.
- Identification of any parts of the APE that are Federal, State, or Tribal-owned (i.e., not privately owned) lands.

2.5.1 Cultural Background

This section of the ER should provide a discussion of the historic use of the land and the activities that have occurred within the APE and the surrounding area. This includes a description of the cultural history of the region (including the proposed project site) from the beginning of human settlement to the present, and summarizes how this information was collected for the proposed APE. Information can be derived from background research (literature review and site file search) and from the use of plat and other historic maps showing ownership, acreage, property boundaries, and the location of existing or former historic structures. Other sources that can assist with description of the cultural background include land records, archival sources, local museums or historical societies, libraries, planning documents, mapping/imaging, and online sources. If available, consult ethnohistoric sources to identify Indian Tribes and other groups that may have historic and cultural ties to the proposed project area.

2.5.2 Historic and Cultural Resources at the Site and in the Vicinity

This section of the ER should provide a description of historic and cultural resources identified within the direct and indirect APEs (e.g., transmission-line corridors, and in the vicinity). All cultural resource survey reports that are developed to identify and assess effects to historic and cultural resources should be referenced and submitted with the license application. However, information (i.e., reports, maps, and site forms) that discloses the locations of unevaluated, potentially eligible, or eligible historic properties (e.g., archaeological sites) should be withheld from public disclosure. This information may be protected under NHPA Section 304 (54 U.S.C. 100707), especially if there is a risk of harm to the resource. The NRC protects cultural resource information disclosing the location of cultural resources (e.g., maps) under Section 304 of the NHPA, consistent with 10 CFR 2.390(a)(3). Section 304 of NHPA requires the NRC to "withhold from disclosure to the public, information about the location, character, or ownership of a historic resource if the agency and the Secretary of the Interior agree that disclosure may (1) cause a significant invasion of privacy, (2) risk harm to the historic resource, or (3) impede the use of a traditional religious site by practitioners." Applicants should discuss with the staff during pre-application interactions how to handle sensitive historic information.

The applicant should rely on qualified professionals who meet the Secretary of Interior's standards, 36 CFR Part 61, "Professional Qualification Standards," to develop the historic and cultural resource sections in the ER. The applicant is encouraged to engage the NRC staff as early as possible in the planning process, in accordance with 10 CFR 51.40, "Consultation with NRC staff," to avoid issues related to disclosing sensitive location information related to historic and cultural resources when drafting the ER.

The ER should provide the following information:

- description of all past and current historic and cultural resource investigations conducted to identify historic and cultural resources within and surrounding the APE;
- documentation of field methods used to identify resources within the APE;
- description of all historic and cultural resources, (e.g., prehistoric and historic archaeological sites, standing structures, cemeteries, and traditional cultural properties), and isolated finds and features; and
- evaluation of historic and cultural resources for NRHP eligibility (i.e., historic properties) including:
  - description of the process and methods used to evaluate these resources; and
  - documentation of SHPO, THPO, and Indian Tribes concurrence with process, methods, and conclusions.

2.5.3 Consultation

Consultation is the responsibility of the Federal agency, and the NRC is required to take the lead on consulting with the SHPO, THPO, Indian Tribes (on a government-to-government basis), and interested parties as outlined in 36 CFR Part 800; consultation is not the responsibility of the applicant.[5] The applicant should engage with these parties to gather sufficient information pertinent to the NHPA Section 106 review process in order to assist the NRC in the timely completion of its NHPA Section 106 compliance requirements. The ER should contain a summary of the applicant's initial outreach efforts to date, including the process used to identify Indian Tribes and potential interested parties about the proposed project. The applicant should evaluate the significance of the historic and cultural resources and assess any effects the proposed project may have on them. For areas not surveyed (e.g., areas too disturbed or devoid of potential historic and cultural resources), proper documentation, a basis for exclusion, and concurrence on survey methodology from the SHPO should be provided.

The ER should contain copies of all correspondence with the SHPO, THPO, Indian Tribes, or members of the public with whom the applicant engaged to gather information about historic and cultural resources within the APE. These documents should be included in an Appendix of the ER. Applicants may refer to NEI 10-07 regarding the information gathering process, engaging with potential consulting parties, and the importance of early coordination.

[5] If an applicant is corresponding with Indian Tribes before the NRC initiates government-to-government consultation, then the applicant should clarify to the Indian Tribes that the NRC will be initiating and conducting government-to-government consultation at a later date for the project. 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. A federally recognized Tribe may prefer to communicate directly with NRC at the government-to-government level.

2.6 Air Resources

The applicant should describe the climate, meteorology, and air quality of the site and surrounding region, summarize atmospheric dispersion characteristics at the site, and provide details of the onsite meteorological monitoring program. The applicant should provide in the ER sufficient descriptions of key models, assumptions, parameters, conditions, input data used, resulting output, and approaches to allow for NRC staff's evaluation. If there is relevant information in other supporting documentation (i.e., FSAR, DCD, or other references), indicate where in those documents this information can be found.

2.6.1 Climate

The applicant should provide a description of the regional climate and meteorological conditions at the site and include sufficient data to permit an independent evaluation by the NRC staff. The following information should be provided:

- A discussion of the sources of climate and meteorological information (e.g., nearby National Weather Service stations and onsite meteorological stations), periods of record, station locations, and station representativeness of local and regional meteorology.

- A description of the general climate of the region with respect to types of air masses, synoptic features (e.g., high- and low-pressure systems and frontal systems and principal storm tracks), general airflow patterns, temperature and humidity characteristics, precipitation, and any mesoscale circulations (e.g., valley flow and land-sea/lake breeze).

- Description of topographic features in the immediate vicinity of the onsite meteorological tower and within an 80 km (50 mi) radius of the proposed plant, including any modifications attributable to the proposed plant that could influence meteorological instrumentation.

- Summaries of onsite monthly and annual wind roses and comparisons to nearby representative stations using the wind speed classes defined of RG 1.23, "Meteorological Monitoring Programs for Nuclear Power Plants," for a consecutive 24-month period of data that is not older than 10 years from the date of the application (and preferably three or more years of data if available).

- Summaries of onsite diurnal, monthly, and annual air temperatures and comparisons to regional climatic averages and extremes. Climatic normals are typically defined as 30-year averages.

- Summaries of onsite diurnal, monthly, and annual dewpoint temperatures (or other measurements of atmospheric moisture) and comparisons to climatic averages and extremes.

- Summaries of onsite monthly and annual precipitation and snowfall amounts and comparisons to climatic averages and extremes.

- Summaries of monthly and annual occurrences of heavy fog (i.e., visibility less than 0.25 mi (0.4 km)) and appropriate summaries of other parameters (e.g., icing) to support the description of cooling system impacts.

- Summaries of onsite monthly and annual atmospheric stability.

- Annual joint frequency distributions of wind speed and wind direction by atmospheric stability class for measurement heights and wind speed classes as defined in RG 1.23.

- Estimates of monthly and seasonal mixing-heights, including frequency and duration (persistence) of inversion conditions.

- A description of the severe weather phenomena (e.g., hurricanes, tornadoes and waterspouts, thunderstorms, severe wind events, lightning, and hail) affecting the site and vicinity, including seasonal and annual frequencies.

- Discussion of potential climate change in the vicinity of the site over the period encompassing the licensing action and impacts on relevant meteorological parameters (e.g., temperature, precipitation, and the frequency and severity of storms). This discussion should be based on assessments conducted by Federal agencies with a mandate to evaluate the effects of climate change , but applicable regional and local studies conducted by other entities may be included. Climate change in the affected environment section should cover the project life and resources that are likely to be impacted by climate change during this period.

2.6.2 Air Quality

The applicant should describe the air quality at the site and surrounding region and provide sufficient detail to evaluate impacts from building and operating the plant. The following information should be provided:

- A description of the site and regional air quality, including the Air Quality Control Region as listed in 40 CFR Part 81, "Designation of Areas for Air Quality Planning Purposes."

- Identification of any nonattainment or maintenance areas with respect to criteria air pollutants identified in 40 CFR Part 50, "National Primary and Secondary Ambient Air Quality Standards." This should include the county the site is located and surrounding counties

- Location of nearest Mandatory Federal Class 1 Areas (40 CFR Part 81), where air quality and visibility are protected under the Regional Haze Program.

- Discussion of greenhouse gases (GHGs) and estimates of yearly emissions (expressed in units of carbon dioxide [CO_2] equivalents [$CO_2(e)$][6]) at a global, national, and State level and, if available, provide State or Public Utility Commission GHG emission reduction goals. This discussion should be based on values provided by Federal agencies with a mandate to estimate GHG emissions and is needed to provide context for GHG emissions from the proposed project.

2.6.3 Atmospheric Dispersion

The applicant should provide short-term atmospheric dispersion estimates for use in evaluation of dose from design-basis accidents and long-term dispersion and deposition estimates for evaluation of radiological impacts from normal operations. The applicant should provide meteorological data from at least two consecutive annual cycles (and preferably three or more entire years), including the most recent one-year period, at the time of application submittal. If two years of onsite data are not available at the time the application is submitted, the applicant should provide at least one annual cycle of meteorological data collected onsite with the application. Hourly averages of onsite meteorological parameters should be

[6] $CO_2(e)$ is a metric used to compare the emissions of GHG based on their global warming potential (GWP). GWP is the total energy that a gas absorbs over a period of time, compared to CO_2. The $CO_2(e)$ is obtained by multiplying the amount of the GHG by the associated GWP.

provided using the recommended electronic data format described in Appendix A of the most current revision of RG 1.23. Sufficient input data should be included to permit independent evaluations and assessments of atmospheric diffusion characteristics and station impacts on the environment.

Short-Term Dispersion Estimates

The applicant should provide estimates of atmospheric dispersion factors (χ/Q values) at the site exclusion area boundary (EAB) and at the outer boundary of the low-population zone (LPZ) for appropriate time periods using realistic (50th percentile) meteorology. For the EAB, provide the 0-2-hour 50th percentile χ/Q estimate. For the LPZ, provide the 50th percentile χ/Q estimate for: (1) the 8-hour time period from 0 to 8 hours; (2) the 16-hour period from 8 to 24 hours; (3) the 3-day period from 1 to 4 days; and (4) the 26-day period from 4 to 30 days.

RG 1.145, "Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants," provides guidance for calculating EAB and LPZ χ/Q values. The applicant should adequately describe the methods for generating these distributions. Discussion of the effects of topography and nearby bodies of water on short-term dispersion estimates should be provided.

Long-Term Dispersion Estimates

Consistent with NRC guidance in RG 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors," the applicant should provide estimates of annual average χ/Q and deposition (D/Q) at appropriate locations (e.g., site boundary, nearest vegetable garden, nearest residence, nearest milk animal, and nearest meat cow in each 22½-degree direction sector within a 5 mi (8 km) radius of the site), at points of maximum individual exposure, and at points within a radial grid of sixteen 22½-degree sectors (e.g., centered on true north, north-northeast, northeast) and extending to a distance of 50 mi (80 km) from the station. A set of data points should be located within each sector at increments of 0.25 mi (0.4 km) out to a distance of 1 mi (1.6 km) from the plant, at increments of 0.5 mi (0.8 km) from a distance of 1 to 5 mi (1.6 to 8 km), at increments of 4km (2.5 mi) from a distance of 5 to 10 mi (8 to 16 km), and at increments of 5 mi (8 km) thereafter to a distance of 50 mi (80 km). Estimates of χ/Q (undecayed and undepleted; depleted for radioiodines) and D/Q radioiodines and particulates should be provided at each of these grid points.

RG 1.111 presents criteria for characterizing χ/Q and D/Q conditions for evaluating the consequences of routine releases. The applicant should describe the methods for generating these χ/Q and D/Q values. The applicant should provide a detailed description of the model inputs, including the suitability of input parameters, source configuration, and topography. The meteorological data used as input to the models should be provided.

2.6.4 Meteorological Monitoring

The applicant should describe the preoperational and operational programs for meteorological measurements at the site, including all data-collection programs used to describe the site meteorological and atmospheric dispersion characteristics. The description should include the following:

- A site map showing tower locations with respect to man-made structures, topographic features, and other site features that may influence site meteorological measurements.

- Distances to nearby obstructions of the flow in each downwind sector.

- Discussion of measurements made; instruments and performance specifications; measurement elevations and instrument siting; calibration and maintenance procedures; data output and recording systems and locations; and data processing, archiving, and analysis procedures.

- Estimates of overall system accuracy for each meteorological parameter measured.

RG 1.23 provides guidance for an onsite meteorological measurements program that the NRC staff considers acceptable for the collection of basic meteorological data needed to support plant licensing and operation.

2.7 Nonradiological Health

The applicant should describe the environment at the site and within the vicinity of the site with respect to existing nonradiological human health. This includes the identification of people or groups that could be vulnerable to nonradiological health impacts including public health, etiological agents, transportation activities, noise and electromagnetic fields. This section provides the basis for evaluation of impacts on human health from building and operating the proposed project.

2.7.1 Public and Occupational Health

The applicant should identify the State agency or office or Federal agency with regulatory jurisdiction over the public and occupational health at the site and in the vicinity. The applicant should provide the following information in the ER:

- Description of the regulations related to potential impacts on public and occupational health at the site and in the vicinity,

- Identification of people or groups in the vicinity that could be vulnerable to nonradiological health impacts from building- and operations-related activities (e.g., construction workers, workers at any co-located plants, nearby residents, transients and recreational visitors).

- Description of any existing issues involving hazardous chemicals on or near the site.

Occupational Injuries

- A discussion of Federal and State statistics for occupational injuries and illnesses related to similar projects. Federal statistics are available from the U.S. Bureau of Labor Statistics.

- A description of existing safety standards, practices, and mitigation procedures for avoiding or minimizing the incidence of injuries and illnesses to workers and the public.

Etiological Agents and Emerging Contaminants

Etiological agents are disease-causing organisms that affect human health. Some of these disease-causing organisms have been associated with the operation of station cooling systems. Etiological agents have been referred to as “thermophilic microorganisms” in previous NRC documents (e.g., NUREG-1555). Etiological agents associated with nuclear power stations include more than just thermophilic microorganisms and may be present in elevated numbers in unheated systems as well as in cooling systems, receiving and source waterbodies, and site sewage-treatment facilities.

Contaminants and materials are being discovered in water where they previously had not been detected or are being detected at levels that may be significantly different than expected. The proposed

use of reclaimed water or impaired water sources for station cooling raises a potential human health and ecological concern related to the release of these chemicals and materials to the environment. These chemicals or materials, found in reclaimed and contaminated source water in very low concentrations, potentially could be harmful to humans and the environment.

The applicant should provide the following information:

- A description and the incidence of organisms of concern for public and occupational health, including enteric pathogens (e.g., *Salmonella* spp*. and Pseudomonas aeruginosa*), thermophilic fungi, bacteria (e.g., *Legionella* spp*. and Vibrio* spp.), dinoflagellates (*Karenia brevis*), blue-green algae, and free-living amoeba (e.g., *Naegleria fowleri* and *Acanthamoeba* spp.) during the previous 10 years in the state in which the site is located.

- Characteristics of the site that could encourage the growth and distribution of etiological agents.

- A summary of all the chemicals and materials that are known from the influent for stations using reclaimed water or impaired water for cooling.

- The ER should reference information from the U.S. Centers for Disease Control and Prevention, State public health agencies, and local health agencies.

2.7.2 Noise

The applicant should characterize the existing noise environment at the site. The description should include the following:

- General description of the site with respect to noise (e.g., rural, industrial, etc.).

- Location of the closest noise-sensitive human receptors, including (if within a reasonable distance) closest residence, closest public building, closest recreational area, and closest industrial site.

- Results of any ambient noise studies that have been conducted, including the locations of noise sources and measurements, and corresponding noise levels, including meteorological conditions during the measurement period and the resulting effects on the measured noise levels. Any such ambient noise studies should be performed at a representative number of locations, including measurement at the closest noise-sensitive human receptors (see next bullet), each of which is sampled over a number of days that include weekday, weekend, and seasonal variations in noise levels, and for both a “leaf-off” and “leaf-on” condition for vegetation.

- Noise regulations or ordinances, including Federal, State, and local code and regulations.

2.7.3 Transportation

The applicant should describe the existing road transportation networks for the site, vicinity and region. These discussions will become the basis for analyses in the land use and socioeconomic sections. The description should include the following:

- Roads: Include carrying capacity and condition, availability and type of public transportation; and planned modifications that might affect traffic flow to and from the proposed plant site. Describe the use of roads and highways in industry-standard terms (e.g., Level of Service designation or

similar process). Discuss current and projected trends for usage of these routes, including any existing plant-related commuter patterns for operations and outages. State whether or not heavy-haul roads will be needed.

- Current accident statistics for the regional transportation networks.

2.7.4 Electromagnetic Fields

The applicant should provide information about the existing sources of electromagnetic fields (EMFs) in the vicinity and region and the electric shock and chronic effects of transmission lines. The information provided in the ER should include the following:

- Electric and magnetic fields for existing or anticipated transmission lines. In the United States, transmission lines operate at a frequency of 60 Hz (60 cycles per second), which is considered to be extremely low frequency.

- Electric shocks from exposure to energized conductors or from induced charges in metallic structures.

- Any new information regarding whether a consensus has been reached by the appropriate Federal health agencies pertaining to the effects of long-term or chronic exposure to EMFs. These health effects have been studied for several years and were evaluated in NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants," Initial, and Revision 1, (NUREG-1437).

2.8 Radiological Environment and Radiological Monitoring

The purpose of a radiological environmental monitoring program (REMP), which is located in the Offsite Dose Calculation Manual, is to provide a basis for evaluating concentrations of radioactive materials and radiation levels in the environment from radiological releases once a reactor is operational. A well-designed and well-implemented environmental program will characterize the environment before operations to allow future reasonable, direct comparison with data collected after power operation begins. The preoperational program can also be used for all or some of the operational REMP.

According to RG 4.1, "Radiological Environmental Monitoring for Nuclear Power Plants," the preoperational monitoring program should be established and implemented at least 2 years before the initial facility operation; however, the preoperational REMP should be described in the ER.

For a partially developed or undeveloped site that does not have operating or permanently shut down reactors, the applicant should summarize any information available from the appropriate literature about background radiological characteristics of the site. This characterization should address the sources of natural background and the background radiation levels from those sources in the area surrounding the site. The naturally occurring background radiation dose rates at the site should be estimated and provided in the ER.

For a proposed new nuclear unit being constructed on or adjacent to currently operating or permanently shut down nuclear plants, information on background radiological characteristics should be provided from the Annual Radiological Environmental Operating Report and the Annual Radioactive Effluent Release Report. The applicant should review approximately 5 years' worth of data from the past reports and make a comparison of the exposures and concentrations in air, water, and vegetation between the preoperational monitoring and the operational monitoring results. A 5-year period provides a data set

that covers a broad range of activities that occur at a nuclear power plant, such as refueling outages, routine operation and maintenance activities that can affect the generation and release of radioactive effluents into the environment. In addition, any special reporting requirements or special monitoring programs (e.g., groundwater-monitoring programs), whether industry- or NRC-initiated programs, and any event reports for groundwater contamination should be noted in the ER. The applicant should also review the volume and radioactivity content of radioactive solid waste generated each year and the number of shipments of waste and where the waste would be shipped.

The type of data and information needed will be affected by site- and station-specific factors, and the degree of detail should be modified according to the anticipated magnitude of the potential radiological impacts of the radioactive effluents from the plant. The specific criteria for a radiological monitoring program can be found in RG 4.1.

To the extent the information is available, the ER should include the following information:

- A discussion of the environmental exposure pathways (i.e., air, water, and direct) as they relate to the type of reactor and local geography and terrain.

- A map or aerial photograph of the site vicinity with proposed monitoring and sampling locations clearly identified and keyed to indicate the medium sampled at each location. The map or photograph should be suitable to show distance and direction of each location from the plant, particularly with regard to the effluent release points.

- A description of the existing monitoring program when appropriate, including (1) the number and location of sample collection points and measuring devices and the pathway sampled or measured; (2) sample size, sample collection frequency, and sampling duration; (3) type and frequency of analysis; (4) general types of sample collection and measuring equipment; (5) lower limit of detection for each analysis; (6) the approximate date on which the proposed program will be effective; and (7) the quality assurance program for REMPs (see RG 4.15, "Quality Assurance for Radiological Monitoring Programs (Inception through Normal Operations to License Termination)—Effluent Streams and the Environment").

- A discussion justifying the choice of sample sites, analyses, sampling frequencies, sampling and measuring durations, sample sizes, and lower limits of detection.

- A discussion of the amount of radioactive solid waste generated and transported from the five years of reports reviewed above.

- If applicable, a description of the implementation of NEI 07-07, Revision 1 "Industry Ground Water Protection Initiative," dated March 2019.

- A description of any NRC initiatives or radiological environmental reporting requirements.

Chapter 3

3.0 Site Layout and Project Description

As specified in 10 CFR 51.45(b), the ER "shall contain a description of the proposed action." The ER should include sufficient information to describe the site layout, design, and the activities required to construct and operate the plant and associated structures and facilities as well as the physical activities involved in constructing and operating the plant. This description should be sufficiently detailed to support the staff's environmental impact conclusions.

3.1 External Appearance and Plant Layout

A description of the overall appearance of the proposed plant and all associated facilities is needed to assess the physical scope of the proposed project and visual impacts. Associated facilities include any proposed new structures or structure modifications (onsite or offsite) that need to be completed for the proposed plant to be constructed or operated (e.g., transmission lines; road, rail, barge, or other transportation-related improvements; water-management structures or impoundments; borrow pits; and spoils storage areas).

The applicant should clearly define and use consistent site terminology (e.g., "site," "property," or "project" boundaries) throughout the ER. The ER should include the following information relating to the external appearance and layout of the proposed plant:

- topographic maps of the proposed site and vicinity showing the layout of the proposed plant relative to the site and vicinity; the exclusion area; site boundary; waterbodies; existing and planned roads, rail lines, and utility corridors; liquid and gaseous release points (and their elevations); meteorological towers; land to be cleared; waste disposal areas; and other buildings and structures (both temporary and permanent) associated with the proposed project (e.g., a site utilization plan);

- the relationship between the proposed plant and any existing units, structures or facilities, including removal or modification of existing structures;

- whether proposed and existing units would share any proposed or existing facilities or structures;

- a description of the proposed plant including any aesthetic principles and concepts used in the design and layout of the proposed facilities, and any plans to seclude and screen the facilities and to architecturally integrate the buildings and landscaping into the environs;

- representative ground-level photographs of the site on which major station features are superimposed;

- a low, oblique aerial photograph of the site and vicinity on which major station features are superimposed; and

- an architectural rendering of the proposed project to include landscaping and all major station features.

3.2 Proposed Plant Structures, Systems and Components

A description of the overall proposed nuclear energy generating system is important for the evaluation of environmental impacts resulting from the proposed project. The rated and design core thermal power, the rated and design gross electrical output, and the rated and design net electrical output (in megawatts [MW]) should be stated. The rated power is defined as the power level at which each reactor would be operated if licensed, and the design power is defined as the highest power level that would be permitted by the proposed plant design. The gross electrical output is the power level measured at the output terminals of the generator and expressed in MW(e). The net unit electrical output is equal to the gross electrical output minus the nominal service and auxiliary loads. The following information relating to the reactor-power-conversion system for the proposed plant should be included in the ER:

- Reactor-power-conversion system, including the manufacturer and the design status (i.e., certified design or DCD revision).
- The number of units and description of each reactor, including (as applicable) reactor type, vendor, architect-engineer, contractor, fuel assembly description, total quantities of uranium, and percentage uranium-235 enrichment.
- The planned average irradiation level of spent fuel, in megawatt-days/ton.
- A description of the turbines and condensers.
- A simplified flow diagram for the reactor-power-conversion system.
- Service or auxiliary power load.
- Type of cooling system.

A description of all proposed plant SSCs is needed to clarify the physical scope of the proposed project for assessing the impacts of building and operation. The description should include, but is not limited to the following:

- Plant grade and major structure elevations, using a consistent vertical datum.
- Stormwater drainage system (e.g., number, location, and size of temporary and permanent retention/detention ponds, diversion structures, or other hydrological alterations).
- Site layout with the location and dimensions (e.g., area and height above grade) of structures and support facilities (e.g., switchyard, laydown areas, parking areas, future independent spent fuel storage installation (ISFSI), warehouses, and training facilities), including offsite support facilities and substations. Indicate permanent and temporary areas of land disturbance.
- Heat-dissipation system flow diagram; design, size, and location of cooling towers, cooling lakes or ponds, spray canals or ponds.
- Creation or modification of any water storage (reservoir) or cooling pond, including dams or dikes. For any water-storage facility, describe the total and usable storage capacity, surface area, evaporation rate, flow control structures or components, and associated water transfer systems (e.g., refill, withdrawal and conveyance).

- Water-intake systems, including plan view and cross-sectional view scale drawings. The description should include location, size, height, and depth of structure; number and size of intake bays and pumps; screen types and sizes; type of screen cleaning system; fish-return system; and associated pipelines or other conveyance structures.

- Water discharge system, including plan view and cross-sectional view scale drawings. The description should include the location and type of discharge structure(s) including depth below the surface and relationship to the bottom of receiving waterbodies; discharge receiving area alterations; and associated pipelines or other conveyance structures.

- Other water systems (e.g., service, fire, potable, and sanitary systems) with source, delivery, and discharge (if applicable) identified.

- Well structures (use, depth, diameter, construction, location, pumping rate or discharge rate for injection wells).

- Supplemental water sources, onsite or offsite (location, design, construction and management).

- Transportation infrastructure (e.g., location, extent, and number of roads, culverts, bridges, rail, barge slip, and barge facilities).

- Other in- or over-water structures.

- Transmission (e.g., location, extent, voltage, and number of existing transmission facilities, modifications to existing transmission facilities, use or modification of existing transmission corridors, new transmission corridors, new transmission lines, transmission structure types, and switchyards).

3.3 Building Activities

Building activities, methods, and durations influence the environmental impacts of the proposed project. The applicant should describe the type of activities needed to build or install the proposed structures and associated facilities described in Section 3.2, and should indicate the sequencing and estimated duration of activities, especially when multiple units are proposed. The ER should include consideration of seasonal constraints on building activity. If multiple units are proposed or if the proposed project is co-located with an existing facility, the ER should include consideration of activities and workforce related to concurrent building and operation.

The description of building activities in the ER should also include the following:

- Applicants should be prepared to provide spatial data in electronic format (current industry-standard format) for the proposed plant (permanent as-built structures) and associated building uses (including temporary structures and use areas).

- Maps or scale drawings showing the extent of area to be disturbed during building (both onsite and offsite) and the construction use of the site or project areas (e.g., laydown, spoils stockpile or disposal, concrete batch plant, module assembly, temporary roads, or parking) relative to the as-built proposed structure locations.

- Extent, equipment, and methods for land clearing, grading, and excavation.

- Depths of excavations, particularly deep excavations that could require dewatering; and width and depth of trenches (e.g., for pipelines).

- In-water and nearshore activities (e.g., dredging, excavation, dewatering, filling, and impoundments).

- Equipment and methods should be described, as well as extent and duration of shoreline and in-water disturbance and any temporary structures (e.g., cofferdams, barge moorings, and silt curtains).

- Source of water for building purposes, estimated rate and quantity of water use, and proposed wastewater-management practices for building activities.

- Source and quantity of fill material for construction purposes.

3.4 Operational Activities

The applicant should describe the type of activities involved in operating the proposed plant and the associated structures and facilities described in Section 3.2. Descriptions should provide sufficient detail to assess specific effects of all operating systems on the environment. All modes of operation should be described, including normal operation, refueling, and emergency shutdown situations. Seasonal and operational variations that change amounts of water intake or discharge, gaseous effluent releases, or other potential environmental releases should be discussed.

3.4.1 Plant-Environment Interfaces during Operation

The applicant should describe plant design and heat-dissipation system parameters and their associated site interface values, clearly indicating the units of measure for the interface value and whether the value is for a single unit or all proposed units. The applicant should also describe the operational activities for structures and facilities associated with the transmission system, transportation infrastructure, and the stormwater-management system. Information on operational environmental interfaces should include, but is not limited to, the following:

- Water Interfaces

    - A quantitative water-use diagram showing anticipated flow rates to and from the various station water systems (e.g., heat-dissipation system, sanitary system, radwaste and chemical waste systems, and process water systems), including the source of water for each system and the receiving water for any liquid discharge to a waterbody.

    - A table of anticipated normal operational flow rates and maximum flow rates, indicating assumptions and conditions for each.

    - The flow diagram and tabulated information that clearly presents the operating plant water balance by accounting for withdrawals, consumptive use (water that is not returned to the source waterbody, for example, water from a river that is lost to evaporation in the cooling towers), and liquid discharges.

    - A description of intake operation, including approach and through-screen velocities, debris, and fish-return-system operation at all intake or pumping locations.

- Pertinent temperatures and methods used for estimating evaporation and drift rates.

- Cooling-tower blowdown volume, flow rates, temperature range, and number of cycles of concentration assumed for normal operation and any other modes of operation considered.

- Description of chemicals (e.g., corrosion inhibitors, antifouling agents) to the intake and discharge system.

- Estimated temperature and chemical constituent concentrations in wastewater at the discharge point.

- A description of controlling structures and flow patterns, residence times, rate of temperature changes, evaporation rate, and seepage rate for any cooling-water reservoirs or discharge canals.

- Maintenance procedures and frequency for the intake and discharge structures (e.g., dredging or mucking, biofouling treatment, screen maintenance, and pump maintenance), including proposed waste- or debris-disposal practices.

- Maintenance procedures and frequency for the stormwater-management system, including proposed waste- or debris-disposal practices.

- Land Interfaces

  - Maintenance procedures and frequency for transmission corridors and switchyards, roads, parking areas, rail lines, and other infrastructure, including proposed waste- or debris-disposal practices.

- Air Interfaces

  - Location, including elevation, of plant vents and other exhaust vents, the number and capacity of diesel/turbine generators and other emission sources, estimated frequency of operation, and associated emissions. If air is used for heat dissipation or for the main operational cooling system then describe the system. If a dry cooling tower is used instead of a wet cooling tower then the information for cooling-water intake/discharges consumptive water use and aquatic impacts should be adjusted accordingly.

3.4.2 Radioactive Waste Management

Radioactive waste-management and effluent-control systems should be designed so as to control and maintain the radioactive material released annually in liquid and gaseous effluents from normal operation, including anticipated operational occurrences, to a level that is as low as is reasonably achievable in accordance with the requirement of 10 CFR 50.34a, “Design objectives for equipment to control releases of radioactive material in effluents-nuclear power reactors.” The information should be taken from the FSAR and summarized in the ER. References to the FSAR sections should be made in the ER. The following information relating to the radioactive waste-management system should be included in the ER:

- a summary description of the liquid and gaseous radioactive waste-management and effluent-control systems;

- process and instrumentation diagrams and system process flow diagrams of the liquid and gaseous radioactive waste-management and effluent-control systems referenced from the FSAR;

- identification of sources of radioactive liquid and gaseous waste material within the proposed plant;

- identification of principal release points for radioactive materials to the environment;

- elevation of gaseous effluent vents;

- identification of direct radiation sources stored onsite as solid waste (e.g., an ISFSI or permanently shutdown units on the site);

- information requested in Appendices A and B of RG 1.112, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Light-Water-Cooled Nuclear Power Reactors;"

- a summary description of the solid radioactive waste-management system to include the expected total volume of the solid radioactive waste that would be shipped offsite annually;

- solid radioactive waste storage plans and capabilities, including annual quantities of waste produced;

- a discussion on where the Class A, B, and C low-level waste will be sent;

3.4.3 Nonradioactive Waste Management

The applicant should describe any nonradioactive solid- or liquid-waste materials such as water-management waste, solid waste, gaseous waste, and hazardous waste that may be generated during building and operation. The description should include estimates of the quantities of wastes to be disposed of, their pollutant concentrations, the manner in which they will be treated and controlled and the procedures for disposal. The information related to these waste systems for the proposed plant should include, but are not limited to the following:

- description of liquid effluents, including treatment, characteristics, rate and frequency of release;

- for effluents containing chemicals or biocides, a list of chemicals, annual amounts used, frequency of use, and concentration in waste stream;

- sanitary effluent discharges, treatment, and disposal;

- estimates for quantities of solid waste, collection, and disposal;

- location and elevation of gaseous effluent vents;

- description of gaseous effluents, including treatment, characteristics, quantity and frequency of release;

- hazardous waste accumulation, treatment, and disposal;

- description of plant systems producing mixed waste (hazardous and low-level radioactive), and minimization plans;
- mixed-waste storage plans and capabilities, including annual quantities of waste produced; and
- mixed-waste disposal plans.

Chapter 4

4.0 Environmental Impacts from Construction of the Proposed Project

The applicant must describe the impacts of building the proposed project as specified in 10 CFR 51.45(b)(1) and 51.45(c). For each impact category in Chapter 4, the applicant should identify the measures and controls that would be used to mitigate and limit adverse environmental impacts. As discussed in Section C, the term "building" includes all preconstruction and construction activities. The definition of what is construction and what is not construction can be found in 10 CFR 51.4. As discussed previously in Section C.VI, under the revised LWAs rule, the applicant should separate the impacts of preconstruction and construction activities to address the latter, as they are the activities being authorized. However, the applicant should also describe the impacts associated with preconstruction activities (e.g., site-preparation activities, transmission lines) so they can be evaluated as part of the cumulative impacts related to the proposed action. Specific information to include in the ER, as part of or in addition to the description of impacts, is covered in the following sections.

4.1 Land Use

The applicant should describe the land- or ground-disturbing alterations of building activities and the resulting impacts on land use and resource use. All impacts should be quantified to the extent possible using acreage, volumetric, or chronological measures. Applicants should be aware of nearby Superfund and/or industrial or previously industrial sites in order to avoid interference with nearby cleanup activities or site disturbances. The applicant can contact State agencies or regional EPA Superfund divisions for site-specific information if necessary. In addition, if the site is industrial or a previously industrial site, the applicant should consider contacting EPA or State agencies to see if there is any possible contamination from previous industrial activities that may require cleanup. If any such site could affect land use or resource use impacts, these impacts should be described in the ER.

4.1.1 Onsite Impacts

The following information relating to the land use impacts from building activities should be included in the ER:

- Land disturbance related to building activities on a short-term or long-term basis tabulated and summarized in terms of acreage of land area by activity (e.g., grading, excavation, trenching, dredging, borrow pits, and clearing vegetation).

- Disposition of spoils from excavation work or dredging, including volumes of excavated or dredged material and ultimate disposition location by volume to onsite or offsite locations. Include the acreage required for spoils disposal.

- A summary of the proposed footprint of land disturbance (by acre) for permanent and temporary uses (e.g., power block, auxiliary buildings, cooling infrastructure, laydown areas, batch plants, parking, and administration).

- Impacts on any affected local or regional land use or economic-development plans.

- Discussion of possible zoning conflicts.

- Disruption to ongoing natural resource management activities, including agricultural, forestry, and mineral extraction activities.

- Disruption to land- or water-resource access.
- Disruption to existing land uses or private land access caused by building activities.
- Characterization of raw material resource-extraction volumes associated with building activities (e.g., reservoir timber clearing and sand and gravel mining).
- Impacts on legislatively designated lands (e.g., prime farmland) or activities in designated coastal zones and a discussion on the status of any agency coordination or permitting undertaken regarding such lands.
- Impacts on floodplains and wetlands (can cross-reference other ER sections).[7]
- Maps depicting the locations of expected land use impacts including footprints for temporary and permanent facilities.

4.1.2 Offsite Impacts

The following information relating to the land use impacts of building offsite facilities (including new offsite transmission lines and other linear facilities, as well as alterations to existing offsite facilities) should be included in the ER:

- Characterization of land uses that will be altered by offsite development activities.
- A summary of the proposed footprint of land disturbance (by acre) for permanent and temporary uses (e.g., transmission towers, substations, intake structures, and pipelines).
- Resulting land use classification conversions summarized by acreage.
- Impacts on any affected local or regional land use or economic-development plans.
- Disruption to land- or water-resource access caused by offsite activities.
- Disruption to existing land uses at the site or vicinity caused by building activities (e.g., private land access for transmission tower erection).
- Maps depicting the locations of expected land use impacts including footprints for temporary and permanent facilities.

[7] Executive Order 11988, "Floodplain Management" was issued on May 24, 1977, to restore and preserve the natural and beneficial values served by floodplains. This Executive Order directs agencies to, among other things, determine whether the proposed action will occur in a floodplain, to evaluate the potential effects of any actions that may take place in a floodplain, and to consider alternatives to avoid adverse effects and incompatible development in floodplains.

- Discussion of possible effects on floodplains, wetlands, agriculture, forestry, mineral extraction, and hazardous waste cleanup activities (can cross-reference other sections of ER where possible).

4.2 Water Resources (Surface Water and Groundwater)

The applicant should describe the hydrologic alterations associated with building activities and the resulting impacts on consumptive and nonconsumptive water use[8] and on water quality. Water use and discharge of effluents during building are described as part of the site layout and plant description (Chapter 3).

4.2.1 Hydrologic Alterations

The applicant should identify and describe the building activities, including site preparation, onsite activities and offsite activities that could result in hydrologic alterations at the site, within transmission corridors, and offsite within the resource impact area (see Chapter 2.0). The description should include analyses of the resulting hydrologic alterations and the physical effects of these alterations on water uses and users (quantity and quality); practices proposed to minimize hydrologic alterations having adverse impacts; and an assessment of compliance with the applicable Federal, State, regional, local, and Tribal standards and regulations.

Activities resulting in hydrological alterations that could affect water use and water quality may include, but are not limited to, the building of cofferdams and stormwater management and drainage systems, dredging operations, placement of fill material in the water, and the creation of shoreside facilities. Other examples include building of intake and discharge structures for cooling water or other purposes, straightening or deepening of a water channel, building in a floodplain, clearing and grading, excavation, and groundwater dewatering of excavations.

The ER should include a description of the following:

- modification of site drainage patterns (e.g., storm water modifications, ditches, drains);
- change in floodplain capacity, and expected changes in water levels and groundwater heads;
- effects of alterations on the quantity and availability of water within the resource impact area;
- effects of alterations to river discharge, including changes in the seasonal variation of flow, or groundwater discharge to wetlands;
- effects of effluent discharge on the water quality of the receiving waterbodies, including the effects of erosion and sediment transport;
- effects of alterations or dewatering activities on the movement or extent of existing groundwater contaminant plumes;
- proposed actions to minimize the effects of the hydrologic alterations; and

[8] Consumptive water use reduces the available water supply. For instance, evaporation due to cooling-tower operation results in a transfer of water from the cooling system to the atmosphere, thereby reducing the volume of water in the water source. Nonconsumptive water use does not reduce the available water supply, rather it is discharged back into the river and is not consumed by the plant.

- identification of applicable standards and regulations.

When a mathematical model is used to evaluate the effects of hydrologic alterations, the applicant should describe the conceptual basis for the model, including the rationale for eliminating plausible alternative conceptualizations, the assumptions used in developing the model, the range of applicability of the model, input data used, the resulting output, the basis for boundary conditions, parameter estimation and calibration procedures followed, and estimates of uncertainty in model forecasts. The applicant should provide sufficient data to permit staff evaluation of modeling results. The applicant should provide in the ER sufficient descriptions of key models, assumptions, parameters, data used, and approaches to allow for NRC staff's evaluation. If there is relevant information in other supporting documentation (i.e., FSAR, DCD, or other references), indicate where in those documents this information can be found.

4.2.2 Water-Use Impacts

The applicant should identify those water uses and water users (Chapter 2 of this RG) that are potentially affected by the changes in the quantity and/or availability of water resulting from hydrologic alterations during building. The applicant should evaluate the water-use impacts by quantifying the anticipated reduction in water availability for each water use, including the projected duration of any forecast reduction, and provide a description of the analyses performed to determine the impacts.

4.2.3 Water-Quality Impacts

The applicant should identify those water uses and water users (Chapter 2 of this RG) that are potentially affected by the changes in water quality resulting from hydrologic alterations during building. The applicant should evaluate the water-quality impacts by quantifying the anticipated reduction in use resulting from the changes in water quality and provide a description of the analyses performed to determine the impacts.

4.2.4 Water Monitoring

The overall plan for protection of waterbodies that may be affected by building activities should be discussed. A description of the proposed measures to ensure compliance with applicable water-quality and water-use standards and regulations should also be provided. When compliance involves monitoring, the monitoring program should be described in sufficient detail to justify the ability of the monitoring to provide timely and accurate information so that appropriate actions can be taken to limit building impacts.

4.3 Ecological Resources

This section addresses the information related to terrestrial, wetland and aquatic ecological impacts from building activities at the proposed site. The applicant should provide adequate details in the ER to fully determine the impacts on terrestrial and aquatic species and habitats as a result of building activities.

4.3.1 Terrestrial and Wetland Impacts

Impacts on terrestrial resources should be based on a conservatively estimated footprint of ground disturbance encompassing the plant and associated facilities. The estimated footprint should also account for temporary features, such as laydown areas. Estimates of the footprint used in the ER should be conservative enough to characterize terrestrial impacts in a way not overwhelmed by future minor adjustments to the proposed site layout. Supplementary guidance on some of the more common

environmental impact analyses capable of providing some of the information outlined below is available in RG 4.11.

Terrestrial Habitats

The ER should address the following potential effects on terrestrial habitats from building the proposed facilities:

- Proposed methods for land clearing and grubbing vegetation; temporary and permanent erosion, runoff, and sedimentation control; and dust suppression and construction best management practices (BMPs) that might be used.

- Overlays of the estimated footprint of disturbance on terrestrial habitat maps, with separate indications for permanent and temporary disturbance.

- Tables quantifying each terrestrial habitat type within the estimated footprint with separate quantifications for permanent and temporary impacts for the site and for each offsite corridor or parcel.

- Tables or text comparing estimated losses of each terrestrial habitat type against total extent in the vicinity and a discussion of the relative importance of habitat types lost based on functions (e.g., importance to wildlife).

- Description of any plans for restoration (e.g., grading, contouring, seeding, and planting) of temporarily disturbed terrestrial habitats and an estimate of the time required for restored habitats to regain pre-disturbance conditions and functionality.

- Determination of whether excavation or other site-preparation activities might substantially dewater wetlands or surface waterbodies (e.g., ponds, springs, and seepages) or alter surface drainage patterns in a way that might affect terrestrial biota and a discussion of possible impacts on affected habitats and wildlife.

Wetlands

Information on wetland impacts should be as consistent as possible with Federal, State, and local wetland permit applications, and possible discrepancies should be explained. Wetland permit applications are sometimes prepared subsequent to the ER; in such cases, wetland impact data presented in the ER should be conservative enough to account for likely impact levels ultimately reported in permit applications. The ER should also include information on unregulated wetland impacts, including impacts on wetlands not under regulatory jurisdiction. The ER should include the following:

- Estimated disturbance footprint overlaid onto the wetland maps developed for Chapter 2.

- Tables estimating wetland impacts using a widely recognized wetland classification system (e.g., the National Wetlands Inventory). Separate data should be provided for each wetland classification and each category of impact (e.g., permanent fill, temporary fill, permanent dredging, and temporary dredging). Separate tables should also be provided for the site and for each offsite parcel or corridor.

- Discussion of wetland impacts and their effect on the functions and values of wetlands.

- Discussion of construction BMPs that may be used to protect wetlands (e.g., buffers, mats, seasonal work limitations, signage, barriers, special erosion, and sedimentation control methods).

- Discussion of applicable Federal, State, and local wetland permit requirements and status of the application(s).

- Discussion of anticipated wetland mitigation. Address opportunities for avoidance and minimization of wetland impacts as well as possible compensatory mitigation. For mitigation required by the USACE, discuss how it would comply with 33 CFR 332 "Compensatory Mitigation for Losses of Aquatic Resources." If possible, provide a tabular comparison of possible wetland losses and mitigation gains using a common metric such as functional service units (preferred approach) or acreage.

Wildlife

Qualitative discussions of possible effects on terrestrial wildlife are generally sufficient for an ER. However, evaluations should be based on quantitatively estimated causal factors (e.g., noise levels, structure heights, and corridor widths). The ER should include a discussion of the following:

- Possible mortality or physical injury to wildlife, especially immobile or weakly mobile species or life stages (e.g., eggs and juvenile stages).

- Increased traffic from construction workers that might injure terrestrial wildlife. The proximity of traffic to habitat and possible routes of wildlife movement should be considered.

- Noise from building activities that could startle wildlife or alter behavior (e.g., feeding, sheltering, movement, and reproduction).

- Habitat losses or degradation that could reduce carrying capacity of habitats in the surrounding landscape.

- Habitat losses and fragmentation that may affect movement and migration of wildlife.

- Tall structures or equipment (e.g., cranes) that might injure birds and bats, considering height and proximity to migration routes and areas of wildlife concentration.

Important Species and Habitats

The ER should include discussions related to the effects of building the proposed project on important terrestrial species and habitats:

- The effects on each terrestrial species identified as important using the criteria in Table 2-1.

- The effects on future viability of Federal or State-listed endangered, threatened, or special status species.

- Any relevant correspondence that has been initiated with the FWS, or State, local, or Tribal natural resource agencies about endangered, threatened, or other special status species and habitats. The ER should briefly summarize and provide copies of key correspondence (e.g., letters, emails, or phone call summaries).

- Cross-references to the aquatic ecology section below may be appropriate for important species using both terrestrial and aquatic habitats (e.g., crocodilians and some waterfowl).

4.3.2 Aquatic Impacts

This section addresses the information related to aquatic ecological impacts from building activities at the proposed site. Applicants should consider the important aquatic species and habitat identified in Chapter 2 that may be affected by the proposed project. Supplementary guidance on some of the more common environmental impact analyses capable of providing some of the information outlined below is available in RG 4.24.

The following information relating to aquatic impacts should be included in the ER:

- Identification of the aquatic habitats that may be affected or lost by proposed building activities and description of the proposed construction methods used at these locations.

- Discussion of the construction BMPs that might be used to minimize impacts on aquatic resources.

- Basis for the proposed location of the intake and discharge structures in relationship to the presence and function of aquatic habitats and biota.

- Quantity and quality of habitat temporarily or permanently modified, lost, or fragmented as a result of building activities.

- Discussion of the tolerances and/or susceptibilities of important aquatic species on the site and in the vicinity to physical or hydrological alterations, runoff, turbidity, and chemical and noise (both surface and subsurface) pollution that may result from building activities.

- Spatiotemporal distribution shifts or behavioral alterations of important species that may result from building activities.

- A summary of any correspondence or discussions with FWS, NMFS, or State, local, or Tribal natural resource agencies about the effect of building activities on important species or habitats, including federally designated critical habitat. Briefly summarize and provide copies of key correspondence (e.g., letters, emails, or phone call summaries).

- Discussion of anticipated stream mitigation. Address opportunities for avoidance and minimization of stream impacts as well as possible compensatory mitigation. For mitigation required by the USACE, discuss how it would comply with 33 CFR Part 332. If possible, provide a tabular comparison of possible stream losses and mitigation gains using a common metric such as functional service units (preferred approach) or linear feet.

4.4 Socioeconomics

The applicant's ER should describe socioeconomic impacts of building activities that could occur in the economic region surrounding the proposed site. Socioeconomic impacts from building activities occur primarily within the economic region identified in Chapter 2.0 of this RG. The NRC staff considers the economic region as a subset of the 50 mi (80 km) region surrounding the proposed site. The scope of the review should be guided by the magnitude and nature of the expected impacts of building the proposed project.

4.4.1 Physical Impacts

The applicant's ER should describe physical impacts during construction on the community, people, existing buildings, transportation infrastructure (roads, railways, and waterways). The geographic scope for this discussion could be smaller than the economic region because physical impacts typically attenuate with distance. The applicant should provide the following information in the ER:

- Description of potential impacts to existing structures during nuclear power facility building/construction/installation.

- Description of any transportation infrastructure (e.g., roads, railways) realignment impacts necessary to accommodate the project, including road deterioration and any repair and maintenance of transportation infrastructure caused by heavy-haul activities, deliveries, and construction worker commuting.

- State or local ordinances, if any, requiring the applicant to conduct transportation infrastructure improvements or repairs to support the project.

- Description of changes to the visible viewshed, including:

  - day and night visibility of the construction site from changes to the existing landscape (e.g., timbering, clearing, and leveling);

  - tall structures and equipment (e.g., cranes and towers);

  - nighttime light nuisances (e.g., light pollution from work area illumination, aircraft warning lights, and light from night delivery vehicles); and

  - description of mitigating actions taken and any Federal, State, Tribal, local, and industrial standards, regulations, ordinances, and practices to reduce physical impacts of building/construction activities.

The ER should also provide a high-level discussion of expected population changes from building/constructing the proposed nuclear power facility. The discussion of population changes should focus on the economic region where the majority of socioeconomic impacts would occur. The applicant should provide the following information in the ER:

- Text and tables describing workforce impacts on the local population during construction. This information should include the incremental increase in operations staff while the nuclear power facility is being built.

- Estimates and assumptions of the general classifications of labor (skill and craft groupings) to be used for the proposed project, and workforce schedule, including the following:

  - starting date;

  - workforce schedule (e.g., hours per week, days per week, number of shifts, and percent of workforce by shift);

  - quantified monthly workforce increases and decreases over the construction period;

- the magnitude and duration of peak workforce;
- post-peak workforce reductions; and
- the number and timing of operations workforce members present on site during building/construction.

- Discussion of residency patterns for construction workers, including the following:
  - origin, including within and outside the economic region;
  - residential distribution of workers within the economic region; and
  - any family characteristics, including size, children by age group (i.e., pre-school, elementary, middle, and high school ages).

- Description of any existing onsite workforce and proposed project workforce (i.e., construction and operations workers) co-located with an existing operating power station.

4.4.2 Economic Impacts

Economic impacts during nuclear power facility building/construction/installation include employment and tax revenue. Information in this section will also be used in the benefit-cost/need for power analysis. The applicant should use an industry-standard economic input-output model to estimate the economic impacts during nuclear power facility building/construction/installation. The information should include monetized estimates, to the extent practicable.

Economy

The applicant's ER should include the following information on economic impacts during nuclear power facility building/construction/installation:

- Identification and description of input-output model, input parameters used, and results. Information from regional input-output models should include:
  - direct and indirect employment during nuclear power facility building/construction/installation; and
  - expected direct and indirect income effects in support of building/constructing/installing the nuclear power facility.

- Explanation of any assumptions affecting the conclusions, including the number of construction workers used in the model, who will receive benefits, and where those benefits would most likely occur. If the economic impacts are derived from an input (e.g., peak employment), a sensitivity analysis discussion should explain how the model's output could be affected by changes in that input.

Taxes

The applicant's ER should include a comprehensive list and discussion of tax-revenue generated during the building/construction/installation of the new nuclear power facility. Typical tax revenues include the following:

- Income – Federal, State, County, and local income taxes should be described. The applicant should include information on any assumptions about the number of construction workers, wages, and work schedules that would inform the calculation of income tax revenue.

- Sales and use – the ER should include, if present, State, County, and local sales and use tax revenue forecasts during building/construction/installation of the nuclear power facility and applicant's estimated purchases during construction including services, materials, and supplies. The information should include an explanation of tax rates, the assumptions behind the calculation of revenues, and a monetized estimate for each tax authority.

- Property – the ER should include property tax revenue estimates including revenue subject to special government incentives, payment-in-lieu-of-tax agreements, or other assessment processes that differ from those for the general public. The information should include an explanation of tax rates, the assumptions behind the calculation of revenues, and a monetized estimate for each tax authority.

4.4.3 Infrastructure Impacts

The applicant's ER should include an assessment of the socioeconomic effects on each of the following including a discussion of the process and assumptions, along with tables and/or figures, that illustrate impact conclusions.

Traffic

The information should be accompanied by tables and/or figures to support the analysis. The applicant's ER should include the following information:

- traffic volume assessments discussing the magnitude of the effect and shift schedule during the building/construction/installation of the nuclear power facility compared to baseline estimated traffic for the affected roads; and

- traffic congestion and consequences during operations and outages for co-located operating power stations.

Recreation

The applicant's ER should include information on local recreation venues, capacity, occupation rate, and seasonal characteristics. The analysis should include the following information:

- The effects of aesthetic changes (e.g., lighting and visual degradation impacts of tall structures or equipment and land cover removal during construction, as discussed under physical impacts) that may reduce the attractiveness and enjoyment of tourists and recreational users.

Housing

The applicant's ER should describe the impacts on local housing during building/construction/installation of the nuclear power facility. The information should be accompanied by tables and/or figures to support the impact analysis. The housing impact assessment should include the following:

- Estimated in-migrant population.
- The underlying assumptions, including:
  - geographical distribution,
  - housing choice (e.g., rental; temporary or mobile housing, such as campgrounds and recreational vehicle parks), and
  - property tax implications.
- Whether demand would impact rental housing market.

Public Services

The applicant's ER should describe the expected public service impacts attributable to building/constructing/installing the nuclear power facility. The information should be accompanied by tables and/or figures to support the analysis. The information on public services should include the impacts of increasing demand:

- Estimated water and sewer use in affected communities due to increased demand during the building/construction/installation of the nuclear power facility, and the impact.
- Estimate of the number of public-school students that would be added to schools, including the expected change in student-teacher ratios, with a comparison to any mandated maximum ratio.

4.5 Historic and Cultural Resources

NHPA Section 106 (54 U.S.C. 300101 et seq.) requires that Federal agencies consider the effects of the agency's undertaking on historic properties included in, or eligible for, the NRHP and, before approval of an undertaking, give the Advisory Council on Historic Preservation (ACHP), a reasonable opportunity to comment on the undertaking. The NHPA defines "undertakings" as any project or activity that is funded or under the direct jurisdiction of a Federal agency, or any project or activity that requires a "Federal permit, license, or approval." The ACHP's regulations at 36 CFR Part 800, "Protection of Historic Properties," set forth the procedures that define how Federal agencies meet Section 106 responsibilities.

If an applicant decides to commence building activities (e.g., site-preparation activities), the applicant should be cognizant of the anticipatory demolition statutory provision in Section 110(k) of the NHPA (54 U.S.C. 306113).[9] For additional information, the applicant should refer to 36 CFR 800.9(c).

[9] The NRC is required to comply with the NHPA including the anticipatory demolition clause, Section 110(k) of the NHPA (54 U.S.C. 306113).

The applicant is encouraged to engage the NRC staff as early as possible in the planning process, in accordance with 10 CFR 51.40, "Consultation with NRC staff," to avoid issues such as anticipatory demolition.

The applicant should provide the information and analysis needed for the NRC to comply with Section 106 requirements in a manner that minimizes the potential for delays in the environmental review. The applicant should identify any activities and impacts associated with building that could affect historic and cultural resources within the APE (onsite or offsite, direct and indirect effects). Applicants should involve the SHPO, local historic preservation officials, THPO, and Indian Tribes in the assessment. The ER should include the following information (with appropriate reference to Chapter 2.0 of the ER to avoid duplication of information):

- Description of ground-disturbing activities (e.g., land clearing, grading, excavating, road work, and building the facility), increases in traffic, and audio and visual intrusions that could affect onsite and offsite resources located within the direct and indirect APEs.

- Description of historic properties found in the direct and indirect APEs that may be affected by the proposed project. Use the criteria specified in 36 CFR 800.5 to assess adverse effects on historic properties. Provide a basis and documentation for how a conclusion is reached.

- Description of historic and cultural resources that are not determined to be historic properties, but may be considered important in the context of NEPA (e.g., sacred sites, cemeteries, local gathering areas).

- Discuss the direct and indirect effects (e.g., ground disturbance, physical, visual, auditory, atmospheric such as fugitive dust, light, and traffic), if any, from the proposed project, and from any associated transmission lines on nearby historic properties or important historic and cultural resources.

    - For indirect effects, the assessment should include drawings or modified photographs indicating the station facilities and their surroundings, if visible from these nearby important vantage points.

    The assessment should lead to one of three conclusions (see 36 CFR 800.4):

    - No historic properties present.

    - Historic properties present, but the undertaking will have no effect upon them.

    - Adverse effect: The undertaking will harm one or more historic properties (see 36 CFR 800.5).

If a qualified professional has recommended a "no historic properties present" determination, then the applicant should provide supporting documentation in the ER.

If a qualified professional has recommended a finding of no adverse effect to historic properties, the applicant should develop a plan that outlines protective measures to minimize or avoid these effects. The applicant should engage the SHPO, THPO, Indian Tribes, and interested parties in the formalization of these protection plans and document this within the ER.

If a qualified professional determines that adverse effects to historic properties could occur, the applicant should engage with the SHPO, THPO, Indian Tribes, and interested parties and document this determination in the ER. The ER should describe any procedures and cultural resource management plans developed by the applicant to protect historic and cultural resources during building activities as well as any measures to avoid, minimize or mitigate adverse effects. These procedures should also include steps to take in the event of inadvertent discoveries, including the discovery of human remains.

The applicant should be aware that the NRC, as a Federal agency, is responsible for consulting with the SHPO, THPO, Indian Tribes, and interested parties as part of the Section 106 compliance process. If the NRC determines an adverse effect may occur, it will, in accordance with 36 CFR Part 800, develop proposed measures in consultation with identified consulting parties that might avoid, minimize, or mitigate such effects. Such measures, as appropriate, would be discussed in the NRC staff's EISs. If the NRC staff determines that adverse effects would occur, it can develop a Memorandum of Agreement or Programmatic Agreement (See 36 CFR 800.6), as appropriate. See Appendix B for additional information on consultation.

4.6 Air Resources

The applicant should describe meteorological and air quality impacts associated with building activities. The description should include the following:

- Identification of applicable local, State, and Federal air regulations and required air permits for construction.

- Sources and types of air pollutant emissions, including mitigating measures and plans to minimize air emissions.

- Estimates of building schedule and associated annual air emissions for criteria air pollutants identified in the National Ambient Air Quality Standards from sources such as on-road construction vehicles, commuter vehicles, fugitive emissions, non-road construction equipment, marine engines, and/or locomotive engines. If the proposed site is located in a nonattainment or maintenance area with respect to a criteria pollutant, the emission estimates can be used as a basis for assessing the applicability of a conformity analysis (see 40 CFR Part 93, "Determining Conformity of Federal Actions to State or Federal Implementation Plans," Subpart B, and NRC Memorandum, "Revision to Staff Guidance for Conducting General Conformity Determinations").

- Estimates of GHG emissions (expressed in units of CO_2 equivalents), including GHG emissions from on-road construction vehicles, commuter vehicles, non-road construction equipment, marine engines, and/or locomotive engines and comparison of these GHG emissions to State and national GHG emissions from Chapter 2. The applicant may provide either a site-specific analysis or refer to the generic GHG footprint for a 1,000 MW(e) reactor. The analysis should be adjusted according to the proposed action (number of units, electrical output). The assumptions, factors, and other information used in any site-specific analysis should be described in sufficient detail to allow an independent evaluation and assessment of the resulting GHG emissions estimate.

- The applicant should provide in the ER sufficient descriptions of key models, assumptions, parameters, conditions, input data used, resulting output, and approaches used in the analyses for building impacts to inform NRC staff's evaluation in the EIS. If there is relevant information in other supporting documentation (i.e., FSAR, DCD, or other references), indicate where in those documents this information can be found.

4.7 Nonradiological Health

The applicant should describe the nonradiological health impacts associated with building activities, including impacts on public and occupational health, noise, and traffic.

4.7.1 Public and Occupational Health

The applicant should describe the impacts from building activities on public and worker nonradiological health. The description should include the following:

- public health risks from building activities (e.g., air pollution from dust and vehicle emissions)
- occupational health risks to workers and onsite personnel from activities such as building, maintenance, testing, excavation and modifications
- estimate of the total occupational injuries and illnesses for building activities anticipated for the project, including information on interpretation of the statistical results
- description of safety standards, practices, and mitigation procedures that will be used to reduce public and occupational health risks

4.7.2 Noise

The applicant should describe noise impacts associated with building activities, including the following:

- applicable Federal, State, and local regulations and/or ordinances governing noise from building activities;
- background noise measurements and closest noise-sensitive receptors or sensitive areas (Chapter 2 of this RG);
- types of sources of noise at the site or along transportation routes, such as graders, jackhammers, dump trucks, etc.;
- predicted peak noise level measurements for each identified source type, along with estimated noise levels at representative distances, with attenuation by distance alone (i.e., not taking advantage of any intervening foliage, terrain changes, or permanent barriers between the source and the receptor), measured or calculated at the closest noise-sensitive human receptors identified in Section 2.8.2; and
- BMPs and any other mitigation strategies required or planned for noise abatement.

If the measured or calculated noise level from any identified source type exceeds 65 dBA (see NUREG-1437, Initial and Revision 1, for additional information) at any noise-sensitive human receptor or at the site boundary when calculated with attenuation by distance alone, the applicant should determine the noise level that would result from taking advantage of natural attenuation, such as intervening foliage, natural barriers, and changes in terrain. The determination of natural attenuation may be accomplished by the applicant performing a series of leaf-on and leaf-off noise surveys or by using an industry-standard modeling or calculation process. If the measured or calculated noise level from the source exceeding the 65 dBA threshold cannot be demonstrated to be reduced through natural attenuation to below the

threshold, the applicant should describe specific mitigation measures to be used to reduce the noise level to below 65 dBA.

4.7.3 Transportation of Construction Materials and Personnel to and from the Proposed Site

The applicant should provide estimates of the potential health impacts from nonradiological traffic-related accidents related to transporting construction materials and workers to and from the proposed site. Nonradiological impacts refer to the accidents, injuries, and fatalities estimated to occur from traffic accidents during movement of construction materials and personnel to and from the proposed site during building. Where possible, the impacts should be estimated using information specific to the proposed site (e.g., by using county-specific accident statistics). The following information should be provided:

- Summary of provisions for site access during building, including during outages of co-located operating units.

- Description of the method(s) used to estimate nonradiological traffic-related accident impacts, including traffic accidents, injuries, and fatalities. Traffic-related accident impacts should be estimated using round-trip distances. The impacts should account for both construction workers and shipments of construction materials.

- Specification of input parameters and sources used in the impact assessment. Parameters and source documents should be defensible and should be consistent with parameters used for socioeconomic analysis to determine physical impacts on road and traffic assessments for key roads. If assumptions are used to fill in missing or highly uncertain data (e.g., commute distances, persons per vehicle, and shipping distances for materials), the assumptions should be bounding and reasonable (i.e., the assumptions used in the analysis would be broad enough to overestimate the transportation impacts yet not so broad that they could mask the true environmental impacts of the reactor and lead to invalid conclusions). The applicant should provide in the ER sufficient descriptions of key models, assumptions, parameters, conditions, input data, resulting output, and approaches to allow for NRC staff's evaluation. If there is relevant information in other supporting documentation, indicate where in those documents this information can be found.

- Annual number of traffic accidents, injuries, and fatalities.

4.8 Radiological Health

The applicant should evaluate the potential radiological impacts on the proposed project's construction workforce that includes the radiological sources located on the project site or adjacent to the site, such as an operating or shutdown nuclear plant or other nuclear fuel cycle facility.

For multi-unit sites, the applicant should provide estimated annual doses to construction workers in a new unit construction area, as a result of radiation from onsite radiation sources from the existing operating unit(s). Examples of typical onsite radiation sources include the turbine systems (for boiling water reactors), stored radioactive wastes, the ISFSI, auxiliary and reactor buildings, and radioactive effluents (i.e., direct radiation from the gaseous radioactive effluent plume). The ER should be consistent with the applicable sections of the FSAR, especially for the location of the maximum exposure. Sections 12.3 and 12.4 of the Standard Review Plan (SRP), NUREG-0800, directs the staff to perform an assessment of dose to construction workers on a facility adjacent to an existing nuclear unit or units. The applicant should provide the annual person-rem (or person-Sievert) doses associated with such construction areas, providing detailed information as to the estimated number of construction workers and

estimated annual doses (from direct, gaseous, and liquid sources) to these workers, including bases, models, assumptions, and input data. The applicant should also describe any additional dose-reducing measures taken as a result of the dose assessment process for specific functions or activities. The applicant should indicate whether it has followed the guidance in the most recent version of RG 8.19, "Occupational Radiation Dose Assessment in Light-Water Reactor Power Plants – Design Stage Man-Rem Estimates" and how the applicant has followed this guidance, if the applicant has done so. Conversely, if the applicant has not followed this guidance, then the specific acceptable alternative methods used should be described in sufficient detail.

The ER should use the same units of measure as used in the FSAR. The ER should include the following:

- the physical layout of the site, including the location and orientation of onsite, adjacent existing operating nuclear units or permanently shutdown units

- whether the construction worker would be considered a member of the public or a radiation worker and the basis for that assumption

4.8.1 Direct Radiation Exposures

In the ER, the applicant should provide the following:

- The sources of direct radiation exposures: These sources should include, but not be limited to, independent spent fuel storage facilities, radioactive waste handling facilities, low-level waste storage facilities, condensate storage tanks, skyshine, and operating or permanently shutdown nuclear facilities co-located at the site.

- The estimated dose rate from direct radiation to construction workers from each source and the assumptions and methods used for estimating the dose.

- The number and principal locations of construction workers who will be exposed to the radiation sources described below and the total amount of time per year that they will spend at those locations.

4.8.2 Radiation Exposures from Gaseous Effluents

In the ER, the applicant should provide the following:

- Radioactive gaseous release data from the operating units, co-located units, or permanently shutdown units. The applicant should provide the location of the major gaseous effluent release points. The applicant should address the assumptions for using this release data (the year or years of data used and why this data is used or other release data is used, such as from the DCD for the reactor design).

- An estimate of the annual total effective dose equivalent from the gaseous effluents to a construction worker, providing the assumptions and methods used to make the estimate.

4.8.3 Radiation Exposures from Liquid Effluents

In the ER, the applicant should provide the following:

- Radioactive liquid effluent release data from the operating units, co-located units, or permanently shutdown units. The applicant should provide the location of the major liquid effluent release points. The applicant should address the assumptions for using this release data (the year or years of data used and why this data is used or other release data is used, such as from the DCD for the reactor design).

- An estimate of the annual total effective dose equivalent from the liquid effluents to a construction worker, providing the assumptions and methods used to make the estimate.

4.8.4 Total Dose to Construction Workers

In the ER, the applicant should provide the following:

- Estimated annual dose to an individual construction worker, including the location of maximum exposure, all models, assumptions, and input data used in arriving at the dose.

- Estimated annual collective dose to the construction work force, including all models, assumptions, and input data used in arriving at the dose.

- If construction workers are classified as members of the public, a comparison of the estimated annual dose to an individual construction worker to the dose criteria for a member of the public (10 CFR 20.1301, "Dose limits for individual members of the public;" 20.1302, "Compliance with dose limits for individual members of the public"). If construction workers are classified as radiation workers (which would require certain training), compare the individual construction worker dose to; 10 CFR 20.1201, "Occupational dose limits for adults;" 20.1203, "Determination of external dose from airborne radioactive material;" and 20.1204, "Determination of internal exposure."

4.9 Nonradioactive Waste Management

The applicant should describe the environmental impacts that could result from the generation, handling, and disposal of nonradioactive waste during building activities. As discussed in Chapter 3 of this RG, the types of nonradioactive waste that would be generated, handled, and disposed of during building activities should be described. These would include cleared vegetation, building material debris, municipal waste, spoils, stormwater runoff, sanitary waste, dust and other air emissions, used oils and lubricants from vehicle maintenance, and other hazardous chemicals.

4.9.1 Impacts on Land

The applicant should describe the impacts on the land resulting from generation, handling and disposal of nonradioactive waste during building of the project. The description should include the following:

- summary of pertinent portions of the discussion from the section related to land use impacts from building activities;

- plans for storing and disposing of cleared vegetation or soil, rock or other resulting debris;

- general description of onsite waste expected to be generated, including types and approximate quantities, from building and equipment maintenance activities and the workforce; and

- plans for disposal of waste, including plans to minimize or recycle generated waste.

4.9.2 Impacts on Water

The applicant should describe the impacts from liquid waste generated during building activities. The description should include the following:

- Types of liquid waste generated during building and equipment maintenance activities.
- Typically, liquid wastes are from sanitary wastewater-treatment systems and stormwater runoff or from vehicle maintenance activities.
- Plans for onsite or offsite treatment of liquid waste.
- Any State or local codes or regulations that require provisions for treatment.
- Permits required for treatment and disposal of liquid waste.

4.9.3 Impacts on Air

The applicant should describe the building activities that would generate impacts on air quality, including GHGs. The applicant should identify if these impacts have been addressed in the Air Resources section of this Chapter. The description should include the following:

- Activities that would generate dust or emissions that might impact the air quality (e.g., burning vegetation and combustion of fuel in equipment). Include any temporary activities that might be necessary for building activities (e.g., an onsite concrete batch plant). Activities could be onsite or along transmission corridors.
- Any State or local codes that govern air quality (e.g., bans on burning materials).

4.10 Measures and Controls to Limit Adverse Impacts During Construction Activities

Environmental measures and controls may be required by Federal, State, and local agencies during building activities to minimize effects to the environment. The applicant should identify in Table 4-1 the Federal, State or local requirement or BMP for the measure or control. In addition to the discussion of the effects of building, the applicant should furnish details of the programs with which it plans to monitor activities affecting site-related environmental resources and quality, and describe the duration of these efforts. A description of the measures and monitoring required for compliance with Federal, State, and local environmental regulations and laws should also be provided for each resource area. The description should include plans for restoration, protection of resources or development of appropriate substitutes, and measures taken to control adverse impacts on resources. The applicant should describe measures designed to mitigate or reverse undesirable effects such as those described previously for each resource area. Table 4-1 is an example of the types of measures and controls to be documented.

Table 4-1. Summary of Measures and Controls to Limit Adverse Impacts during Construction Activities

Impact Category	Planned Measures and Controls During Construction
Land Use Impacts	
Site and Vicinity	Measures and controls that minimize impacts
Transmission Corridors	Measures and controls that minimize impacts
Offsite Areas	Measures and controls that minimize impacts
Water-Related Impacts	
Hydrologic Alterations	Measures and controls that describe alterations to surface waters and flow and groundwater
Water Use	Measures and controls that describe availability of use of surface-water and groundwater resources
Water Quality	Measures and controls that minimize impacts on surface-water and groundwater resources
Ecological Impacts	
Terrestrial Ecosystems	Measures and controls to minimize adverse impacts on terrestrial resources (including wetlands) onsite, offsite, and special permitting that may be required for managed species
Aquatic Ecosystems	Measures and controls to minimize adverse impacts on aquatic resources onsite, offsite, and special permitting that may be required for managed species
Socioeconomic Impacts	Physical, Economic (Economy and Taxes), and Socioeconomic (Traffic-, Recreation-, Housing-, Public Services- and Education-related) measures and controls to mitigate impacts.
Historic and Cultural Resources	Measures for identification, consultation, and preservation following discovery
Air Resources	Controls to minimize dust, emissions
Nonradiological Health	Measures and controls for worker safety
Radiation Exposure to Construction Workers	Controls and monitoring for minimization of dose to construction workers
Nonradioactive Waste	Disposal plan for solid, liquid, gaseous wastes, sanitary waste

Chapter 5

5.0 Environmental Impacts from Operation of the Proposed Plant

The ER should adequately describe the impacts of operating the proposed plant as required in 10 CFR 51.45(c), including offsite facilities that support operation of the plant (e.g., transmission lines, pipelines). For each impact category in Chapter 5, the ER should identify the measures and controls that would be used to mitigate and limit adverse operational environmental impacts. Specific information to include in the ER, as part of, or in addition to, the description of impacts, is covered in the following sections.

5.1 Land Use

The greatest land use impacts are typically associated with building activities. Land use impacts associated with operations are expected to be minimal because activities are generally restricted to previously disturbed areas of the site or offsite areas (e.g., outage worker parking, temporary access routes, periodic vegetation clearing, landscaping, and sporadic access closures). The scope of the review is guided by the magnitude and nature of the expected impacts associated with proposed plant operations and site-specific characteristics. Impacts should be quantified to the extent possible using acreage, volumetric, or chronological measures.

5.1.1 Onsite Impacts

The following information related to the land use impacts associated with operations should be included in the ER:

- characterization of any land-disturbance activities expected during operations (e.g., maintenance and operations activities and construction of additional waste storage facilities, including an ISFSI)
- discussion of any anticipated land use classification conversions summarized by acreage
- discussion of any changes in land uses on agricultural, forestry, or mineral extraction activities or on floodplains or wetlands (can cross-reference other sections of ER where possible)
- description of impacts on the provisions of any affected local or regional land use or economic-development plans associated with operations
- description of any disruption to land- or water-resource access issues or concerns during operations
- description of any disruption to existing land uses or private land access issues or concerns at the site or vicinity caused by operations.

5.1.2 Offsite Impacts

The following information related to the land use impacts associated with operations in offsite areas should be included in the ER:

- discussion of expected transmission-line corridor maintenance activities during operations affecting land use

- characterization of any land-disturbance activities in other offsite areas expected during operations

- discussion of land use classification conversions summarized by acreage

- description of impacts on local or regional land use or economic-development plans from operations in offsite areas

- description of any disruption to land- or water-resource access required to facilitate operations

- description of any disruption to existing land uses or private land access at the site or vicinity caused by operations

- description of any possible disruption to hazardous waste cleanup activities

- discussion of any changes in land uses on agricultural, forestry, or mineral extraction activities or on floodplains or wetlands (can cross-reference other sections of ER where possible).

5.2 Water Resources (Surface Water and Groundwater)

The applicant should describe the hydrologic alterations associated with station operation and the resulting impacts on consumptive and nonconsumptive water uses and on water quality. In evaluating water-related impacts, the applicant should consider the effects of reasonably foreseeable changes in the hydrologic environment (e.g., climate, land use, and water use) over the duration of the license for the resource impact area.

5.2.1 Hydrologic Alterations

The applicant should describe the operational activities expected to result in hydrologic alterations at the site, within transmission corridors, and offsite within the resource impact area. Examples of operational activities that might affect water use and water quality include withdrawal of water for station use, surface-water diversions, maintenance dredging, groundwater dewatering, and effluent discharge, etc. The description should include analyses of the resulting hydrologic alterations and the physical effects of these alterations on water uses and users (quantity and quality); practices proposed to minimize hydrologic alterations having adverse effects; and an assessment of compliance with the applicable Federal, State, regional, local, and Tribal standards and regulations.

Station water use and discharge of effluents during operation are requested in Chapter 3.0 of this RG. The applicant should identify those water-supply and water quality conditions under which station operation would be affected (e.g., high-water levels, derating caused by insufficient supply of cooling water, etc.).

The ER should include a description of the following:

- Anticipated hydrologic alterations resulting from station operation. For example, the applicant should discuss alterations in water levels and groundwater heads; alterations in flow rates and circulation patterns caused by diversion, intake, and discharge structures; and alterations in erosion, deposition, and sediment transport characteristics.

- The effects of these alterations on the quantity and availability of water within the resource impact area. For example, the applicant should assess, as applicable, how hydrologic alterations affect river discharge (including changes in the seasonal variation of flow) or groundwater discharge to wetlands.

- The effects of effluent discharge on the water quality of the receiving waterbodies. Thermal, chemical, and radiological effects should be evaluated.

- The proposed actions to minimize the effects of the hydrologic alterations.

- List of required permits and certifications under the applicable Federal, State and local standards and regulations.

When a mathematical model is used to evaluate the effects of hydrologic alterations, the applicant should describe the conceptual basis for the model (including the rationale for eliminating plausible alternative conceptualizations), the assumptions used in developing the model, the range of applicability of the model, input data used, the resulting output, the basis for boundary conditions, parameter estimation and calibration procedures followed, and estimates of uncertainty in model forecasts. The applicant should provide in the ER sufficient descriptions of key models, assumptions, parameters, data, and approaches to allow for NRC staff's evaluation. If there is relevant information in other supporting documentation (i.e., FSAR, DCD, or other references), indicate where in those documents this information can be found.

5.2.2 Water-Use Impacts

The applicant should identify those water uses and water users discussed in Chapter 2 of this RG that are potentially affected by the changes in the quantity and/or availability of water resulting from hydrologic alterations. The applicant should evaluate the water use impacts by quantifying the anticipated reduction in water supply reliability for each water use and provide a description of the analyses performed to determine the impacts during operations.

5.2.3 Water-Quality Impacts

The applicant should identify those water uses and water users discussed in Chapter 2 of this RG that are potentially affected by the changes in water quality resulting from hydrologic alterations during operations. The applicant should evaluate the impacts by quantifying the anticipated reduction in each use resulting from the changes in water quality and provide a description of the analyses performed to determine the impacts.

5.2.4 Water Monitoring

The overall plan for protection of waterbodies that may be affected by station operations should be discussed. A description of the proposed measures to ensure compliance with applicable water quality and water use standards and regulations should also be provided. When compliance involves monitoring, the operational monitoring program should be described in sufficient detail to establish the ability of the monitoring to provide timely and accurate information so that appropriate actions can be taken to limit the impacts of station operations.

5.3 Ecological Resources

This section addresses the information related to terrestrial, wetland and aquatic ecological impacts from operations at the proposed site. The applicant should provide adequate details in the ER to fully determine the impacts on terrestrial and aquatic species and habitats resulting from nuclear power plant operations.

5.3.1 Terrestrial and Wetland Impacts

Operation of a nuclear power plant, once built, does not normally involve further physical loss of terrestrial habitats or wetlands but can still affect habitat quality and wildlife. Supplementary guidance on some of the more common terrestrial ecology environmental impact analyses is available in the most recent revision of RG 4.11.

Terrestrial Habitats

The ER should include a discussion of the following potential effects on terrestrial habitats from operating the proposed facilities:

- Effects on terrestrial habitats from land-disturbance activities expected (e.g., construction of additional waste storage facilities, including an ISFSI installation if the applicant has current plans to build such a facility).

- Effects on terrestrial habitats from facility and landscape maintenance activities (e.g., pesticide use, mowing, danger tree trimming and removal, and trampling by heavy equipment).

- Effects of runoff and stormwater management on wetlands and other terrestrial habitats. Ensure compatibility with hydrology sections.

- Salinity from cooling-tower drift, or drift from operating other facilities (e.g., evaporation ponds) that potentially could affect terrestrial resources. If the maximum estimated ground-level salinity deposition exceeds 1 kg/ha/mo at any location at any time, also include deposition isopleths overlaid on terrestrial habitat maps and an estimate of the area of each habitat type included in each isopleth band.

- Fogging and icing that could affect terrestrial species and habitats.

- Operation of cooling ponds, evaporation ponds, and other operational water features that could affect adjoining wetlands and other terrestrial habitats.

- Use of groundwater and surface water that could affect terrestrial habitats (e.g., wetlands, shorelines, and riparian habitats). An overlay of modeled groundwater withdrawal isopleths over terrestrial habitat maps may be helpful if withdrawals could be capable of causing substantial habitat modifications. Information should be consistent with similar information presented in the aquatic ecology and hydrology sections of the ER.

Wetlands

Operating a nuclear power plant does not normally involve filling wetlands. However, wetlands are a habitat type that should be addressed together with upland (non-wetland) terrestrial habitat types. Particular attention should be paid to the possibility that groundwater withdrawals could affect the hydrology of nearby wetlands and that surface-water withdrawals could affect nearby shorelines and wetlands fringing water sources.

Wildlife

The ER should include a discussion of the following potential effects on terrestrial wildlife during operations:

- Effects of operational noise (e.g., mechanical noise, vehicular noise, and noise from cooling towers) on terrestrial wildlife. Estimated noise isopleth overlays may be helpful if noise levels exceeding 85 dBA are anticipated in areas of high-quality habitat.

- Loss or injury of wildlife caused by traffic. Wildlife movement and migration patterns over the surrounding landscape should be considered. The discussion should remain consistent with traffic-related discussions presented elsewhere in the ER.

- Effects on terrestrial wildlife from maintaining transmission-line rights-of-way and other exterior areas and corridors.

- Injury to birds and bats colliding with tall structures (e.g., natural draft cooling towers, communication towers, and electric transmission lines).

- Electrocution of birds and other wildlife by transmission lines and other electrical facilities.

- Effects on terrestrial wildlife from electromagnetic radiation generated at switchyards and along electric transmission lines.

Important Species and Habitats

Applicants should carefully consider which species and habitats that meet the criteria for importance in Table 2-1 could potentially be affected over the operational life of the proposed plant. The ER should include the following information with respect to potential effects of operations on important species and habitats:

- A discussion of how operation could affect terrestrial species and habitats identified as important using the criteria in Table 2-1.

- A discussion of any relevant correspondence that has been initiated with the FWS or State, local, or Tribal natural resource agencies about endangered, threatened or other special status species and habitats. The applicant should briefly summarize and provide copies of key correspondence (including requests and responses by letters, email, or phone call summaries).

- Cross-references to the aquatic ecology section below may be appropriate for important species using both terrestrial and aquatic habitats (e.g., crocodilians and some waterfowl).

5.3.2 Aquatic Impacts

Operation of a nuclear power plant would affect the aquatic environment. Supplementary guidance on aquatic ecology environmental impact analyses is available in RG 4.24.

The ER should include the following information relating to operational aquatic impacts:

- Description of the water withdrawal and consumptive water use from station operations and its effects on aquatic resources.

- Discussion of the conformance of the proposed intake structure to the EPA CWA Section 316(b) national technology-based performance and proportional-flow requirements (66 FR 65256) for Phase I for new facilities.

- Information about NPDES permits for the proposed site and/or current NPDES permit for existing units sited in proximity to the proposed units.

- Description of the susceptibility of important aquatic species at specific life stages to entrainment, and impingement in conjunction with operation of the plant cooling system and entrainment or impingement rates from operation of the plant using data from studies as discussed in RG 4.24, including existing historical data from studies from co-located or nearby nuclear or fossil units.

- Discussion of stock assessments, if available and appropriate, as a metric for impact on the species for those important species potentially affected by station operation.

- Discussion of species and habitats that may be adversely affected by periodic operations (e.g., thermal backwashing).

- Discussion of species that may be affected by potential adverse effects from recirculation of heated effluent from the plant-discharge system and altered hydrodynamic characteristics including altered circulation or current patterns. Discussion of habitats affected by the cooling-water system including bottom scouring near the discharge.

- Discussion of the temperature tolerance, duration of exposure, and avoidance behavior of susceptible important aquatic species in relation to thermal discharge, including heat shock and cold shock, at all affected life stages. This discussion should be based on a model, map and description of the thermal plume and should include variation seasonally and throughout the water column.

- Description of any potential changes to vectors causing aquatic species disease as a result of thermal discharges.

- Description of any potential changes to numbers of nuisance, invasive, and introduced species, including fish, aquatic vegetation and benthic invertebrates (e.g., *Corbicula* spp. *or Mytilus* spp.) onsite or in the vicinity of the proposed plant as a result of thermal discharges.

- Discussion of effects on important aquatic species resulting from chemical alterations (e.g., changes in salinity, dissolved oxygen, and biocides) to the receiving waterbody. Consider effects from both cooling-tower drift and cooling system discharges.

- Discussion of effects on important aquatic species resulting from physical alterations (e.g., maintenance dredging to the receiving waterbody) including its substrate and aquatic vegetation.

- Description of any transmission-line and pipeline corridor maintenance practices anticipated to adversely affect aquatic biota.

- Summary of any relevant correspondence or discussions with FWS, NMFS, or State, local, or Tribal natural resource agencies on the endangered, threatened or other special status species and habitats, including federally designated critical habitat. Briefly summarize and provide copies of key correspondence (including requests and responses by letters, email, or phone call summaries).

5.4 Socioeconomics

The applicant's ER should describe the socioeconomic impacts during operations at a nuclear power facility. The scope of the review is guided by the magnitude and nature of the expected socioeconomic impacts during facility operations.

5.4.1 Physical Impacts

The applicant's ER should describe physical impacts during facility operations on the community, people, existing buildings, and roads. Physical impacts include noise, odors, exhausts, thermal emissions, and visual intrusion. The geographic scope may be smaller than the economic region, because impacts typically attenuate with distance. The applicant's ER should provide the following information:

- Potential impacts to existing structures during operation of nuclear power facility.

- Description of any transportation infrastructure (roads, rails, waterways) impacts caused by deliveries and worker commuting, and any anticipated increases in road repair and maintenance.

- Description of aesthetic viewshed visible to the public, including:

    - day and night visibility of nuclear power facility and the cooling-tower plumes in conflict with the natural viewshed (e.g., tall structures affecting views), and

    - nighttime light pollution from security lighting, warning lights and vehicles.

- Description of any mitigating actions taken for mitigating physical impacts during nuclear power facility operations.

The ER should also provide a high-level discussion of expected population changes during operation. The discussion of population changes should focus on the economic region where the majority of workers are expected to reside. The applicant's ER should provide the following information:

- Estimated in-migrating operations workers by county and community, including:

    - family size, and

    - residential distribution (i.e., by county and community).

- Discussion of the location of any operations workers already residing in the economic region.

5.4.2 Economic Impacts

Economic impacts during nuclear power facility operations include employment and tax revenue. Information in this section will also be used in the benefit-cost/need for power analysis. The applicant should use an industry-standard economic input-output model to estimate the economic impacts during nuclear power facility operation. The information should include monetized estimates, to the extent practicable.

Economy

The applicant's ER should include the following information on the economic impacts during nuclear power facility operation:

- Identification and description of input-output model, input parameters used, and results. Information from regional input-output models should include:
    - direct and indirect employment during nuclear power facility operation, and
    - expected direct and indirect income effects in support of nuclear power facility operation.
- Explanation of any assumptions affecting the conclusions, including the number of workers used in the model, who will receive benefits, and where those benefits would most likely occur. A sensitivity analysis discussion should explain how the model's output could be affected by changes in the input.

Taxes

The applicant's ER should include a comprehensive list and discussion of tax-revenue generated during nuclear power facility operation. Typical tax revenues include the following:

- Income – Federal, State, County, and local income taxes during nuclear power facility operations. The applicant should include information on any assumptions about the number of operations workers, wages, and work schedule that would inform the calculation of income tax revenue.
- Sales and use – the ER should include, if present, State, County, and local sales and use tax revenue forecasts during nuclear power facility operations and applicant's estimated purchases during operation including services, materials, and supplies. The information should include an explanation of tax rates, the assumptions behind the calculation of revenues, and a monetized estimate for each tax authority.
- Property – the ER should include property tax revenue estimates during nuclear power facility operations including revenue subject to special government incentives, payment-in-lieu-of-tax agreements, or other assessment processes that differ from those for the general public. The information should include an explanation of tax rates, the assumptions behind the calculation of revenues, and a monetized estimate for each tax authority.

5.4.3 Infrastructure Impacts

The applicant's ER should include an assessment of the socioeconomic effects on each of the following including a discussion of process and assumptions, along with tables and/or figures that illustrate impact conclusions:

Traffic

The information should be accompanied by sufficient tables and/or figures to support the analysis. The applicant's ER should include traffic volume assessments discussing the magnitude of the effect and shift schedule during operation of the nuclear power facility compared to baseline estimated traffic for the affected roads.

Recreation

The applicant's ER should include information on local recreational venues, capacity, occupancy rate, and seasonal characteristics. The analysis should include the following information:

- The effects of aesthetic changes (e.g., lighting and visible degradation impacts as discussed under physical impacts) that may reduce the attractiveness of and enjoyment of tourists and recreational venues.

Housing

The applicant should describe the expected impacts on local housing resources attributable to the operations workforce over the 40-year life of the proposed project. Sufficient tables and/or figures to support the analysis should accompany all discussion. The housing assessment should include the following:

- The expected number of in-migrating workforce members.
- The underlying assumptions, including:
  - family size
  - operations worker residential distribution
  - assumptions related to housing choice (e.g., rental housing, purchase of existing homes versus new construction)
  - the property tax impacts from new construction of residential properties.
- The location of expected housing resources by type in the context of the total housing resource for each affected county in the economic region (from Chapter 2).
- Whether the housing demand for new residents creates adverse impacts on the rental market.

Public Services

The applicant should describe the expected impacts on public services in the economic region attributable to the operations-related in-migrating population. The discussion should be accompanied by

sufficient tables and/or figures to support the analysis. The assessment of public services should include the impacts of increasing demand for public services by workers and their families:

- Estimate of the expected contribution to water and sewer use for each affected community, and the resulting impact on each service in the economic region.

- Identification of the potential impact on police or fire services for each affected community in the economic region, including the expected increase in the number of employees (differentiated between duty officers and support staff), and the change in ratio of police or firefighters to population in order to maintain the current level of service.

- Identification of the expected number of new volunteer staff (as opposed to employee staff) needed to maintain the same ratio of first responder staff to population served.

- Estimate of the expected impacts on medical facilities in the region.

- Estimate of the number of students that would be added because of in-migrating families, including the expected change in student-teacher ratios, with a comparison to any mandated maximum ratio.

5.5 Historic and Cultural Resources

NHPA Section 106 (54 U.S.C. 300101 et seq.) requires that Federal agencies consider the effects of the agency's undertaking on historic properties included in, or eligible for, the NRHP and, before approval of an undertaking, give the ACHP a reasonable opportunity to comment on the undertaking. The NHPA defines "undertakings" as any project or activity that is funded or under the direct jurisdiction of a Federal agency, or any project or activity that requires a "Federal permit, license, or approval." The ACHP's regulations at 36 CFR Part 800, "Protection of Historic Properties," set forth the procedures that define how Federal agencies meet Section 106 responsibilities.

Although the NRC retains the responsibility to formally initiate the Section 106 review, the applicant should provide information and analysis for the NRC to comply with Section 106 requirements in a manner that minimizes the potential for delays in the environmental review. The applicant should identify any activities and impacts associated with the period of plant operations, including maintenance-related and reasonably foreseeable future construction activities (e.g., warehouse, ISFSI), that could affect historic and cultural resources within the APE (onsite or offsite, direct and indirect effects). The applicant should provide a site utilization plan that includes the location of reasonably foreseeable future construction activities. Applicants should involve the SHPO, local historic preservation officials, THPO, and Indian Tribes in the assessment. The ER should include the following information (with appropriate reference to Chapter 2 of the ER to avoid duplication of information):

- Description of any operational activities, including maintenance activities that could affect onsite or offsite resources (e.g., ground-disturbing activity not discussed in Chapter 4, increases in traffic, and noise and visual intrusions (i.e., cooling towers and other plant structures)).

- Description of historic properties found in the direct and indirect APEs that may be affected by operational activities. The criteria specified in 36 CFR 800.5 should be used to assess adverse effects to historic properties. The assessment should provide a basis and documentation for how a conclusion is reached.

- Description of the effects associated with operation, including maintenance activities on historic and cultural resources that are not determined to be historic properties, but may be considered by SHPO, THPO, Indian Tribes, or members of the public to have cultural significance/importance in the context of National Environmental Policy Act of 1969, as amended (e.g., sacred sites, cemeteries, local gathering areas).

- Discuss the direct and indirect effects (e.g., ground disturbance, physical, visual, auditory, atmospheric such as fugitive dust, light, and traffic), if any, from the period of plant operations, including maintenance-related and reasonably foreseeable future construction activities (e.g., warehouse, ISFSI), on nearby historic properties or important historic and cultural resources.

- For indirect effects, the assessment should include drawings or modified photographs indicating the station facilities and their surroundings, if visible from these nearby important vantage points.

  The assessment should lead to one of three conclusions (see 36 CFR 800.4):

  - No historic properties present.

  - Historic properties present but the undertaking will have no effect upon them.

  - Adverse effect: The undertaking will harm one or more historic properties (see 36 CFR 800.5).

If a qualified professional (see Section 2.6.2) has recommended a "no historic properties present" determination, then the applicant should provide supporting documentation in the ER.

If a qualified professional has recommended a finding of no adverse effect to historic properties, the applicant should develop a plan that outlines protective measures to minimize or avoid these effects. The applicant should engage the SHPO, THPO, Indian Tribes, and interested parties in the formalization of these protection plans and document this within the ER.

If a qualified professional determines that adverse effects to historic properties occur, the applicant should engage with the SHPO, THPO, Indian Tribes and interested parties and document this determination in the ER. The ER should describe any procedures and cultural resource management plans developed by the applicant to protect historic and cultural resources during operations, as well as any measures to avoid, minimize or mitigate adverse effects. These procedures should also include steps to take in the event of inadvertent discoveries, including the discovery of human remains.

The applicant should be aware that the NRC, as a Federal agency, is responsible for consulting with the SHPO, THPO, Indian Tribes and interested parties as part of the Section 106 compliance process. If the NRC determines an adverse effect will occur, it will, in accordance with Part 800, develop proposed measures in consultation with identified consulting parties that might avoid, minimize, or mitigate such effects. Such measures, as appropriate, would be discussed in the NRC staff's EIS. If the NRC staff determines that adverse effects would occur, it can develop a Memorandum of Agreement or Programmatic Agreement (See 36 CFR 800.6), as appropriate. See Appendix B for additional information on consultation.

5.6 Air Resources

The ER should adequately describe the impacts on the atmosphere from cooling system operations, as well as the impacts on air quality from operation of the proposed plant and associated

transmission lines. The scope of the review is based on the magnitude and nature of the expected impacts associated with the operations and the characteristics of the site and vicinity. The applicant should provide in the ER sufficient descriptions of key models, assumptions, parameters, conditions, input data used, resulting output, and approaches used in the analyses for operation impacts on allow for NRC staff's evaluation. If there is relevant information in other supporting documentation (i.e., FSAR, DCD, or other references), indicate where in those documents this information can be found.

5.6.1 Cooling System Impacts

The applicant should describe atmospheric impacts from cooling system operations. The description should include the following:

- type of cooling system
- cooling system characteristics (e.g., the number of towers and fans, location, elevation above sea-level, tower physical dimensions, and release height)
- performance characteristics (e.g., air and water mass flow rates, water temperature entering and leaving the tower, air temperature leaving the tower, and amount of heat released)
- drift characteristics (e.g., drift rate, drift droplet size distributions, and concentration of dissolved and suspended solids)
- analytical technique(s) for estimating cooling system impacts (e.g., model and meteorological data used)
- estimates of cooling system impacts at the site and vicinity, including the following:
  - monthly and/or seasonal and annual plume lengths
  - monthly and/or seasonal and annual additional hours of fogging and icing
  - monthly and/or seasonal and annual amounts and locations of salt deposition
  - monthly and/or seasonal and annual increases in humidity and precipitation, including snowfall
  - potential local weather modification from cloud formation/shadowing
  - interactions of plume with other pollutant sources.

5.6.2 Air Quality Impacts

The applicant should describe air quality impacts associated with operations. The description should include the following:

- Identification of applicable Federal, State, and local air regulations and required air permits for operation.
- Sources and types of air pollutant emissions, including mitigating measures, and plans to minimize air emissions.

- Estimates of annual air emissions for criteria air pollutants identified in the National Ambient Air Quality Standards from sources such as diesel generators, engines, boilers, cooling towers, and commuter vehicles. If the proposed site is located in a nonattainment or maintenance area with respect to a criteria pollutant, the emission estimates can be used as a basis for assessing the applicability of a conformity analysis (see 40 CFR Part 93, Subpart B and NRC Memorandum "Revision to Staff Guidance for Conducting General Conformity Determinations").

- Estimates of GHG emissions (expressed in units of CO_2 equivalents) resulting from station operation, including GHG emissions from standby diesel generators and workforce transportation. The applicant should compare these GHG emissions to State and national GHG emissions and, if available, State or Public Utility Commission GHG emission reduction goals (from Chapter 2). The applicant may provide either site-specific estimates or refer to the generic GHG footprint for a 1,000 MW(e) reactor. The analysis should be adjusted according to the proposed action (number of units, electrical output). The assumptions, factors, and other information used in any site-specific analysis should be described in sufficient detail to allow an independent evaluation and assessment of the resulting GHG emissions estimate.

5.6.3 Transmission-Line Impacts

The applicant should describe air quality impacts associated with transmission lines, including a description and quantification of ozone (O_3) and nitrogen oxides (NO_x) production associated with power transmission.

5.7 Nonradiological Health

The applicant should address nonradiological human health impacts of operating a new nuclear power plant. This includes a discussion of health impacts on the public and workers from operation of the cooling system, noise generated by operations, EMFs, and transportation. In addition, the applicant should address any other sources of potential nonradiological health impacts (e.g., chemical).

5.7.1 Etiological Agents and Emerging Contaminants

The applicant should describe the operation of systems that might increase the presence and distribution of etiological agents and emerging contaminants that affect human health. These include the operation of cooling systems (e.g., release of thermal discharges into reservoirs or rivers, and cooling towers). The discussion should include the following:

- Type of cooling system, the source and discharge waterbody.

- Types of etiological agents that may be present.

- Temperature increase expected for the aquatic environment from the plant's thermal discharge. If discharge of blowdown water is to a river, the contribution of discharge to total flow and the change in water temperature should be described. Seasonal differences in temperature should also be described.

- The pathways for public and worker exposure from cooling system discharge (e.g., use of reservoir for recreational activities, collection of shellfish in thermal discharge, or workers performing cooling-tower maintenance).

- Suspected contributing factors related to the incidence of disease should be discussed. Potential linkage between operation and these agents should be provided. Historical records of disease incidence should be presented.

- The potential pathways for the transfer of contaminants and materials in the reclaimed water or impaired surface waters to both the public and station workforce should be addressed. Transfer of these chemicals and compounds to members of the public and the workforce could occur as a result of maintenance and operation of the station cooling systems as well as from the disposal of sanitary wastes. Releases from the proposed facility in the form of drift or blowdown should be evaluated.

- The effect of cycles of concentration associated with the use of closed-cycle cooling on the release of chemicals and materials in the reclaimed water or impaired water sources to the public, the workforce and the environment from cooling-tower drift or station blowdown.

- The effect of discharges to the environment from the sanitary waste system and its potential impact on humans should be discussed.

- A discussion of State and local restrictions or requirements on the use of reclaimed or polluted water by the proposed facility.

- Any BMPs and any other mitigation strategies required or planned to address the impacts of etiological agents or emerging contaminants.

5.7.2 Noise Impacts

The applicant should describe noise impacts associated with operations. The description should include the following:

- applicable Federal, State, and local regulations and/or ordinances governing noise from building activities

- background noise measurements and closest noise-sensitive human receptors or sensitive areas (Chapter 2 of this RG)

- sources of noise from the proposed plant (e.g., operation of mechanical draft cooling towers and intake pumps)

- peak noise level measurements for each identified source type, along with estimated noise levels at representative distances, with attenuation by distance alone (i.e., not taking advantage of any intervening foliage, terrain changes, or permanent barriers between the source and the receptor)

- measurement or calculation of the levels of noise from each of the identified sources at the closest noise-sensitive human receptors identified in Section 2.8.2, including a description of any noise-abatement models

- any BMPs and any other mitigation strategies required or planned for noise abatement for operation of the proposed plant.

If the measured or calculated noise level from any identified source type exceeds 65 dBA (see NUREG-1437, Initial and Revision 1, for additional information) at any noise-sensitive human receptor or at the site boundary when calculated with attenuation by distance alone, the applicant should determine the noise level that would result from taking advantage of natural attenuation, such as intervening foliage, natural barriers, and changes in terrain. The determination of natural attenuation may be accomplished by the applicant performing a series of leaf-on and leaf-off noise surveys or by using an industry-standard modeling or calculation process. If the measured or calculated noise level from the source exceeding the 65 dBA threshold cannot be demonstrated to be reduced through natural attenuation to below the threshold, the applicant should describe specific mitigation measures to be used to reduce the noise level to below 65 dBA.

5.7.3 Electric Shock Impacts

The applicant should describe electric shock effects of EMFs associated with transmission lines. The description should include the following:

- types of transmission lines (Chapter 3 of this RG)
- types of potential exposures to transmission lines (e.g., electric shock from direct contact or induced charge to metal structures)
- impact on human health compared to national standards (e.g., National Electric Safety Code) and State and local codes and regulations.

5.7.4 Chronic Effects of Electromagnetic Fields

Operating power transmission lines in the United States produce EMFs of non-ionizing radiation at 60 Hz, which is considered to be an extremely low frequency (ELF)-EMF. The NRC has reviewed the available scientific literature on chronic effects on human health from ELF-EMF and concurs with the conclusions of the Advisory Group on Non-Ionising Radiation as stated in "Power Frequency Electromagnetic Fields, Melatonin and the Risk of Breast Cancer;" by the National Institute of Environmental Health Sciences (NIEHS) as stated in "NIEHS Report on Health Effects from Exposure to Power-Line Frequency Electric and Magnetic Fields;" and the World Health Organization as stated in "Extremely Low Frequency Fields." The NIEHS report contains the following conclusion:

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

See also the discussion of this issue in NUREG-1437 (Initial and Revision 1) and Table B-1 in 10 CFR Part 51. The applicant should review and report whether there is any new information regarding whether a consensus has been reached by the appropriate Federal health agencies pertaining to the effects of long-term or chronic exposure to EMFs.

5.7.5 Occupational Health

The applicant should describe human health risks for operations personnel engaged in activities such as maintenance, testing, and plant modifications for the proposed project. The description should include the following:

- The incidence of occupational health risks described in Chapter 2.0 of this RG.

- Occupational health risks compared to the incidence rate for workers in similar occupations (e.g., electric power generation, transmission, and distribution). Include State and Federal labor references in the discussion.

- Standards, practices, and procedures to reduce the potential for occupational injury and fatality risk.

5.7.6 Human Health Impacts from Transportation

The applicant should provide estimates of the potential human health impacts related to nonradiological traffic-related accidents from commuting operations and outage workers and transportation of supplies, equipment, and nonradiological waste to and from the proposed site. Nonradiological traffic-related impacts refer to the accidents, injuries, and fatalities estimated to occur from traffic accidents during movement of operations workers to and from the proposed site during operations. Where possible, the impacts should be estimated using information specific to the proposed site (e.g., by using county-specific accident statistics). The following information should be provided:

- Summary of provisions for site access during operations, including during outages.

- Description of the method(s) used to estimate nonradiological traffic-related accident impacts, including nonradiological traffic accidents, injuries, and fatalities. Nonradiological traffic-related accident impacts should be estimated using round-trip distances.

Specification of input parameters and sources used in the impact assessment. Where assumptions are used to fill in missing or highly uncertain data (e.g., commute distances, persons per vehicle, and number of deliveries), the assumptions should be bounding and reasonable (i.e., the assumptions tend to overstate transportation impacts yet are not so conservative that they could mask the true environmental impacts of the reactor and lead to invalid conclusions). The applicant should provide in the ER sufficient descriptions of key models, assumptions, parameters, conditions, input data, resulting output, and approaches to inform NRC staff's evaluation. If there is relevant information in other supporting documentation, indicate where in those documents this information can be found.

- Annual number of traffic accidents, injuries, and fatalities.

5.8 Radiological Health during Normal Operation and Radioactive Waste Management

The applicant should evaluate the potential radiological impacts on the public, workers and nonhuman biota that includes the radiological sources from operation of the proposed facility. This includes a discussion of the estimated radiation dose to members of the public, workers, and to the nonhuman biota inhabiting the area around the proposed site. The applicant should also evaluate the environmental impacts from low-level solid waste (LLW) management and onsite storage of spent fuel. The ER should use the same units of measure as used in the FSAR.

5.8.1 Exposure Pathways

The applicant should provide the following in the ER:

- The environmental pathways by which radiation from radioactive effluents can be transmitted from the proposed plant to living organisms. Figure 5-1 identifies the exposure pathways to humans and Figure 5-2 addresses the exposure pathways to nonhuman biota.

- The sources of direct radiation exposures. These sources should include, but not be limited to, independent spent-fuel storage installations, radioactive waste handling facilities, low-level waste storage facilities, condensate storage tanks, fuel buildings, turbine buildings, and skyshine.

- The pathways for gaseous effluents considering immersion in the gaseous plume, inhalation of iodines and particulates, ingestion of iodines and particulates through the cow milk, goat milk, animal meat, and vegetation pathways, radiation from iodines and particulates deposited on the ground.

- The pathways for liquid effluents considering drinking water, ingestion of fish and invertebrates and shoreline activities for water containing radioactive effluents.

- Site-specific unusual pathways uniquely associated with the proposed facilities.

5.8.2 Radiation Doses to Members of the Public

In the ER, the applicant should provide an estimate of the maximum annual individual dose and the annual total collective doses to the population within 50 mi (80 km) from radioactive gaseous and liquid effluents released from the plant during operation. The ER should provide the inputs for these calculations as well as the source of the data used. The information in the ER should be consistent with the information in the FSAR.

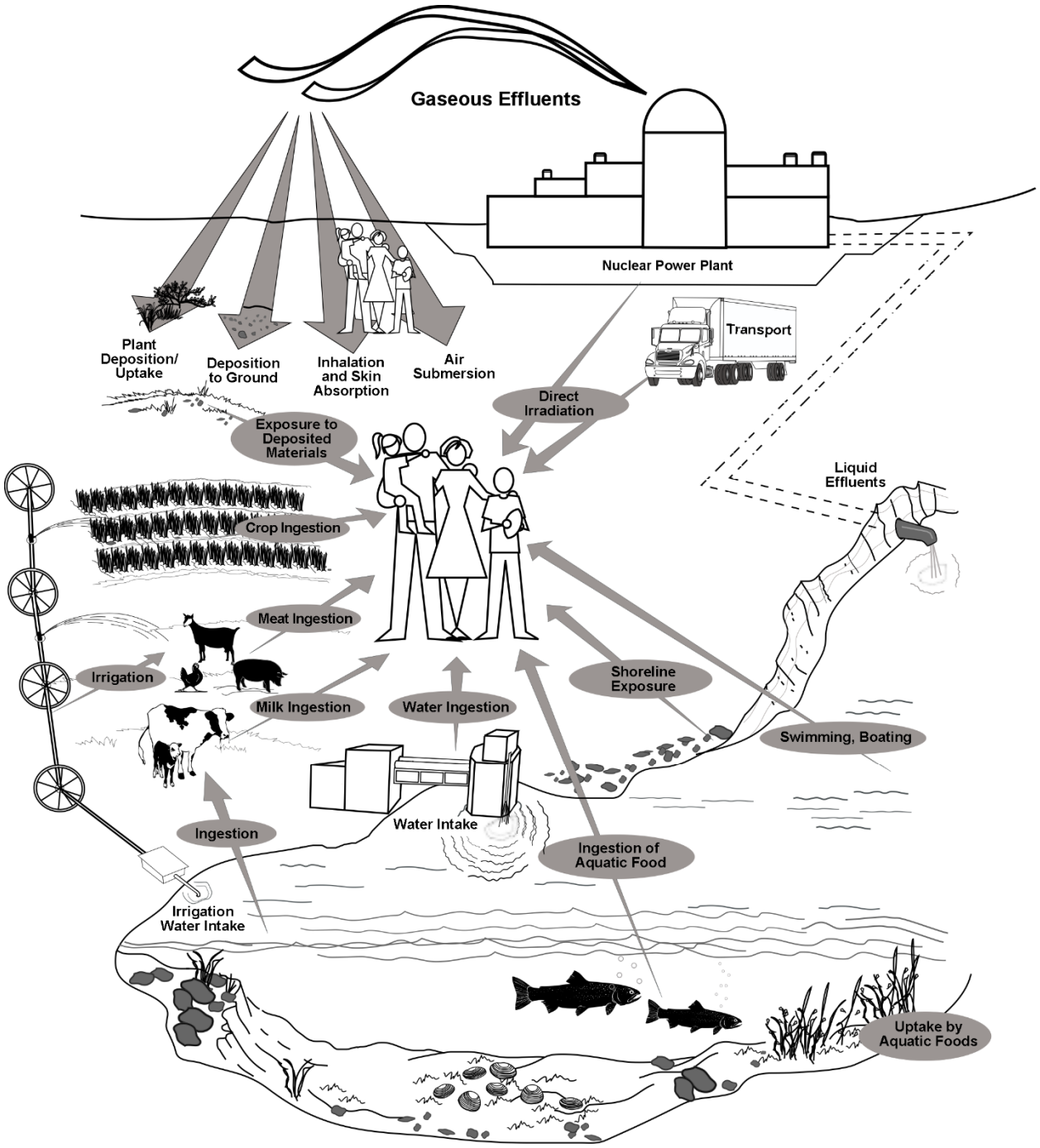

Figure 5-1. Example Exposure Pathways to Humans (adapted from Soldat et al. 1974)

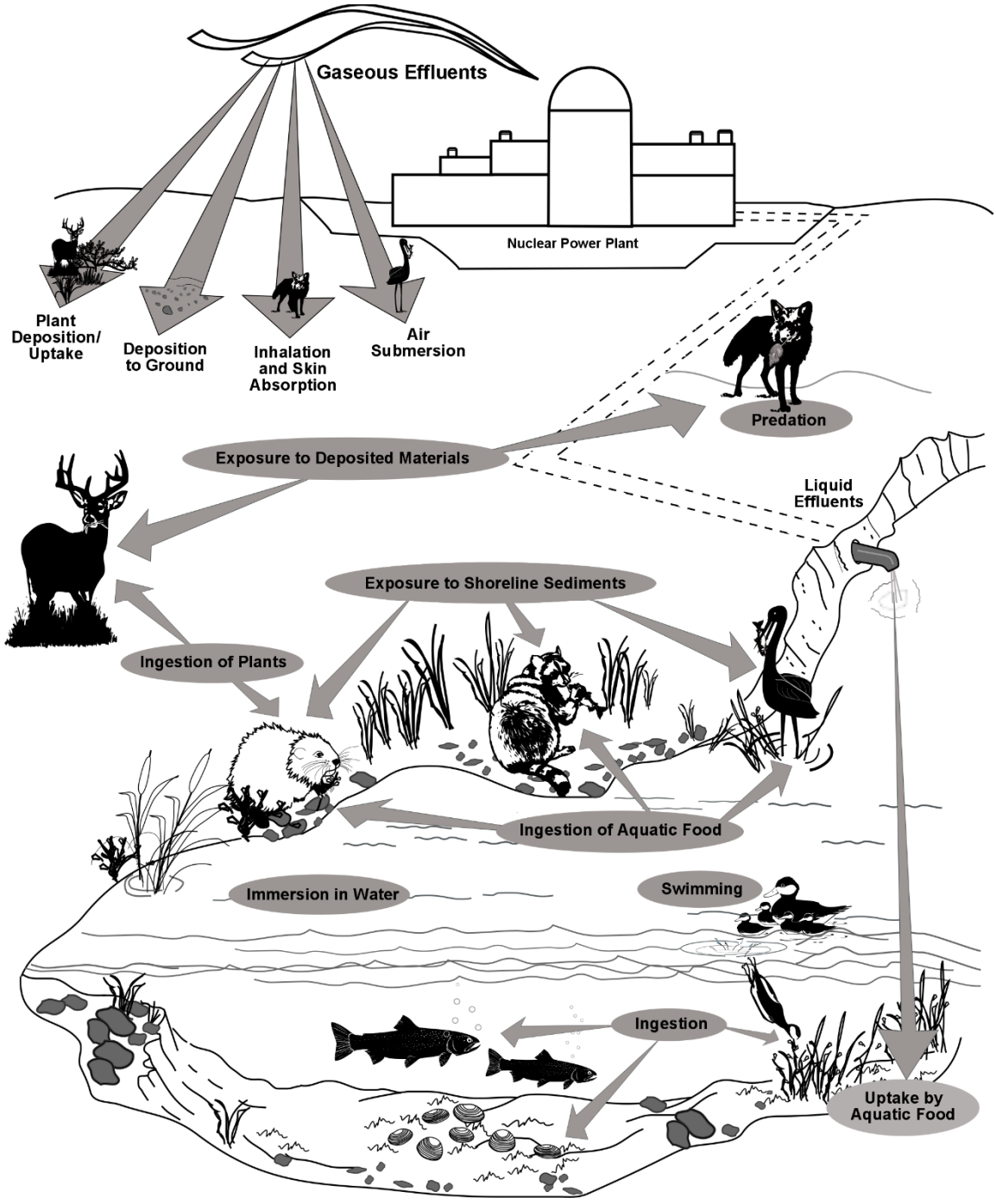

Figure 5-2. Example Exposure Pathways to Nonhuman Biota (adapted from Soldat et al. 1974)

Liquid Effluent Pathway

The ER should contain the following:

- Liquid pathway doses to the maximally exposed individual (MEI) calculated using the current NRC-approved computer code (e.g., LADTAP II), that comply with RG 1.109, "Calculation of Annual Doses to Man From Routine Releases of Reactor Effluents for the Purposes of Evaluating Compliance with 10 CFR Part 50, Appendix I." The applicant should provide in the ER sufficient descriptions of key models, assumptions, parameters, conditions, input data, resulting output, and approaches to inform NRC staff's evaluation. If there is relevant information in other supporting documentation (i.e., FSAR, DCD, or other references), indicate where in those documents this information can be found.

- The activities considered in the dose calculations: (1) consumption of drinking water affected by liquid effluents; (2) consumption of fish and invertebrates from water sources affected by liquid effluents; (3) direct radiation from swimming, boating, and shoreline activities on waterbodies affected by liquid effluents; and (4) ingestion of irrigated foods.

- Other parameters used as inputs to the current approved computer code including effluent discharge rate, dilution factor for discharge, transit time to receptor, and liquid pathway consumption and usage factors (i.e., shoreline usage, fish consumption, and drinking water consumption).

- The location of the MEI, the age of the MEI (i.e., infant, child, teen, or adult), and source of the majority of the dose. In addition, the ER should provide the maximally exposed organ, and source of that dose.

- The calculated annual collective population doses in units of person-rem for this pathway based on an estimated population distribution late in the timeframe of the proposed license.

In the ER, the applicant should provide the doses to the MEI in a table similar to Table 5-1.

Table 5-1. Annual Doses to the Maximally Exposed Individual for Liquid Effluent Releases from the Proposed Facility

Pathway	Age Group	Total Body (mrem/yr)	Maximum Organ (mrem/yr)	Thyroid (mrem/yr)
Drinking Water	Adult			
	Teen			
	Child			
	Infant			
Fish and Invertebrate	Adult			
	Teen			
	Child			
Direct Radiation	All			

Source: [Provide all sources of data.]

Gaseous Effluent Pathway

The ER should contain the following:

Gaseous pathway doses to the MEI using the currently NRC-approved computer code (e.g., GASPAR II), at the nearest residence, garden, and meat animal and the EAB that comply with RG 1.109. The applicant should provide in the ER sufficient descriptions of key models, assumptions, parameters, conditions, input data, resulting output, and approaches to inform NRC staff's evaluation. If there is relevant information in other supporting documentation (i.e., FSAR, DCD, or other references), indicate where in those documents this information can be found.

- The calculated annual collective population doses in units of person-rem for this pathway based on an estimated population distribution late in the timeframe of the proposed license.
    - The following activities should be considered in the dose calculations: (1) direct radiation from immersion in the gaseous effluent cloud and from particulates deposited on the ground; (2) inhalation of gases and particulates; (3) ingestion of meat and milk from animals eating grass affected by gases and particulates deposited on the ground; and (4) ingestion of garden vegetables affected by gases and particulates deposited on the ground.
- The gaseous effluent releases used in the estimate of dose to the MEI and population and other parameters used as inputs to the computer program should be provided (e.g., population data, atmospheric dispersion factors, ground deposition factors, receptor locations, and consumption factors).

The doses to the MEI should be presented in a table similar Table 5-2.

Table 5-2. Doses to the Maximally Exposed Individual from Gaseous Effluent Pathway

Pathway	Age Group	Total Body Dose (mrem/yr)	Max Organ (Specify) (mrem/yr)	Skin Dose (mrem/yr)	Thyroid Dose (mrem/yr)
Plume (distance and direction)					
Ground (distance and direction)					
Inhalation Nearest residence (distance and direction)					
Vegetable (distance and direction)					
Meat animals (distance and direction)					
Milk animals (distance and direction)					

5.8.3 Impacts on Members of the Public

This section describes the applicant's evaluation of the estimated impacts from radiological releases and direct radiation from the proposed facility. The evaluation should address dose from

operations to the MEI located at the proposed site boundary and the population dose (collective dose to the population within 50 mi (80 km)) around the proposed site.

Maximally Exposed Individual

The applicant should provide the total body and organ dose estimates to the MEI from liquid and gaseous effluents for the proposed facility and compare it to the design objectives of 10 CFR Part 50, Appendix I. A comparison of the dose estimates for the proposed facility should be presented in a table similar to Table 5-3.

For multiple units, or building of a new unit adjacent to an operating unit, the applicant should compare the combined dose estimates from direct radiation and gaseous and liquid effluents from the operating facility and the proposed facility. The data should be provided in a table similar to Table 5-4 and compared to the dose standards in 40 CFR Part 190, "Environmental Radiation Protection Standards for Nuclear Power Operations."

Table 5-3. Comparison of MEI Annual Dose Estimates from Liquid and Gaseous Effluents to 10 CFR Part 50, Appendix I Design Objectives

Radionuclide Releases/Dose	Applicant Assessment	Appendix I Design Objectives
Gaseous Effluents (noble gases only)		
Beta air dose (mrad/yr)		20
Gamma air dose (mrad/yr)		10
Total body dose (mrem/yr)		5
Skin dose (mrem/yr)		15
Gaseous Effluents (radioiodines and particulates)		
Organ dose (mrem/yr)		15
Liquid Effluents		
Total body dose (mrem/yr)		3
Maximum organ dose (mrem/yr)		10

Table 5-4. Comparison of Doses to 40 CFR Part 190

	Operating Facility	Proposed Facility		
Radionuclide Dose	Combined Liquid, Direct, and Gaseous Dose (mrem/yr)	Combined Liquid, Direct, and Gaseous Dose (mrem/yr)	Site Total Dose (mrem/yr)	40 CFR Part 190 Dose Standards (mrem/yr)
Whole body dose				25
Thyroid				75
Any other organ				25

Source: [Provide all sources of data.]

Population Dose

The applicant should estimate the annual collective population total body dose in units of person-rem within an 80 km (50 mi) radius of the proposed site. The estimated collective dose to the same population from natural background radiation should also be estimated and the two values compared. The

dose from natural background radiation should be calculated by multiplying the 80 km (50 mi) population estimate for the year operation is expected to cease (for the 40-year license including through one license renewal) by the average annual background dose rate of 311 mrem/yr from the National Council on Radiation Protection and Measurements (NCRP), "Ionizing Radiation Exposure of the Population of the United States," or the currently accepted natural background dose rate at the location being considered for the proposed site.

5.8.4 Occupational Doses to Workers

The applicant should provide an estimate for the annual occupation dose to workers, including outage activities, in units of person-rem. This value can either be estimated from the DCD for the reactor design, from the Preliminary Safety Analysis Report, FSAR, or from reports on doses to workers at operational units at the site.

5.8.5 Doses to Nonhuman Biota

The applicant should determine if there is any potential for significant radiological impacts on biota other than members of the public and, if so, estimate the nature and magnitude of the impact. The scope of the review should include an analysis of radiation-exposure pathways to biota.

In the ER, the applicant should include the following:

- Pathways identified in Section 5.9.1 of this RG.

- Biota to be evaluated. The biota to be considered are those species of local flora and local and migratory fauna defined as "important" (Table 2-1) and whose terrestrial and/or aquatic habitats provide the highest potential for radiation exposure. Or, the applicant should specify surrogates for aquatic species (e.g., fish, invertebrates, and algae) and for terrestrial species (e.g., muskrats, raccoons, herons, and ducks).

- An estimation, considering exposure pathways and the distribution of facility-derived radioactivity in the environs, of the following: (1) the maximum radionuclide concentrations that may be present in important local flora and local and migratory fauna and (2) the internal dose rates (millirad/year) that may result from those concentrations. Values of bioaccumulation factors, concentration ratios, and transfer factors used in preparing the estimates should be based on site-specific data, if available; otherwise, values from the literature may be used. The applicant should tabulate and reference the values of bioaccumulation factors used in the calculations. Dose rates to important local flora and local and migratory fauna that receive the highest external exposures should be provided along with a description of the calculational models. The bioaccumulation factor for aquatic organisms is the value of the ratio: (concentration in organism)/(concentration in water). The soil-to-plant concentration ratio is the ratio of plant concentration (dry weight)/(the concentration in dry soil). The feed-to-organism transfer factor is the ratio of (concentration in fresh tissue)/(daily intake of the radionuclide by the organism). Values of bioaccumulation factors, concentration ratios, and transfer factors can be obtained from the IAEA documents "Sediment Distribution Coefficients and Concentration Factors for biota in the Marine Environment" and "Handbook of Parameter Values for the Prediction of Radionuclide Transfer in Terrestrial and Freshwater Environments."

The applicant should provide the doses from the liquid and gaseous pathways and the total body nonhuman biota dose from all pathways.

Table 5-5 is an example of how to present the data.

Table 5-5. Nonhuman Biota Doses for Proposed Reactor(s)

Biota	Liquid Pathway Dose (mrad/yr)	Gaseous Pathway Dose (mrad/yr)	Total Body Biota Dose All Pathways (mrad/yr)
Fish			
Invertebrate			
Algae			
Muskrat			
Raccoon			
Heron			
Duck			
Source: [Provide all sources of data]			

The applicant should then compare the estimated total body dose rates to surrogate biota species that would be produced by releases from the proposed facility to the IAEA guidelines in "Effects of Ionizing Radiation on Plants and Animals at Levels Implied by Current Radiation Protection Standards" and the NCRP biota dose guidelines in "Effects of Ionizing Radiation on Aquatic Organisms." The results of the analysis should be provided in a table similar to Table 5-6.

Table 5-6. Comparison of Biota Doses from the Proposed Reactor(s) to Relevant Guidelines for Biota Protection

Biota	Total Body Dose (mrad/d)	IAEA/NCRP Dose Guidelines for Protection of Biota Populations (mrad/d)
Fish		1,000
Invertebrate		1,000
Algae		1,000
Muskrat		100
Raccoon		100
Heron		100
Duck		100

5.8.6 Radiological Monitoring

Regarding the REMP, located in the Offsite Dose Calculation Manual, for the site, the applicant should provide the following:

- The dates when the preoperational REMP began and when the operational REMP began. If the site does not have an operational reactor or does not have a permanently shutdown reactor, the applicant should provide the date when the preoperational REMP is expected to start.
- A brief summary of the REMP.
- If there is an operational REMP at the site, the applicant should address whether the current REMP will be used or if there will be changes to the REMP from the addition of the proposed plant.

5.8.7 Solid Waste Management and Onsite Spent Fuel Storage

Based on the information provided in Section 3.4.2, Radioactive Waste Management, the applicant should provide the following:

- A summary of plans for minimizing the production and processing of Class A, B, and C LLW onsite.
- An estimate of the amount of Class A, B, and C LLW that can be stored onsite and an estimate for how long it would take for storage to meet maximum capacity.
- A discussion about whether there are plans for constructing temporary storage facilities onsite.
- An estimate of the quantity of spent fuel that will be able to be stored onsite in both the spent fuel pool and in an ISFSI and provide an estimate of when the spent fuel storage would meet maximum capacity.
- Information on whether there are plans for building an ISFSI, being cognizant of the analysis in NUREG-2157.

5.9 Nonradioactive Waste Management

Liquid and gaseous radioactive releases from the reactor are considered effluent releases and are evaluated in Section 5.9. The applicant should describe the environmental impacts that could result from the generation, handling, and disposal of nonradioactive waste during operation. The types of nonradioactive waste that would be generated, handled, and disposed of during operation include municipal solid waste, industrial solid wastes, stormwater runoff, sanitary waste, liquid effluents containing chemicals or biocides, industrial liquid wastes, used oils and lubricants from vehicle maintenance, and combustion emissions. In addition, small quantities of hazardous waste, including mixed waste, may be generated during operations. Mixed waste is waste that is a combination of hazardous and low-level radioactive waste.

5.9.1 Impacts on Land

The applicant should describe the expected nonradioactive waste streams destined for land-based treatment or disposal during operation. The description should include the following:

- Type of waste streams. Typical solid waste generation comes from water-treatment wastes, laboratory wastes, trash, sanitary waste, cooling-water intake screen debris, and small quantities of hazardous and mixed waste.
- Actions to address waste streams, including waste minimization, recycling, transportation, storage, and disposal.
- Federal, State, and local codes and regulations that address solid waste, including any permits necessary for solid waste at the site.

The applicant should then describe the expected impacts on land use associated with the disposal of nonradioactive waste.

5.9.2 Impacts on Water

The applicant should describe nonradioactive liquid-waste streams associated with operations. The description should include the following:

- Type of waste streams. Typical liquid-waste generation comes from cooling-water blowdown, auxiliary-boiler blowdown, water-treatment wastes, discharge from floor and equipment drains, stormwater runoff, effluents from the sanitary sewage-treatment system, and facility and vehicle maintenance activities.

- Actions to address waste streams, including waste minimization and treatment, recycling, storage, and disposal.

- Federal, State, and local codes and regulations that address liquid waste, including any permits necessary for liquid-waste disposal at the site.

The applicant should then describe the expected impacts on water resources associated with the releases of nonradioactive waste.

5.9.3 Impacts on Air

The applicant should describe nonradioactive gaseous waste streams associated with operations. Identify if these impacts have been addressed under Air Resources Impacts. The description should include the following:

- Type of waste streams. Typical gaseous waste generation comes from emissions from the combustion of fossil fuels, volatile emissions from those fuels, and other volatile organic compounds from the use of materials such as paints, oils, and solvents.

- Actions to address waste streams, including any emission-control systems and waste minimization.

- Federal, State, and local codes and regulations that address gaseous emissions. Include any permits necessary for liquid-waste disposal at the site.

The applicant should then describe the expected impacts on air quality associated with the emissions of nonradioactive waste.

5.10 Environmental Impacts of Postulated Accidents

The applicant should evaluate the radiological consequences to the environment from potential accidents at the proposed site. The term “accident” refers to any off-normal event due to equipment failure or malfunction that results in the release of radioactive materials into the environment. The evaluation should be site-specific and focus on events that could lead to releases substantially in excess of permissible limits for normal operations (i.e., design-basis accident [DBAs] and severe accidents). Severe accident mitigation alternatives (SAMAs) should be evaluated to determine if there are any procedures, training activities, or plant-design alternatives (i.e., severe accident mitigation design alternatives [SAMDAs]) that could significantly reduce environmental risks at the site. As discussed below, the applicant’s evaluation should be performed in accordance with the current version of NRC guidance documents.

5.10.1 Design-Basis Accidents

DBAs are evaluated in the FSAR and include a spectrum of events that the plant should be designed specifically to accommodate. DBA analyses have a direct impact on the design of safety-related systems, structures, and components that are designed to ensure adequate protection of the public health and safety. These safety analyses are intentionally performed in a very conservative manner to compensate for uncertainties in accident progression. The radiological consequences of DBAs are assessed as part of the safety review to demonstrate that the plant can be sited and operated without undue risk to the health and safety of the public.

Due to the conservatisms used in modeling of accident progression and atmospheric transport in the safety evaluation of DBAs in the FSAR, these analyses do not provide a realistic picture of the environmental consequences of accidents that the plant is designed to accommodate. The environmental impacts evaluation of DBAs using realistic assumptions on accident progression and atmospheric transport would be expected to result in estimated dose consequences lower than those documented in the FSAR. Therefore, for the ERs it is appropriate to evaluate the DBAs using the FSAR accident release assumptions in conjunction with realistic atmospheric transport assumptions.

Within the ER, the applicant should evaluate DBAs using site-specific data and realistic meteorology (i.e., 50th percentile atmospheric dispersion) to estimate doses at offsite locations. The radiological consequences of the DBAs are assessed, and the resulting doses compared to relevant dose criteria used in the NRC staff's safety review of DBAs (see NUREG-0800, Chapter 15). The applicant should provide the following information to support the NRC staff's environmental review of DBAs:

- list and description of each DBA being considered as having a potential for releases to the environment; the DBAs should be consistent with the DBAs listed in applicable guidance (e.g., those described in RG 1.183, "Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Plants"), and analyzed in the FSAR

- time-dependent isotopic activities (i.e., the source term) released to the environment for each DBA

- estimated doses for each DBA using realistic (i.e., 50th percentile) atmospheric dispersion factors (χ/Q values) for the site (see Chapter 2 of this RG), taking into account the following:

    - For the EAB, the dose should be calculated for a 2-hour period.

    - For the LPZ, the dose should be calculated for the course of the accident (i.e., 30 days, including 0–8 hours, 8-24 hours, 1–4 days, 4–30 days).

    - comparison of the DBA doses with review dose criteria given in regulations related to the application (e.g., 10 CFR 50.34(a)(1), 10 CFR 52.17(a)(1), and 10 CFR 52.79(a)(1) SRPs (i.e., SRP criteria, Table 1 in SRP Section 15.0.3 of NUREG-0800) and RGs, (e.g., RG 1.183), as applicable.

- conclusion on the degree of environmental impact caused by postulated DBAs at this site.

5.10.2 Severe Accidents

The applicant should evaluate the mean environmental (i.e., individual, population, economic, and contaminated land area) probability-weighted consequences, or risks, of severe accidents involving

radioactive material within a 50 mi (80 km) radius of the site. Severe accidents involve multiple failures of equipment or function and, therefore, the likelihood of occurrence is lower for severe accidents than for DBAs; however, the consequences of such accidents may be higher. The risks for specific severe accident types are defined as the product of the probability of that type of accident occurring multiplied by the estimated consequences for that type of accident. Severe accident types (or major release categories), source terms, and associated probabilities (i.e., core damage frequencies) are reactor-specific and determined from the design (i.e., Level 1 and Level 2) probabilistic risk assessment (PRA).

The Level 1 and Level 2 PRAs should be consistent with NRC staff's safety review guidance for PRAs (see SRP Chapter 19 of NUREG-0800). The site-specific environmental risks of severe accidents (i.e., Level 3 PRA) should consider all severe accident types from the Level 1 PRA and apply all source terms from the Level 2 PRA. The Level 2 PRA information for the transition from radioactive material release to Level 3 PRA needs to have clear traceability of the release category quantifications back to the radioactive material release analysis. This would ensure that the necessary event information (e.g., event frequencies, source term release fractions and plume segments) from internally initiated events, fire events, flooding events, low power and shutdown events, and externally initiated events that could affect the Level 3 PRA analysis is provided in a suitable form for the NRC staff environmental review.

The ER should estimate the risks applying an acceptable methodology that uses onsite and regional meteorology, population, and land use data (see Chapter 2 of this RG for relevant site-specific meteorological, population and land use guidance.) Relevant environmental pathways that lead to radiation dose should be considered in the consequence assessment, including the air, ground, food, surface water, and groundwater. The applicant should provide the following information to support the NRC staff's environmental review of severe accidents:

- reference for the reactor design and the associated PRA (through Level 2) used in the severe accident risk analysis.

- list of severe accident release sequences and their associated core damage frequencies (CDFs) from the Level 1 PRA and source terms for internally initiated events, fire events, flooding events, low power and shutdown events, and externally initiated events as are appropriate for the application (e.g., high winds and other external hazards) as determined from the Level 2 PRA.

- description of the methodology used to estimate site-specific severe accident risks (i.e., Level 3 PRA), including the computer code(s) to be used in the analyses, such as MELCOR Accident Consequence Code System (MACCS) code package (see NUREG/CR-6613, "Code Manual for MACCS2: Users Guide, Volume 1").

- sufficient descriptions of key models, assumptions, parameters, conditions, input data, resulting output, and approaches to allow for NRC staff's evaluation. If there is relevant information in other supporting documentation (i.e., FSAR, DCD, or other references), indicate where in those documents this information can be found.

- description of the meteorological data and years used in the analysis and an estimate of severe accident population dose risks from the air pathway.

- description of any emergency response scenarios, including evacuation, sheltering, and dose-dependent relocation assumptions used in the analysis.

- description of the population data used in the analysis based on the 80 km (50 mi) population estimate for the year operation is expected to cease.

- description of the land use characterization (e.g., farmland) and land fractions used in the analysis and an estimate of the contaminated land area risks from severe accidents.

- description of the food pathway model information for the nuclides to be considered, crop categories to be used, transfer factors, and possible mitigative actions.

- description of the economic input data (e.g., land values, relocation costs, and cleanup costs) used in the analysis and an estimate of the economic cost risks from severe accidents.

- description of surface-water users and watershed data used in the analysis and an estimate of severe accident population dose risks from the surface-water pathway.

- description of aquifers used in the analysis and an estimate of severe accident population dose risks from the groundwater pathway.

- description of the comparison of the CDFs estimated for the reactor to those for current-generation reactors and the comparison of the population dose risks to the mean and median values for current-generation reactors undergoing license renewal.

- description of individual (i.e., early fatality and latent cancer) risks and population dose risks from severe accidents; these risks should be compared to the Commission's Safety Goals (51 FR 30028) and with dose risks from routine and anticipated operational releases.

- description of the methodology used to estimate site-specific accident risks (i.e., Level 3 PRA) including the computer code applied, such as MACCS code package.

- description of the parameter information applied in the Level 3 PRA. Note that NUREG/CR-4551, "Evaluation of Severe Accident Risks: Quantification of Major Input Parameters," demonstrates the development of the parameter information for the offsite environmental risk analysis of severe accidents (i.e., Level 3 PRA) that supported NUREG-1150, "Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants."

The applicant should evaluate SAMAs, including procedures, training activities, and plant-design alternatives (i.e., SAMDAs), that could significantly reduce the environmental risks from a severe accident. SAMAs can reduce risk by preventing substantial core damage or by limiting radiological releases from containment in the event of substantial core damage. The current regulations and staff guidance discussed in this section and developed after the Limerick decision (*Limerick Ecology Action vs. NRC,* 1989, 869 F.2d 719, 3d Cir. 1989) directs the NRC staff to consider SAMAs for new reactor licensing actions. Therefore, a SAMA evaluation is required in ERs for combined licenses.

In preparing SAMA analyses, the applicant should apply the latest regulatory guidance as it relates to the determination and estimation of values and impacts, including a sensitivity analysis (e.g., see the current NRC cost-benefit regulatory analysis guidance). Values are the potential benefits of implementing the SAMA and are usually calculated for public health, occupational health, offsite property, and onsite property (see the prior discussion on severe accident analyses). The applicant should apply both a best estimate, or baseline, 7 percent and a sensitivity 3 percent real discount rate as specified by Office of Management Budget in "Regulatory Analysis," and in the current NRC cost-benefit regulatory analysis guidance as part of the value determination. Impacts are the costs of implementing the SAMA. In addition, the applicant could consider methods and processes used in past applications as well as relevant industry guidance on SAMA analysis (e.g., the selection of SAMAs based on NEI 05-01,

Revision A, "Severe Accident Mitigation Alternatives (SAMA) Analysis, Guidance Document."). [10] For those situations that are relevant to the quality of the Level 2 PRA being considered in the application, include design-specific PRA information for consideration of potential design improvements, as provided by 10 CFR 50.34(f).

The applicant should provide the following information to support the NRC staff's environmental review of SAMAs:

- reference for the reactor design and the associated PRA used in the SAMA analysis;
- list of leading contributors to the reactor design core damage frequency (e.g., from dominant severe accident sequences or initiating events) and site-specific risks (e.g., population dose) for each release class and associated source term for both internal and external events;
- methodology, process, and rationale used to identify, screen, and select SAMAs that can reduce severe accident dose consequence risk, considering internal events, fire, flooding, low power and shutdown, and external events;
- methodology, process, and rationale used to further analyze any selected SAMAs to determine the amount of risk reduction that the SAMA could reasonably achieve;
- estimated cost and risk reduction for the selected SAMAs and the assumptions used to make these estimates; and
- description and list of any SAMAs that have been or will be implemented to prevent or mitigate severe accidents or reduce the risk of a severe accident.

5.11 Measures and Controls to Limit Adverse Impacts during Operation

Environmental measures and controls may be required by Federal, State, and local agencies during operation to minimize effects to the environment (10 CFR 51.50(a)). The applicant should furnish details of the programs and compliance activities with which it plans to monitor operation activities affecting site-related environmental resources and quality. The applicant should also describe the frequency of these efforts. The applicant should state the specific nature of its control programs and the control procedures it intends to follow as a means of implementing adherence to environmental quality control limits, as applicable. A description of the measures and monitoring required for conformity to Federal, State, and local environmental regulations and laws should also be provided for each resource area.

[10] NEI 05-01, Revision A, "Severe Accident Mitigation Alternatives (SAMA) Analysis, Guidance Document" provides a template for completing SAMA analysis in support of reactor license renewal. If applied as a guidance document for new reactor applications, the applicant should justify its use in the ER.

Table 5-7 on the following page is an example of the measures and controls for environmental impact categories.

Table 5-7. Summary of Measures and Controls to Limit Adverse Impacts during Operation

Impact Category	Planned Measures and Controls During Operation
Land Use Impacts	
Site and Vicinity	Measures and controls that minimize impacts
Transmission Corridors	Measures and controls that minimize impacts
Offsite Areas	Measures and controls that minimize impacts
Water-Related Impacts	
Hydrologic Alterations	Measures and controls that monitor surface waters and flow and groundwater
Water Use	Measures and controls that monitor use of surface-water and groundwater resources
Water Quality	Measures and controls that monitor and minimize impacts on surface water and groundwater
Ecological Impacts	
Terrestrial Ecosystems	Measures and controls to monitor and minimize impacts on terrestrial resources (including wetlands) onsite, offsite, and special permitting that may be required for managed species
Aquatic Ecosystems	Measures and controls to monitor and minimize impacts on aquatic resources onsite, offsite, and special permitting that may be required for managed species
Socioeconomic Impacts	Community traffic and access to public services measures
Historic and Cultural Resources	Measures for identification, consultation, and preservation following discovery
Air Resources	Controls to monitor and minimize dust, emissions
Nonradiological Health	Measures and controls for worker safety during operation and maintenance activities
Radiation Exposure	Controls and monitoring for minimization of dose to workers, the public, and biota
Nonradioactive Waste	Disposal plan for solid, liquid, gaseous wastes, and sanitary waste generated
Accidents	Controls and measures for minimization of impacts

Chapter 6

6.0 Fuel Cycle, Transportation, and Decommissioning Impacts

The ER should address the environmental impacts from the uranium fuel cycle and solid waste management, the transportation of radioactive material, and the decommissioning of the proposed nuclear plant.

The applicant should summarize information provided in Chapter 3.0 of this RG on the vendor and type of reactors that are proposed in the application, and the power rating in megawatts thermal. The applicant should also provide the assumed capacity factor.

6.1 Fuel Cycle Impacts and Waste Management

The applicant should discuss the environmental impacts from the uranium fuel cycle and solid waste management for the appropriate LWR design. The environmental impacts of this design are evaluated against specific criteria for LWR designs in 10 CFR 51.51, "Uranium fuel cycle environmental data—Table S–3."

The regulations in 10 CFR 51.51(a) state that:

> Under §51.50, every environmental report prepared for the CPs stage or early site permit stage or COLs stage of a light-water-cooled nuclear power reactor, and submitted on or after September 4, 1979, shall take Table S-3, Table of Uranium Fuel Cycle Environmental Data, as the basis for evaluating the contribution of the environmental effects of uranium mining and milling, the production of uranium hexafluoride, isotopic enrichment, fuel fabrication, reprocessing of irradiated fuel, transportation of radioactive materials and management of low-level wastes and high-level wastes related to uranium fuel cycle activities to the environmental costs of licensing the nuclear power reactor. Table S-3 shall be included in the environmental report and may be supplemented by a discussion of the environmental significance of the data set forth in the table as weighed in the analysis for the proposed facility.

The applicant should provide the following information in the ER:

- The type of fuel and the enrichment that will be used in the proposed reactor and whether the type of fuel is appropriate for analysis of environmental impacts against Table S-3 in 10 CFR 51.51(b).

- Using the Table S–3 values that are normalized for a reference 1,000 MW(e) LWR at an 80 percent capacity factor, the applicant should provide the power rating for the each of the proposed units according to the vendor power rating and the assumed capacity factor.

In its ER, the applicant should provide an assessment of the environmental impacts of the fuel cycle as related to the operation of the proposed project based on the values given in the current Table S-3 as well as the radiological impact from radon-222 and technetium-99 as described in the NUREG-1437 (Initial), Addendum 1, and NUREG-1437, Revision 1.[11]

6.1.1 Land Use

For the fuel cycle supporting the 1,000 MW(e) LWR-scaled model, considering the number of units, the power rating, and the capacity factor, the ER should provide the following:

- total annual land requirement,
- approximate number of acres that are permanently committed land, and
- approximate number of acres that are temporarily committed and the number of those acres undisturbed and disturbed.

6.1.2 Water Use

For the fuel cycle supporting the 1,000 MW(e) LWR-scaled model, considering the number of units, the power rating, and the capacity factor, the ER should provide the following:

- the total annual water use (in gal or m^3) required to remove waste heat from the power stations supplying electrical energy to the enrichment step of this cycle, and
- other water uses that involve the discharge to air (e.g., evaporation losses in process cooling) (in gal/yr or m^3/yr) and water discharged to the ground (e.g., mine drainage, deep well injection) (in gal/yr or m^3/yr).

6.1.3 Fossil Fuel Impacts

For the fuel cycle supporting the 1,000 MW(e) LWR-scaled model, considering the number of units, the power rating, and the capacity factor, the ER should provide the following:

- A comparison of direct and indirect consumption of electric energy for fuel cycle operations.
- A discussion of the largest use of electricity in the fuel cycle.
- Estimates of GHG emissions (expressed in units of CO_2 equivalents) resulting from the fuel cycle, including uranium mining and milling, the production of uranium hexafluoride, isotopic enrichment, fuel fabrication, reprocessing of irradiated fuel, transportation of radioactive materials and management of low-level wastes and high-level wastes. The applicant should compare these GHG emissions to State and national GHG emissions. The applicant may provide either site-specific estimates or refer to the generic GHG footprint for a 1,000 MW(e) reactor. The analysis should be adjusted according to the proposed action (number of units, electrical output). The assumptions, factors, and other information used in any site-specific analysis should

[11] The License Renewal GEIS (NUREG-1437) was originally issued in 1996. Addendum 1 was issued in 1999. NUREG-1437, Revision 1, was issued in June 2013. The version of NUREG-1437 cited, whether 1996 or 2013, or Addendum 1 in 1999, is the version in which the relevant technical information is discussed. NUREG-1437, Revision 1 is cited in cases in which the relevant technical information is discussed in both documents.

be described in sufficient detail to allow an independent evaluation and assessment of the resulting GHG emissions estimate.

6.1.4 Chemical Effluents

For the fuel cycle supporting the 1,000 MW(e) LWR-scaled model, considering the number of units, the power rating, and the capacity factor, the ER should provide the following:

- A comparison of the principal effluents (i.e., sulfur oxides, nitrogen oxides, and particulates) for the estimated MWh of electricity for the proposed plant against the most current estimate of MWh of electricity generated in the United States. This value should be a percentage. For example, if the proposed 1,000 MW(e) plant required 969,000 MWh of electricity a year and the United States produced 4.1 billion MWh of electricity in a year, then the proposed plant would produce 0.024 percent of the generated MWh in the United States and therefore the chemical effluents from the fuel cycle processes to support the proposed plant would be 0.024 percent of the national gaseous and particulate chemical effluents for a year of electricity generation.

- An assessment of the liquid chemical effluents produced in the fuel cycle processes.

- An assessment of the tailings solutions and solids generated during the milling processes.

6.1.5 Radiological Effluents

For the fuel cycle supporting the 1,000 MW(e) LWR-scaled model, considering the number of units, the power rating, and the capacity factor, the ER should provide the following:

- The estimated total overall whole body gaseous dose commitment and the whole body liquid dose commitment (in person-rem or person-sieverts) from the fuel cycle, excluding reactor releases and dose commitments because of the exposure to radon-222 and technetium-99.

- An estimate of the 100-year environmental dose commitment to the U.S. population (in person-rem or person-sieverts) for both the gaseous and liquid pathway from the fuel cycle.

- The estimated releases of radon-222 (in curies or becquerels) based on the 1996 version of NUREG-1437. This includes the percent that would be from mining and milling operations, and inactive tails before stabilization, as well as the radon releases (in curies or becquerels) from stabilized tailings.

- An estimate of the 100-year dose commitment from radon-222 to the whole body (in rem or sieverts) using the organ-specific dose-weighting factors from 10 CFR Part 20, “Standards for Protection Against Radiation.”

- An estimate of the 100-year dose commitment from mining, milling, and tailings before stabilization for each site year and an estimate of the 100-year environmental dose commitment from stabilized tailings piles (in rem or sieverts).

- Following the methodology in the 1996 version of NUREG-1437, Section 6.2.2 Uranium Fuel Cycle Environmental Impact, an estimate of the releases of technetium-99 (in curies or becquerels) from the chemical processing of recycled UF6 before it enters the isotope enrichment cascade and the release to the groundwater (in curies or becquerels) from a repository.

- The total body 100-year dose commitment from technetium-99 to the whole body (in rem or sieverts) determined by applying the organ-specific dose-weighting factors from 10 CFR 20.1003 to the gastrointestinal tract and kidney.

6.1.6 Radiological Wastes

For the fuel cycle supporting the 1,000 MW(e) LWR-scaled model, considering the number of units, the power rating, and the capacity factor, the ER should describe the following:

- The annual total number of curies from low-level reactor solid wastes and if it is within the bounds of the estimated total of curies of solid waste identified in Section 3.4.2, Radioactive Waste Management.

- Being cognizant of the analysis in NUREG-2157 "Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel. Final Report" describe the plans for offsite storage of spent fuel.

6.1.7 Occupational Dose

For the fuel cycle supporting the 1,000 MW(e) LWR-scaled model, considering the number of units, the power rating, and the capacity factor, the ER should provide the annual occupational dose attributable to all phases of the fuel cycle for the 1,000 MW(e) LWR-scaled model. This is based on a 600-person-rem occupational dose estimate attributable to all phases of the fuel cycle for the model 1,000 MW(e) LWR (see 1996 version of NUREG-1437, Section 6.2.2.3 Occupational Dose).

6.1.8 Transportation Dose

The annual transportation dose to workers and the general public for the uranium fuel cycle for the reference 1,000 MW(e) LWR is 2.5 person-rem per Table S–3 in 10 CFR 51.51. For the fuel cycle supporting the 1,000 MW(e) LWR-scaled model, considering the number of units, the power rating and the capacity factor, the ER should provide the following:

- The corresponding transportation dose for the proposed reactor(s) (in rem or sieverts).

- The collective transportation dose for the population within 80 km (50 mi) of the site for the year operation is expected to start. Using 311 mrem/yr as the average dose to a U.S. resident from natural background radiation (NCRP Report No. 160), determine the collective dose to the same population and compare the two collective doses (in person-rem or person-sieverts).

6.2 Transportation of Fuel and Wastes

The NRC performed a generic analysis of the environmental effects of the transportation of fuel and waste to and from LWRs in the "Environmental Survey of Transportation of Radioactive Materials To and From Nuclear Power Plants," WASH-1238, and in Supplement 1 to WASH-1238, NUREG-75/038, and found the impact to be small. These documents provided the basis for Table S-4 in 10 CFR 51.52, "Environmental effects of transportation of fuel and waste," which summarizes the environmental impacts of transportation of fuel and waste to and from one 3,000 to 5,000 MW(t) [1,000 to 1,500 MW(e)] LWR. Impacts are provided for normal conditions of transport and accidents in transport for a reference 1,100 MW(e) LWR. Dose to transportation workers during normal transportation operations was estimated to result in a collective dose of 4 person-rem per reference reactor-year. The combined dose to the public along the route and the dose to onlookers were estimated to result in a

collective dose of 3 person-rem per reference reactor-year. The environmental risk of radiological effects from accidents in transport, as stated in Table S-4, is small. The environmental risk of common (nonradiological) causes from accidents in transport was one fatal injury in 100 reference reactor-years and one nonfatal injury in 10 reference reactor-years.

The NRC has generically considered the environmental impacts of spent nuclear fuel with uranium-235 enrichment levels up to 5 percent and irradiation levels up to 62,000 MWd/MTU and found that the environmental impacts of spent nuclear fuel transport are bounded by the impacts listed in 10 CFR 51.52, Table S-4, provided that more than 5 years has elapsed between removal of the fuel from the reactor and shipment of the fuel offsite (see NUREG-1437, Revision 1). However, these analyses apply to license renewal and cannot serve as the initial licensing basis for new reactors.

In accordance with 10 CFR 51.52(a), the ER shall contain a statement concerning transportation of fuel and radioactive wastes to and from the reactor. A full description and detailed analysis of transportation impacts are not required when licensing a LWR, if the reactor meets the following criteria:

- The reactor has a core power level that does not exceed 3,800 MW(t).
- Fuel is in the form of sintered uranium oxide pellets having a uranium-235 enrichment not exceeding 4 percent by weight; and pellets are encapsulated in zirconium alloy-clad fuel rods.[12]
- The average level of irradiation of fuel from the reactor does not exceed 33,000 MWd/MTU and no irradiated fuel assembly is shipped until at least 90 days after it is discharged from the reactor.
- With the exception of irradiated fuel, all radioactive waste shipped from the reactor is packaged and in solid form.
- Unirradiated fuel is shipped to the reactor by truck; irradiated (spent) fuel is shipped from the reactor by truck, railcar, or barge; and radioactive waste other than irradiated fuel is shipped from the reactor by truck or railcar.

If the transportation of fuel and waste to and from nuclear power reactors meets the criteria listed in 10 CFR 51.52(a), the ER need only contain a statement that the environmental impacts are as set forth in Table S-4 of 10 CFR Part 51. No further discussion of such environmental effects is required in the ER.

If the transportation of fuel and waste to and from nuclear power reactors does not meet the criteria listed in 10 CFR 51.52(a), 51.52(b) requires a full description and detailed analysis of the environmental impacts of transportation of fuel and wastes to and from the reactor, including values for the environmental impact under normal conditions of transport and for the environmental risk from accidents in transport, is required.

[12] Regulations in 10 CFR 51.52(a)(2) specify the use of zircaloy as the fuel rod cladding material. The NRC has also specified in 10 CFR 50.46 that ZIRLO™ is an acceptable fuel rod cladding material, and that with regard to the potential environmental impacts associated with the transportation of the M5® clad fuel assemblies, the M5® cladding has no impact on previous assessments determined in accordance with 10 CFR 51.52 (65 FR 794).

6.2.1 Components of a Full Description and a Detailed Analysis of Transportation Impacts

A full description and detailed analysis of transportation impacts should include the following:

- Transportation of unirradiated fuel. The analysis should include the radiological impacts associated with the normal conditions of transport and the nonradiological impacts associated with transportation accidents.

- Transportation of irradiated fuel. The analysis should include the radiological impacts associated with the normal conditions of transport and the radiological and nonradiological impacts associated with transportation accidents.

- Transportation of radioactive waste. The analysis should include the radiological impacts associated with the normal conditions of transport and the nonradiological impacts associated with transportation accidents.

The transportation impacts analysis should use the latest versions of transportation computer codes. For example, SAND2013–8095, "RADTRAN 6/RadCat 6 User Guide," and ORNL/NTRC-006, Revision 0, "Transportation Routing Analysis Geographic Information System (TRAGIS) User's Manual." The following data should be provided in the ER:

- reactor type and rated core thermal power

- fuel assembly description

- average irradiation level of irradiated fuel

- the capacity of the onsite storage facilities to store irradiated fuel and the minimum fuel storage time between removal from the reactor and transportation offsite

- treatment and packaging procedures for radioactive wastes other than irradiated fuel

- general description of transportation packaging systems to be used for fresh fuel, spent fuel, and other radioactive wastes (e.g., packaging system capacity, approximate dimensions, and weight)

- radiation dose rates for loaded packages

- shipping route information based on the locations of fuel fabrication facilities and potential destinations for shipments of spent fuel and radioactive waste

- transport mode for new fuel shipment to the plant

- transport mode for irradiated fuel shipments offsite

- transport mode for other radioactive waste shipments offsite

- shipping route data (e.g., distances and population densities in urban, suburban, and rural population density zones by State) from the fuel fabrication plant to the reactor and from the reactor to the facilities to which irradiated fuel and radioactive waste will most likely be sent, if applicable

- average heat load for irradiated fuel casks in transit

- maximum gross vehicle weight for truck and rail shipments of unirradiated fuel, spent fuel, and radioactive waste

The methods and data used to estimate transportation impacts should be described and the following should be provided:

- Descriptions of the method(s) used to estimate routine (incident-free) radiological impacts, including impacts on populations and MEIs.

- Descriptions of the method(s) used to estimate accident nonradiological and radiological impacts, including nonradiological traffic accidents, injuries, and fatalities, and radiological accident risks. Nonradiological impacts should be estimated using round-trip distances.

- Specification of input parameters and sources used in the impact assessment. Parameters and source documents should be defensible, and where assumptions are used to fill in missing or highly uncertain data, the assumptions should be conservative and reasonable (i.e., the assumptions tend to overstate transportation impacts yet are not so conservative that they could mask the true environmental impacts of the reactor and lead to invalid conclusions).

- Presentation of results, including population doses, maximally exposed individual doses, and health effects for transportation crews and the general public for the following:

    - Workers and the public under normal transport conditions. Results should be presented for workers, onlookers, and persons along the route.

    - Maximally exposed individuals under normal transport conditions. Results should be presented for truck crew members, inspectors, residents along the transport routes, and persons at a truck service station.

    - Annual radiological and nonradiological transportation impacts. Results should be presented for the proposed site and the alternative sites.

- sufficient descriptions of key models, assumptions, parameters, conditions, input data, resulting output, and approaches used to estimate transportation impacts to allow for NRC staff's evaluation. If there is relevant information in other supporting documentation (i.e., FSAR, DCD, or other references), indicate where in those documents this information can be found.

6.2.2 Estimating the Number of Shipments and Normalization of Shipments

The impacts presented in Table S-4 are based on WASH-1238, and in Supplement 1 to WASH-1238, NUREG 75/038 for a 1,100 MW(e) LWR with an 80 percent capacity factor. To facilitate comparison of transportation impacts with the impacts presented in Table S-4, the number of shipments should be normalized to a 1,100 MW(e) LWR with an 80 percent capacity factor or a net electrical output of 880 MW(e):

$$\textbf{Normalized Shipments} = \frac{\textbf{Shipments}}{\textbf{Reactor MW(e)x Capacity Factor}} \textbf{ x 880 MW(e)}$$

In addition to normalizing the number of shipments to the 880 MW(e) reference reactor, for shipments of irradiated fuel, a transportation cask capacity of 0.5 MTU per shipment should be used to estimate the number of shipments. For shipments of radioactive waste, the number of shipments should be normalized to the 880 MW(e) reference reactor and a shipment capacity of 2.34 m^3 per shipment should be used to estimate the number of shipments.

For shipments of unirradiated fuel, the ER should first estimate the total number of shipments over a 40-year plant license, accounting for the initial core load plus average annual reloads for a period of 39 years.

$$\text{Total Shipments} = \text{Initial Core Shipments} + 39 \times \text{Average Annual Reload Shipments}$$

The number of shipments should then be normalized to the 880 MW(e) reference reactor and the annual number of shipments estimated assuming a 40-year plant license.

6.3 Decommissioning

At the end of the operating life of a power reactor, NRC regulations require that the facility undergo decommissioning. In 10 CFR 50.2 "Definitions" and 10 CFR 52.1 "Definitions," decommission means to remove a facility or site safely from service and reduce residual radioactivity to a level that permits - (1) Release of the property for unrestricted use and termination of the license; or (2) Release of the property under restricted conditions and termination of the license. The regulations governing decommissioning of power reactors are found in 10 CFR 50.75, "Reporting and recordkeeping for decommissioning planning," 10 CFR 50.82 "Termination of license" and 10 CFR 52.110, "Termination of license." The radiological criteria for termination of the NRC license are in 10 CFR Part 20, Subpart E. Requirements relating to the minimization of contamination and generation of radioactive waste in facility design and procedures for operation are addressed in 10 CFR 20.1406, "Minimization of contamination." Requirements for applicants for a COL to provide reasonable assurance that funds will be available for the decommissioning process are given in 10 CFR 50.75(b).

The NRC has developed NUREG-0586, "Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities: Supplement 1, Regarding the Decommissioning of Nuclear Power Reactors," (Decommissioning GEIS). At the time of decommissioning, if the predicted environmental impacts from decommissioning activities fall within the bounds of this GEIS or of another EIS related to the facility then no site-specific analysis will be required. For any decommissioning activity that does not meet these conditions, the regulations at 10 CFR 50.82 (a)(6)(ii) "Termination of license" and 10 CFR 52.110 (f)(2) state that licensees "shall not perform any decommissioning activities…that (2) result in significant environmental impacts not previously reviewed" and therefore prohibits the licensee from undertaking the activity until it performs a site-specific analysis of the activity.

In the ER, an applicant should address the following:

- Whether the proposed reactor designs fall within the bounds of the current Decommissioning GEIS. If the proposed design is outside the design envelope evaluated in the current version of the Decommissioning GEIS, then the applicant should address how the design could affect the impact conclusions presented in the Decommissioning GEIS.

- Air quality impacts from GHG emissions associated with plant decommissioning. The description should include the following:

- Estimates of GHG emissions (expressed in units of CO_2 equivalents) over the decommissioning period, including GHG emissions associated with decommissioning equipment and workforce commuting. The applicant may provide either site-specific estimates or refer to the generic GHG footprint for a 1,000 MW(e) reactor. SAFSTOR emissions may be added if the applicant plans on using this decommissioning option. Assumptions, factors, and other information sufficient to allow an independent evaluation and assessment of the GHG emission estimate.

- Reference the section in the application that certifies that sufficient funds will be available to provide for radiological decommissioning in accordance with 10 CFR 50.75(b)(1) and required by 10 CFR 50.33(k)(1).

Chapter 7

7.0 Cumulative Impacts

In this chapter, the applicant should describe any past, present, and reasonably foreseeable future actions in the geographic area of interest surrounding the site that would affect the same resources that would be affected by building and operation of the proposed project, regardless of what agency or person would be responsible for such other actions. The basis for the guidance includes 10 CFR 51.45 with respect to the need to discuss cumulative impacts in an ER.

Cumulative impacts are 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. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time. The goal of the analysis is to introduce environmental considerations into the planning process as early as needed to improve decision-making.

The NRC's cumulative impact assessment approach is depicted in Figure 7-1. This figure depicts the resource impact area and geographic area of interest conceptually using simple polygons. However, the actual resource impact areas and geographic area of interests for each environmental resource must be suited both to the resource and the individual action under consideration. The geographic area of interest is defined as the area where other actions occur that could potentially have impacts within the resource impact area. The geographic area of interest may be different for each resource.

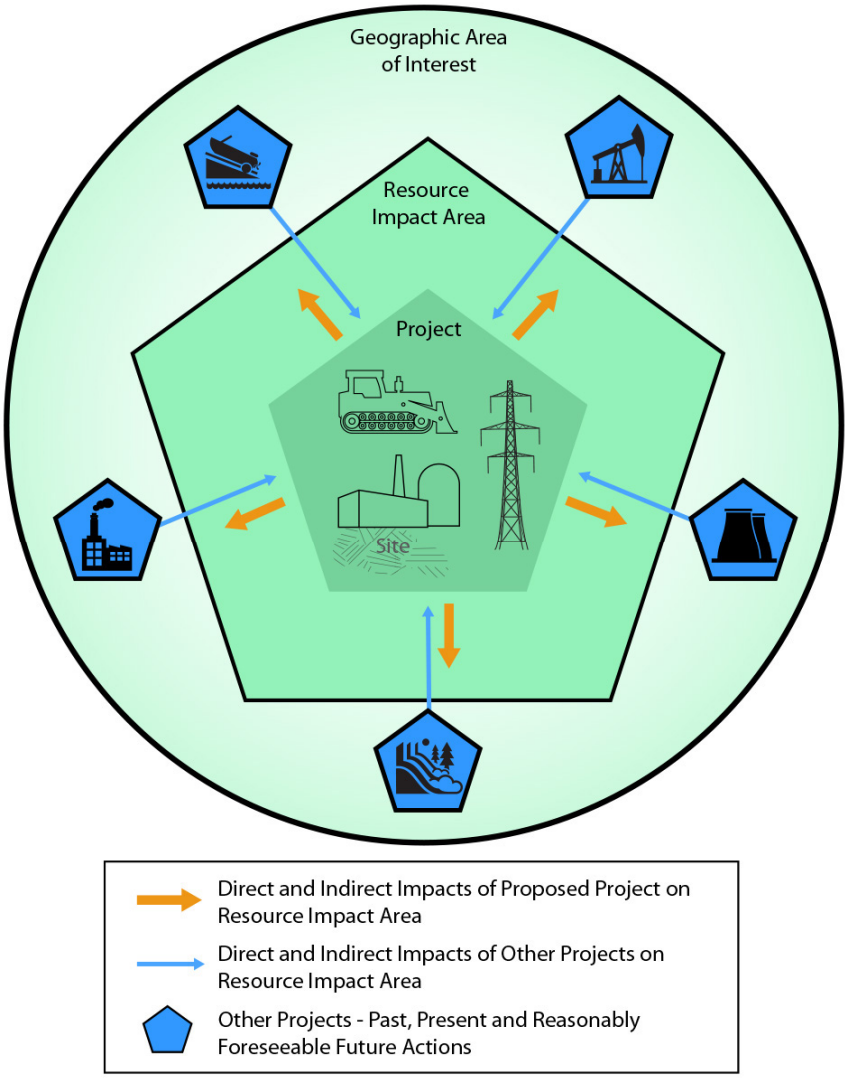

Figure 7-1. NRC Approach to Cumulative Impact Assessment

The ER should address the following information and analysis:

- Complete the list in Table 7-2 of other projects in the geographic area of interest that could contribute to cumulative impacts in the resource impact area.

- A description of those activities within the geographic area of interest that could contribute to cumulative impacts within the resource impact area for each specific resource area.

CEQ guidance, "Considering Cumulative Effects under the National Environmental Policy Act," recommends applying natural ecological or socio-cultural boundaries to the resource impact area. Possible boundaries that could be used to determine the appropriate geographic area for a cumulative impact analysis are in Table 2-2 of the CEQ Guidance. The EPA guidance in EPA Publication 315-R-99-002, "Consideration of Cumulative Impacts in EPA Review of NEPA Documents," recommends that the scope of the cumulative impacts analysis include geographical areas that sustain the resources of concern, but not be extended to the point of becoming unwieldy. Geographical proximity to the proposed action should be considered but should not be used to exclude consideration of other actions.

Jurisdictional borders are sometimes useful in defining the geographic area of interest for resource areas such as land use and some socioeconomic areas; however, this approach may not be appropriate for defining the geographical area for ecological resources for which jurisdictional borders may not correspond to a reliable definition of a resource, such as aquatic ecology. Table 7-1 provides general guidance for each resource on what the appropriate resource impact areas may be. However, professional judgment is needed in selecting resource impact area for a particular resource at a specific site.

Table 7-1. Resource Impact Area by Specific Resource

Resource	Resource Impact Area
Land Use	The resource impact area should encompass the site, the vicinity, and the extent of offsite areas and transmission-line corridors, pipelines, and other elements of the proposed project.
Water Use and Quality	The resource impact area should reflect the use of surface-water and groundwater sources by the project and by other projects in the vicinity of the site.
Terrestrial Ecology	At a minimum, the resource impact area should encompass the site, any offsite parcels or corridors, and related segments of the surrounding landscape. The resource impact area should also encompass any parcels recognized early in the project design process as likely to be used for mitigation activities. A radial distance from the site, such as 6 mi (i.e., the distance used by the NRC to define the project's vicinity) may be used for terrestrial impacts, if appropriate. If one or more corridors extend farther than the selected radial distance, then the resource impact area should include the extended linear corridors such as transmission lines or pipelines.
Aquatic Ecology	The resource impact area should be defined using criteria appropriate to the particular characteristics of the resource, such as salinity regimes, watersheds, substrate, or other environmental characteristics that define suitable habitat ranges and preferences of aquatic resources in the area affected by the project. The resource impact area also includes those areas (such as impoundments or facilities affecting water quality) that have or will add to the incremental effects of the project on aquatic habitats.
Socioeconomics	The resource impact area should encompass the areas of effect and the distances at which impacts of building and operating over the expected license term may occur. The scope will depend on the extent of project activities but normally would include the site, the local community and the economic region identified in Chapter 2.0.
Historic and Cultural Resources	The resource impact area for the cumulative analysis would be the same APE(s) described in Chapter 2.0.
Air Quality	The resource impact area for criteria pollutants is generally the county where the licensing activity is taking place.
Nonradiological Health	The resource impact area changes based on the type of health effect. For example, electric shocks or chronic EMF exposure is possible at the site and along the transmission corridor, whereas etiological agents are a threat in the vicinity of the thermal discharges.
Radiological Health	The resource impact area is considered to be the area that has the potential to increase radiological exposure at any location within a 50 mi (80 km) radius of the proposed site.
Postulated Accidents	The resource impact area is considered to be the area that has the potential to increase risks at any location within a 50 mi (80 km) radius of the proposed site.
Fuel Cycle, Transportation and Decommissioning	The resource impact area is a 50 mi (80 km) radius around the site.

The timeframe for the analysis incorporates the sum of the effects of the proposed project in combination with past, present, and future actions because impacts may accumulate or develop over time.

- Past timeframe is prior to the receipt of the application. In many cases, discussion of the past actions may entail a brief paragraph telling the story of how the resource has changed to its current condition by describing past actions and, as necessary, referring to the baseline discussion in Chapter 2 of the ER.

- Present timeframe is from the time of the receipt of the application until issuance of the final EIS. The present timeframe is the shortest among the three timeframes and should capture any ongoing actions. Many of the resource areas measure the environment as it currently exists. These measurements capture the cumulative impact on the resource from the past and present projects and should be part of the baseline for the resource in Chapter 2 of the ER.

- Future timeframe is from issuance of the final EIS through building and operation of the proposed new unit(s) as well as decommissioning. Future actions are those that are "reasonably foreseeable;" that is, they are ongoing (and will continue into the future); are funded for future implementation; are included in firm near-term plans; or generally have a high probability of being implemented.

In general, the baseline assessment presented in the affected environment for each resource area (Chapter 2.0) accounts for past and present actions. The direct and indirect impact analyses (Chapters 4.0 and 5.0) address the incremental impacts of building and operation. This chapter references these analyses, and does not need to be repeated in the cumulative impact analysis.

Both the proposed project and other actions may contribute to cumulative impacts. Because cumulative impacts are additive, the analysis of cumulative impacts should concentrate only on resources that are potentially affected by past, present, and reasonably foreseeable actions as well as by building and operations activities at the proposed nuclear plant during the expected timeframe of the project. Note that cumulative effects may result from the accumulation of similar effects or the synergistic interaction of different effects.

7.1 Past, Present, and Reasonably Foreseeable Future Projects

The ER should provide a table listing past and present projects, facilities, or actions in the geographic area of interest that contribute to the current baseline and future status of the resource. The table should also include the reasonably foreseeable future projects that could contribute to cumulative impacts on the resource during building, operation, and decommissioning of the unit(s). This table should include the following:

- project/facility/action name;

- summary description;

- location in relation to the proposed unit(s);

- status (e.g., operational, proposed, ongoing, or existing); and

- environmental resources affected.

Examples of other present or proposed actions include other electric power generation projects, chemical or paper processing facilities, bridges, roads, conservation or restoration areas, reservoirs for water storage, quarries or mines, and transmission lines. For operational projects, the applicant should

indicate whether any changes in the project are anticipated that would result in changes to the project's environmental interface (i.e., a power uprate of a power facility).

Database tools such as NEPAssist, may facilitate the environmental review process and project planning in relation to environmental considerations. The web-based application draws environmental data dynamically from EPA GIS databases and web services and provides immediate screening of environmental assessment indicators for a user-defined area of interest. These features contribute to a streamlined review process that potentially raises important environmental issues at the earliest stages of project development.

The applicant should discuss the resources used to identify and develop the listings of other projects and associated references, including any consultations with Federal, State, regional, and local regulators, and Indian Tribes.

Table 7-2 is an example table for listing the projects within the geographic area of interest. This is only an example. Not all applications will have projects listed in all categories.

Table 7-2. Past, Present, and Reasonably Foreseeable Projects and Other Actions Considered in the Cumulative Analysis

Project Name	Summary of Project	Location	Status
[identify projects other than the proposed project]	[provide short summary of project]	[describe location in relation to proposed project]	[provide status, including citation]
Nuclear Projects			
XXX Unit 1	XXX Unit 1 consists of one XXX-MW(e) nuclear power generating plant.	[describe location in relation to proposed project]	[provide status, including citation]
Other Energy Projects			
Hydroelectric Station	[provide short summary of project]	[describe location in relation to proposed project]	[provide status, including citation]
XXX Natural Gas Plant	[provide short summary of project]	[describe location in relation to proposed project]	[provide status, including citation]
XXX Coal Plant	[provide short summary of project]	[describe location in relation to proposed project]	[provide status, including citation]
Transmission Lines	[provide short summary of transmission system]	[can reference a figure for location]	[provide status, including citation for operational as well as proposed transmission lines]
Mining Projects			
XXX Quarry	[provide short summary of project]	[describe location in relation to proposed project]	[provide status, including citation]

Project Name	Summary of Project	Location	Status
Transportation Projects			
Strategic Corridor System Plan	Strategic system of traffic corridors	[describe location in relation to proposed project]	Planning document with no explicit schedules for projects, however, many strategic corridors coincide with routes that would/could be used for development at the proposed site.
Parks and Aquaculture Facilities			
XXXX Park	XX-ac park	[describe location in relation to proposed project]	Managed by [Federal, State or local agency] (citation)
Other Actions/Projects			
City of XXXX	Municipal water withdrawals from the XX River	[describe location in relation to proposed project]	[provide status, including citation]
Various Hospitals and Industrial Facilities that Use Radioactive Materials	Medical isotopes	[describe location in relation to proposed project]	Operational (citation)
XXX Chemical Plant	[provide short summary of project]	[describe location in relation to proposed project]	[describe location in relation to proposed project]
Various Wastewater Treatment Facilities (WWTF)	Sewage treatment	[describe location in relation to proposed project]	Operational (citation)

The ER should contain:

- a list of EISs concerning projects in the same geographic area of interest as the proposed project;
- a description of anticipated regional changes not associated with an individual project (e.g., future urbanization) that could result in cumulative impacts during building, operation, and decommissioning of the unit(s); and
- a description of how the baseline environment used in Chapters 2.0, 4.0, and 5.0 might change as a result of climate change and a discussion of how impacts discussed in Chapters 4.0 and 5.0 would either increase, decrease or remain the same in this new baseline environment. This information could be contained in this chapter or as its own separate appendix to the ER and should be based on assessments conducted by Federal agencies with a mandate to evaluate the effects of climate change , but applicable regional and local studies conducted by other entities may be included.

7.2 Impact Assessment

The applicant should assess the level of cumulative impacts (adverse and/or beneficial). The impacts analyzed in Chapters 4 and 5 of the ER are brought forward into the ER Chapter 7 cumulative analysis. Typically, one or two sentences describing the impact on the resource from building and operation and referring back to the appropriate chapter is sufficient. The analysis in Chapters 4 and 5 of

the ER will have included the past and present impacts on the resource along with the impacts from the project. The cumulative analysis should focus on the reasonably foreseeable future actions that could have a cumulative impact. The applicant should summarize the principal contributor(s) to cumulative impacts for each resource area and describe the interaction between the cumulative outside stresses and those caused by building or operating the proposed project. The ER should also include a discussion of the incremental contribution of the NRC-authorized activities related to the proposed action (e.g., constructing or operating the proposed plant) in relation to the cumulative impacts.

The ER should also include:

- any plans for mitigation of adverse cumulative impacts, or modification of alternatives to avoid, minimize, or mitigate cumulative impacts;

- mitigation that may be required by Federal, State, and local authorities, including information about restoration actions by separate entities, required mitigation of other projects, or voluntary mitigation and enhancement by the entity taking an action; and

- at the end of the chapter a table summarizing the impact on each resource and mitigation, if any, to reduce the cumulative impact.

Chapter 8

8.0 Need for Power

This section of the RG discusses the exclusive use of the nuclear power reactor for the generation and sale of electricity to the public.

The Atomic Energy Act of 1954 as amended affirmed: ". . . the Commission shall also consider, in determining whether the license should be issued or continued, such other factors, including the need for power in the affected area, as the Commission in its judgment deems necessary to protect the public interest." For environmental purposes, the term "power" refers to the thermal power produced by a reactor for generating electricity or for supplying industrial thermal applications, or both. The Commission reaffirmed the importance of the agency's need-for-power analysis in a 2003 response to a petition for rulemaking:

> The principal benefit of constructing and operating a nuclear power reactor is the electric power it produces. Therefore, absent some need for power, justification for building a facility is problematic (see 68 FR 55905).

The goal of the need-for-power analysis is to demonstrate the power generated by the proposed project will be produced and consumed in a manner consistent with the stated purpose and need of the project. However, as the Commission stated in a 2003 response to a petition for rulemaking (see 68 FR 55905).:

> . . . while a discussion of need for power is required, the Commission is not looking for burdensome attempts by the applicant to precisely identify future market conditions and energy demand, or to develop detailed analyses of system generating assets, costs of production, capital replacement ratios, and the like in order to establish with certainty that the construction and operation of a nuclear power plant is the most economical alternative for generation of power.

The need for electrical power analysis should be limited to the discussion of the supply and demand for electricity from the present to the end of the permit period. Any other primary commodities (e.g., desalinization of water, area or industrial heat) that would be produced by the proposed project should follow the guidance in Appendix C, Section C.2.10. Discussion of ancillary benefits (e.g., reduced greenhouse gas emissions, fuel diversity, or grid stability) should be addressed in the benefit-cost section of the ER.

The need-for-power analysis should fully describe and characterize the physical, geographic, regulatory, and administrative provisions and constraints which affect the current and forecast supply of and demand for power. The analysis should be in sufficient detail to fully demonstrate how the proposed project would supply some or all of the service area's future need for power.

The applicant should explicitly state a feasible future date for commencement of full commercial operation of the proposed project. The need-for-power analysis in the ER should include a table and/or graph characterizing the service area's most recent annual hourly peak (summer or winter, whichever is greater) electricity demand. The analysis should provide information over sufficient historical and projected periods to permit the staff to complete an independent assessment of the need for the power to be provided by the proposed project. The historical data should include sufficient years to identify any trends or anomalous factors that could affect the future demand for electricity. The projected period should include information out to three years beyond the planned commencement of full commercial operation of the project (referred to herein as "the analytical year").

The following sections describe the need-for-power analysis process in greater detail, including information needed to adequately describe the power system, power demand, power supply, and the process for assessing the need for power of the proposed project.

The applicant should identify all sources of data used in the need-for-power analysis in the ER and demonstrate how the data upon which the analysis relies was used. For the NRC staff to rely on the analysis in the ER, the analysis should meet the following four acceptance criteria, as discussed in NUREG-1555:

- Systematic. An analysis that has been performed according to an objective, thorough, methodical, deliberate, and organized manner and that has been presented in a step-wise fashion leading to a logical conclusion supported by the data and reasoning provided.

- Comprehensive. An analysis that is detailed, broad in scope, and includes a sufficient number of relevant factors so that the reviewer can reasonably conclude that the analysis may be considered "complete." The depth of analysis and discussion for each factor is commensurate with its relative importance.

- Subject to confirmation. An analysis that is independently reviewed or confirmed by another entity (e.g., Federal or State reviews of integrated resource plans, State certificate of necessity proceedings, Federal Energy Regulatory Commission reviews, or independent system operator [ISO] or regional transmission organization [RTO] reports).

- Responsive to forecasting uncertainty. A stable and robust methodology that is not unduly affected by the presence of outliers or other small departures from the modeled assumptions yet remains capable of characterizing the relative importance of uncertainty among input variables during sensitivity analyses.

The applicant may use any data and supporting information it chooses, but the data and information chosen should support an analysis that meets the NRC's four acceptance criteria. Typical sources include:

- recent demand for power reports or analyses such as annual integrated resource plans, ISO or RTO power market analyses

- State utility regulatory filings

- other regional reports or resource assessments completed by an entity other than the applicant

If analyses from external sources are not available that meet the staff's acceptance criteria, then the applicant's analyses should fully characterize the electricity market and explain how the proposed project would be used in that market. In all cases, the analyses relied upon by the applicant should meet the NRC's four acceptance criteria.

8.1 Description of the Applicant's Power Market

In developing the need-for-power analysis, applicants should clearly describe the specific market structure (or hybrid thereof) under which the proposed nuclear power plant would operate. Commonly recognized markets that affect a need-for-power analysis include:

- Rate-based utility: A rate-based utility provides generation and distribution of electricity under a regulatory obligation to provide electrical service to customers in a non-competitive market with

a defined service area. The rate-based utility generally has to seek permission for expanding its generating fleet, typically in the form of a certification from a utility oversight organization. If certification is required, the applicant should provide a detailed discussion of the status of the certification in the power market discussion.

- Merchant generator: A merchant generator produces and sells electricity into a competitive wholesale or retail power market where that electricity is administrated and delivered to the marketplace via an ISO or RTO. Development of new capacity may or may not require approval by a regulatory body. However, even if a new generating unit were to require a certification similar to that of a rate-based utility, the merchant generator's energy is not necessarily committed to a specific geographic area, does not have a captive rate base, and customers or retailers are not obligated to purchase it.

The description and details provided in this section should be consistent with the project's stated purpose and need statement from Chapter 1 of the ER. The applicant should provide the following information in the ER:

- Description of the manner in which the applicant and owners operate to supply power to the service area. This information should be consistent with information provided in the application in response to 10 CFR 50.33(d) and (i). The discussion should include any State, regional, or market-based regulatory requirements that would affect the production, distribution, and consumption of electricity. Examples include, but are not limited to, resource portfolio standards, impacts from known or potential changes to energy-efficiency standards, and potential impacts from changes to Federal and State environmental policies.

- Detailed explanation for the selection of the intended service area for the project, including any relevant aspects of the service area which would be supported by the proposed project (e.g., proximity to load centers, shortage of available baseload capacity, portfolio diversity, etc.). The service area should be defined in terms of some readily accessible analytical area defined by the applicant's ISO, RTO, or North American Electric Reliability Corporation subregion.

- Recognized and anticipated service obligations such as power purchase agreements or any power market-based agreements deployed for stability and reliability (e.g., reserve, sharing agreements, or must-run).

- Any unique service area or market factors that may affect the accuracy or availability of current and forecast generation, transmission, and distribution of electricity. For example, grid constraints (e.g., congestion and capacity) that limit the proposed project's ability to fully service its geographic market should be identified and discussed.

8.2 Power Demand

The purpose of the power demand section is to fully disclose current and forecast demand for baseload and peak power. The level of detail provided should establish a comprehensive assessment of the existing market, and how the capacity and energy of the proposed project will be used (demanded) in that market once commissioned and operated.

This section of the need-for-power analysis should discuss factors which affect, or are likely to affect, the current and forecast demand for power. This commonly includes economic and weather, data, but could also include explanations of policies and programs implemented or likely to be implemented that may influence the demand for power. Examples include, but are not limited to, discussion of energy-

efficiency and conservation programs, demand-side management programs, and potential impacts from changes to energy standards and codes. The applicant should discuss any factors that could affect demand uncertainty.

Based on the description, conditions, and constraints of the relevant service area or power market provided in Section 8.1 of this RG, the applicant should provide the following information in the ER:

- historical levels of electricity demand, including:
  - annual peak hourly demand and annual baseload demand
  - a disaggregation of electricity demand by market sectors (e.g., residential, commercial, and industrial), extending back for a period sufficient to illustrate any current trends or anomalies that affect future projections of electricity demand;
- current (as close to the application year as practicable) peak total demand and baseload demand for all sectors; and
- future projections of peak total demand and baseload demand, extending to the analytical year.

Demand-Side Management (DSM) and Energy-Efficiency (EE) programs affect demand primarily through reductions of peak and intermediate load. Any future DSM or EE should be discussed in the applicant's demand forecast as a reduction from annual hourly peak demand, but any calculation of future demand based upon an extrapolation of past demand should not include a calculation of DSM/EE reductions from that extrapolation. By construction, the forecasted demand already includes consideration of future DSM/EE and any reduction of demand for DSM/EE would result in double counting. For the purposes of a need-for-power analysis, the NRC staff considers reserve requirements to be a component of electricity demand; therefore, these should be included and quantified by the applicant as part of demand.

Table 8-1 provides a representative format for displaying the changes in baseload and annual peak hourly electricity demand components over the temporal scope of the analysis, noting that the analysis is not necessarily bound or limited to only these data points.

Table 8-1. Demand Forecast Summary (MW(e))

	20WW[a]	20WW	20XX[b]	20YY[c]	20YY	20ZZ[d]
Total Baseload Demand						
Peak Hourly System Demand						
MINUS: DSM[e] and EE[f]						
Total Peak Demand						
PLUS: Reserve Margin						
Total System Demand						

(a) 20WW denotes data years before submittal of the application.
(b) 20XX denotes the year of submittal of the application.
(c) 20YY represents the intervening years in some useful increment.
(d) 20ZZ indicates the year three years after commencement of full commercial operations.
(e) DSM is Demand-Side Management.
(f) EE is Energy Efficiency.

8.3 Power Supply

The intent of the power-supply section is to fully disclose the current and forecast supply of electricity (i.e., capacity), including an analysis of installed capacity, planned capacity, and known or forecast retirements. The applicant should describe and explain the factors that affect, or are likely to affect, the current and forecast supply of electricity in the service area.

The power-supply section should include a description of the regulatory, statutory, and/or business drivers that may influence current fleet and future supply decisions. The applicant should provide any known or forecast factors that could affect uncertainty, with an emphasis on their likelihood. Examples include effects from current Federal emissions regulations; pending Federal regulations on new source review and greenhouse gas emissions; and any potential transition to alternative technologies. To the extent the proposed project addresses any of these factors they should be discussed, quantified, and aligned with the stated purpose and need.

The applicant should include the following information in the ER:

- A comprehensive assessment of the existing supply of generating capacity in the service area or power market predicated on the description, conditions, and constraints provided in Section 8.1. The existing supply of generating capacity should be disaggregated by fuel type and by dispatch (baseload, intermediate, peaking).

- All known or anticipated power purchases or sales which would serve to affect the net supply of power within the area of interest.

- All potential capacity additions, retirements, uprates, and fuel switches for the entire service area.

Recognizing not all planned capacity additions will be built and become operational, the applicant should only include projects currently under construction and/or having an issued certification of need from a utility oversight organization (e.g., a State utility commission) for the projected growth in capacity.

Table 8-2 provides a representative format for displaying the supply of power in a service area or power market over the temporal scope of the analysis, noting that the analysis is not necessarily bound or limited to only these data points.

Table 8-2. Supply Resources Summary (MW(e))

	20WW[a]	20WW	20XX[b]	20YY[c]	20YY	20ZZ[d]
Baseload Resources						
MINUS: Retirements						
PLUS: Additions						
Total Baseload Capacity						
Installed System Capacity						
MINUS: Retirements						
PLUS: Additions						
Total Installed Capacity						
Net Transactions (exported and imported power)						
Total System Supply						

(a) 20WW indicates data years before the submittal of the application.
(b) 20XX denotes the year of submittal of the application.
(c) 20YY represents the intervening years in some useful increment.
(d) 20ZZ indicates the year three years after commencement of full commercial operations.

8.4 Summary of the Need-for-Power Analysis and Conclusions

This section of the ER should provide a summary of the need-for-power analysis for the proposed project and disclose the applicant's conclusions in accordance with the purpose and need definition in Chapter 1 of the ER. The findings summarized in this section should be fully substantiated by data and discussion presented in the preceding sections. This section should result in a final determination of whether or not there is a need for the power from the proposed project in the relevant service area in the analytical year, as defined in Section 8.0.

To provide further insight into the preparation of the need-for-power assessment in the ER, the following descriptions delineate the types of acceptable analyses that applicants may use to make a positive determination of need. Any one of the approaches listed below is sufficient to demonstrate need for power, but the applicant should show the basis for a positive determination of need as well as the results of the analyses outlined in Sections 8.2 and 8.3.

- Certification of Need. Demonstrating that the proposed action has obtained formal certification from a utility authority stating the public need for the proposed project is the most direct method for determining the need for power. Because such a certification is made by the State agency authorized to make such a determination, it is presumed to meet the four acceptability criteria described in this chapter. Therefore, where such regulations are in place and a certificate has been issued, further justification is not necessary. However, the applicant should include descriptions of the power market, power demand forecast, and power supply forecast, as discussed in the preceding sections. The applicant should cite the certification in the conclusions section as the basis for a positive determination of need.

- Peak Demand Assessment. For the relevant market area, future total system demand for electricity (including reserve requirements) should be compared to future total system supply, based on items provided in Table 8-1 and Table 8-2. A positive determination of peak demand can be demonstrated when the projected peak hourly demand for electricity is greater than the projected capacity in the market area by an amount that is greater than (or reasonably close to) the planned capacity of the proposed project in the analytical year. If the entire capacity of the

proposed project cannot be accounted for in the relevant service area, the remainder may be accounted for by demonstrating the remaining capacity of the proposed project can be sold to areas outside the applicant's relevant service area.

- Baseload Demonstration. A positive determination of baseload need can be demonstrated when the projected baseload demand for electricity is greater than the projected baseload capacity by an amount that is greater than (or reasonably close to) the planned capacity of the proposed project. The applicant should include a table similar to Table 8-3 that demonstrates the need for baseload capacity greater than (or reasonably close to) the capacity of the proposed project in the analytical year.

- Market-Based Evaluation. A positive need-for-power determination need not depend on a deficit in the supply of electricity in the analytical year. Rather an applicant can demonstrate a need for power even in a marketplace that has a surplus of electricity. The applicant can either:

  1. Perform a market-based or auction analysis describing how the applicant will price and bid their electricity to ensure the proposed project will participate in the market at levels consistent with baseload capacity factors. This approach should:

     - describe the auction or other mechanism by which the ISO/RTO selects generators to supply power into the market, and

     - provide an analysis illustrating how the project can feasibly compete in the hourly market at a lower price than competitors, ensuring the proposed project's continuous access to the electricity market.

Table 8-3. Demand and Supply Forecast Summary (MW(e))

	20WW[a]	**20WW**	**20XX[b]**	**20YY[c]**	**20YY**	**20ZZ[d]**
DEMAND						
Peak System Demand						
MINUS: DSM and EE						
Total Peak Demand						
Plus Reserve Margin						
Total System Demand						
SUPPLY						
Installed System Capacity						
MINUS: Retirements						
PLUS: Additions						
Total Installed Capacity						
Net Transactions						
Total System Supply						
Surplus (Deficit) Without the Proposed Project						
Project Capacity						
Surplus (Deficit) With the Proposed Project						

20WW[(a)]	20WW	20XX[(b)]	20YY[(c)]	20YY	20ZZ[(d)]

(a) 20WW denotes data years before submittal of the application.
(b) 20XX denotes the year of submittal of the application.
(c) 20YY represents the intervening years in some useful increment.
(d) 20ZZ indicates the year three years after commencement of full commercial operations.

2. Provide evidence that the proposed unit(s) intend to enter into an agreement with the ISO/RTO that in exchange for the guarantee of always being able to sell their electricity, the applicant will agree to take whatever price the ISO/RTO establishes as the hourly market price. This approach should include:

   - a description of the existing market area;

   - a detailed description of the auction or mechanism by which generators are selected to supply power into the market; and

   - documentary evidence of the agreement between the applicant and the ISO/RTO.

In all cases, the applicant is free to employ a need-for-power analysis that is not explicitly identified by the above list, provided such deviation is accompanied by a detailed explanation as to (1) why the applicant employed a different approach and (2) how the applicant's preferred methodology meets the NRC's four acceptance criteria for a need-for-power analysis described in this chapter.

Chapter 9

9.0 Environmental Impacts of Alternatives

The ER should include a discussion of alternatives to the proposed action that is sufficiently complete to aid the NRC staff in (1) discussing alternatives to the proposed action in the EIS (NEPA Section 102(2)(C)(iii) (42 U.S.C. 4321, 10 CFR 51.45(b)(3)), and (2) developing and describing appropriate alternatives to recommended courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources (NEPA Section 102(2)(E) [42 U.S.C. 4321]). To the extent practicable, the environmental impacts of the proposal and the alternatives should be presented in comparative form (10 CFR 51.45(b)(3)).

A key aspect of the alternatives analysis is that the alternatives presented in the ER should be capable of meeting the purpose and need of the proposed project. For large light-water-cooled reactors, the purpose and need has typically involved generating electricity for the grid. Assume, as an example, that the purpose and need for the project includes generating approximately 1,500 MW(e) of baseload power by the year 2030 in the region of interest (ROI). An alternative that cannot generate approximately 1,500 MW(e) of baseload power, or cannot be in service by year 2030, or cannot effectively deliver power to the ROI, cannot meet the purpose and need and should not be retained as an alternative.

A given project will have its own unique purpose and need statement. Some projects may have very different statements of the purpose and need; however, any alternative that will be evaluated must meet the purpose and need. For example, an applicant could propose a project to demonstrate a new reactor technology. In that case, there would be no energy alternatives that meet the purpose and need.

Another key aspect of this analysis is that the alternatives presented in the ER should be reasonable as defined by the CEQ (46 FR 18026). In other words, there should be a reasonable expectation that the alternative could be implemented. For example, if a proposed plant requires 60 million gallons per day (Mgd) of cooling water, then an alternative site for which no such source exists or is likely to be developed is not a reasonable alternative.

Except as described in Appendix A, the ER should include information on four categories of alternatives: the no-action alternative, energy alternatives, site alternatives, and system alternatives. Specific information to include in the ER is covered in the following subsections.

9.1 No-Action Alternative

The discussion of alternatives in the ER should include the no-action alternative under which the requested license or permit is not granted by the NRC. The ER should describe under the no-action alternative the impacts of not implementing the proposed action. Guidance from the CEQ states, “Where a choice of “no action” by the agency would result in predictable actions by others, this consequence of the “no-action” alternative should be included in the analysis” (46 FR 18026). For example, if the proposed nuclear plant would be used to meet a demonstrated need for power, then not building the plant would lead to a failure to meet that need for power. The staff expects that regulatory authorities (typically a State public service commission, or equivalent, in conjunction with any regional transmission operator and electrical reliability council) would take action to meet the need for power before the grid became unreliable. Because of this, the ER should discuss what other steps might be taken to address the need for power, and the associated environmental impacts. For example, if the likely result of the no-action alternative would be that one of the other energy alternatives would be built and operated to meet the need for power, then the ER should include that information and may refer to the discussion of that energy alternative for the associated environmental impacts.

9.2 Energy Alternatives

The first step in the discussion of energy alternatives should be to evaluate and identify the energy sources other than nuclear energy that have the potential to meet the purpose and need for the project and eliminate from detailed discussion energy sources that cannot meet the purpose and need. For example, if a part of the purpose and need is to provide baseload generating capacity, then an alternative that cannot provide baseload[13] generating capacity would be eliminated from detailed study. The second step should be to evaluate in more detail the impacts of the energy sources that can meet the purpose and need for the project. Finally, the ER should compare the impacts of the energy sources that can meet the purpose and need to the impacts of the proposed project and determine if any of the alternative sources are environmentally preferable to the proposed project. The NRC staff's "Energy and System Design Mitigation Alternatives White Paper" may be a useful source of information regarding alternative energy sources.

The discussion of alternatives in the ER should include all energy alternatives that could be used to meet the need for power.[14] Energy alternatives can be divided into two categories; those that do not require new generating capacity (e.g., energy conservation), and those that do require new generating capacity (e.g., a natural gas-fired plant).

For alternatives that do not require new generating capacity, the ER should discuss options that go beyond any already considered in the need-for-power analysis presented in ER Chapter 8. For example, the need-for-power analysis typically has already considered energy savings associated with energy-efficiency and conservation programs that the power company plans to implement. Because these programs have already been considered in the need-for-power analysis, they do not represent an alternative to the proposed action. However, for the alternatives analysis the ER should discuss the possibility of implementing additional measures (beyond those already planned) that could obviate the need for the proposed nuclear power plant. These measures may include importing more power from beyond the ROI, additional energy-efficiency, conservation, and DSM programs,[15] re-activating plants that have been retired, or extending the lives of plants that are currently assumed to retire in the need-for-power analysis. The analysis of these alternatives should consider if these alternatives are reasonable (i.e., can they meet the purpose and need of the project after considering technical and regulatory challenges). If the alternative cannot meet the purpose and need for the project then it should be eliminated from further consideration. If the alternative can meet the purpose and need then it should be retained for comparison to the proposed project.

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[13] "Baseload" refers to an electricity generating unit that can (1) operate with a capacity factor of at least 80 percent, (2) has a high generating capacity, and (3) has a low cost of electricity production.

[14] As discussed in Appendix A, an applicant for an early site permit is not required to address energy alternatives (10 CFR 51.50(b)(2)). However, the applicant can choose to address energy alternatives in such an application.

[15] Energy efficiency, conservation, and demand-side management programs need not be considered by the applicant if the application is for a merchant plant – a plant with no specific service territory. However, if one or more other companies are implementing such programs in the ROI, the ER should include consideration of the effect of those programs on the amount of power needed.

The discussion of alternatives that would require new generation facilities should include renewable and nonrenewable sources and at least one combination of sources. Examples of renewable sources are wind, geothermal, hydroelectric, hydrokinetic (e.g., wave and tidal), biomass (e.g., wood residues), municipal solid waste, energy crops, and solar. Examples of nonrenewable sources are coal, natural gas, and petroleum fuels. A combination of alternatives is one that includes a mix of sources that are available in that region. The decision regarding the mix of sources in the combination should be based on consideration of maximizing the renewable portion of the combination and minimizing the environmental impacts to create a competitive alternative. However, the combination must still be capable of meeting the purpose and need for the project. The analysis of alternative energy sources should consider the availability of the source in the ROI, the extent to which the source is already used in the region, and projections in the growth of the source in the region. Projections may be available from organizations such as power companies, public service commissions, Federal agencies, and universities.

Reasonable energy alternatives are those that can meet the purpose and need of the project. So, for example, if the purpose and need includes providing baseload generating capacity, then any reasonable alternative must also be capable of providing baseload generating capacity.[16] If a potential alternative has a capacity factor significantly lower than that of the proposed project (e.g., wind and solar), consider whether the alternative could be feasible if a form of energy storage or backup power is included. However, the feasibility and environmental impacts of energy storage or backup power would have to be included in the evaluation of the alternative.

Once reasonable alternatives have been identified, the ER should evaluate the environmental impacts of those alternatives for comparison to the impacts of the proposed action. In general, applicants should assume siting of alternative energy facilities at the proposed plant site unless the proposed site would not be suitable for the particular alternative. For alternatives that require a cooling system, the ER should assume a cooling system similar to that evaluated for the proposed project.

The environmental impacts of each reasonable alternative should be compared to the impacts of the proposed action. Based on that comparison, the ER should indicate whether any of the alternatives is environmentally preferable to the proposed action. If none of the alternatives are environmentally preferable, then no further action is needed. If any of the alternatives are found to be environmentally preferable, then the ER should determine whether such alternatives are obviously superior to the proposed action by considering other factors (e.g., cost [capital and operating costs], fuel availability, and regulatory issues). As part of the comparison of reasonable energy alternatives, the ER should compare greenhouse gas emissions associated with each alternative to the emissions from the proposed project.

9.3 Site-Selection Process

The ER should describe the process used by the applicant to identify possible sites for the new nuclear plant and to select the proposed site. The basic steps that should be described in the site-selection process are shown in Figure 9-1.

[16] A baseload power plant is designed to operate continuously to supply all or part of the system's minimum load (DOE/EIA's "Electric Power Industry Terms and Definitions"). Baseload power plants typically have annual load capacity factors that exceed 75 percent, but usually operate 90 to 98 percent of the time ("How to Compare Power Generation Choices" in *Renewable Energy World North America*).

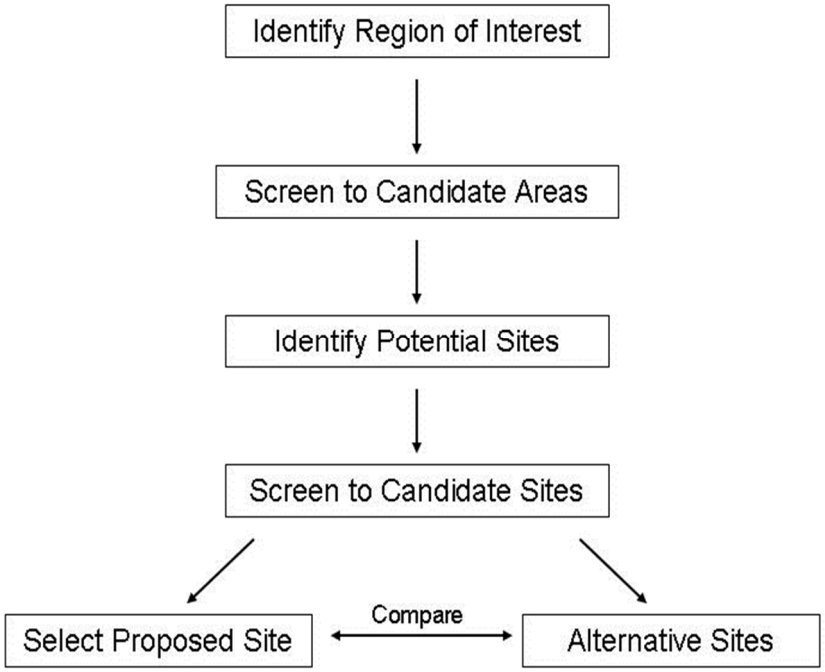

Figure 9-1. Site-Selection Process

The ER should include the following information:

- A description of the ROI, candidate areas, potential sites, and candidate sites. If any potential or candidate sites have been designated by a governmental agency as an acceptable site for a new nuclear power plant, this information should be included in the ER.

- Selection procedures for the ROI, candidate areas, potential sites, candidate sites, and the proposed site.

- The basis for establishing the geographical scope of the ROI.

- Factors considered at each level of the selection process, parameters by which these factors were measured and weighted, and criteria used to define levels of acceptability (e.g., numerical limits or decision standards).

- Methodologies used in the potential and candidate site screening process, including (when used) factors such as (1) importance factors, (2) preference functions, (3) utility functions, (4) weighting factors, (5) ranking scales, (6) scoring schemes, (7) rating systems, and (8) sensitivity analyses.

- For each alternative site, reconnaissance-level information should be included in the ER for the same impact categories used for the proposed site (see Chapters 4.0 and 5.0).

While the ER summarizes the process used to select the proposed site, the NRC staff will need to know the details of the process, which is typically described in a more detailed site-selection report prepared by or for the applicant. If such a report was prepared, it should be provided to the NRC staff at the time the application is submitted to inform the staff's review.

The site-selection process should follow a logical path from the definition of the ROI to the identification of candidate areas, potential sites, and candidate sites, to the selection of the proposed site. The ROI is the geographic area considered in searching for potential and candidate sites. The geographic area of the ROI need not be contiguous, but if it is not, a logical basis for nonadjacent areas should be provided. "Candidate Areas" are one or more areas within the ROI that remain after unsuitable areas (e.g., unsuitable because of high population, lack of water, fault lines, or distance to transmission lines) have been removed. "Potential Sites" are those sites within the candidate areas that have been identified for preliminary assessment in establishing candidate sites. "Candidate sites" are those potential sites within the ROI and that are considered in the comparative evaluation of sites to be among the best that can reasonably be found for the siting of a nuclear power plant. The candidate sites include the proposed site and the alternative sites. The "proposed site" is the candidate site submitted to the NRC by the applicant as the proposed location for a nuclear power plant. "Alternative sites" are those candidate sites that are compared to the proposed site to determine if there is an obviously superior alternative site. In general, the identification of three to five alternative sites in addition to the proposed site could be viewed as adequate. Each of the steps in the process is discussed in more detail below.

9.3.1 The Region of Interest

The ROI is typically selected based on geographic boundaries (e.g., the State in which the proposed site is located), or the relevant service area for the proposed plant. In cases where the proposed plant would not have a service area, the applicant should define a reasonable ROI and provide a justification. The ROI should be more extensive if the diversity of environmental conditions captured by the ROI would be substantially improved or if candidate sites do not meet initial threshold criteria (including the site criteria in 10 CFR Part 100, "Reactor Site Criteria"), and added geographic areas likely would not increase project costs substantially. The ER should describe how the ROI was selected, the extent of and basis for restrictions to the ROI because of siting constraints, and the extent to which the ROI is constrained based on the major load centers to be supplied by the proposed plant.

9.3.2 Candidate Areas

The ER should describe the process used to identify the candidate areas within the ROI. Reasons that areas may be unsuitable include the following:

- does not meet criteria in 10 CFR Part 100 (e.g., seismic unsuitability, proximity to major centers of population density)
- lack of existing infrastructure (e.g., roads and railroads)
- lack of a suitable cooling-water source
- distance to transmission lines, substations, or load centers
- unsuitable topographic features
- potential to impact valuable agricultural, residential, or industrial areas
- potential to impact dedicated land use areas (e.g., parks, historic sites, and wilderness areas)
- conflicts with land use planning programs or other restrictions established by State, county, or local governments.

The applicant's process to identify candidate areas should consider these and other reasonable attributes to identify areas potentially unsuitable for siting a new nuclear power plant. The ER should present the determining characteristics of the identified areas and need not present other characteristics. For example, if an area has no suitable cooling-water source, then the area would be considered unsuitable, and the other factors listed above need not be considered. The areas in the ROI that remain after unsuitable areas are eliminated are the candidate areas.

9.3.3 Potential Sites

Once the candidate areas have been identified, the ER should describe how potential sites within those areas were identified. In selecting potential sites, applicants should use a logical process that treats all sites in the same way, and would reasonably be expected to produce sites that are among the best potential sites in the candidate areas. Applicants should not use a potential site-selection process that focuses on one group or class of sites to the exclusion of other groups of sites without a defensible technical basis. The process used to identify potential sites should typically consider attributes similar to those used in the process of identifying candidate areas. However, in general this step in the process involves a somewhat more detailed look at those criteria. In addition, in many cases, the applicant can use the inverse of the attributes listed above, looking for positive rather than negative attributes. So, for example, the applicant may identify locations in the candidate areas that have ample water, are close to transmission facilities and load centers, have infrastructure in place, etc. However, negative attributes at a specific location (e.g., seismicity or threatened and endangered species), may also be used to de-select some sites.

An applicant is not expected to conduct detailed environmental studies for potential sites, only preliminary investigations using reconnaissance-level information.[17] A reconnaissance-level investigation should take account of information that is readily available over the Internet and from other sources (e.g., existing studies and State and Federal agencies). The applicant does not have to own the land at potential sites; however, no obvious obstruction should prevent the applicant from obtaining the land (e.g., land that is part of a National Park).

The goal of this step in the process is not to identify every potential site in the candidate areas. Depending on the size of the candidate areas, trying to identify all possible sites would yield an unworkable number of possible locations. Instead, the ER should demonstrate that the applicant used a logical process that would reasonably be expected to produce a list of the best potential sites in the candidate areas.

9.3.4 Candidate Sites

Candidate sites are those potential sites that are within the ROI and are considered in the comparative evaluation of sites to be among the best that can reasonably be found for the siting of a new nuclear power plant. The applicant's review of candidate sites should be directed toward the identification of sites suitable for the size and type of nuclear power plant being proposed. The candidate sites include

[17] Reconnaissance-level information" is defined in RG 4.7 as information that is obtainable from published reports, public records, public and private agencies, and individuals knowledgeable about the locality of a potential site. Although in some cases the applicants may have conducted on-the-spot investigations, it is assumed here that these investigations would be limited to reconnaissance-type surveys at this stage in the site selection process. Reconnaissance should include more than just a literature search for issues that are critical to the evaluation of sites. So, for example, reconnaissance should include contact with the water-management agency about water availability in most cases, as discussed in RG 4.7. The amount and quality of information must be sufficient based on the expert judgment of the reviewer to make the required determination for which the information is needed.

the proposed site and the alternative sites. The ER should demonstrate that the applicant's site-selection methodology resulted in the identification of candidate sites that are potentially licensable by the NRC, and among the best that can reasonably be found in the ROI. At least four candidate sites should be identified in the ER.

To be a candidate site, the following minimum criteria should be satisfied:

- Consumptive use of water should not cause significant adverse effects on other users.
- The proposed action should not appreciably reduce the likelihood of survival or recovery of Federal, State, or Tribal listed threatened, endangered, or candidate species or result in the destruction or adverse modification of critical habitat.
- There should not be any potential significant impacts on essential fish habitat or other federally protected aquatic habitats or to known spawning grounds or nursery areas of populations of important aquatic species on Federal, State, or Tribal lists.
- Discharges of effluents into waterways should be in accordance with Federal, State, regional, local, and Tribal regulations and should not adversely impact efforts to meet water-quality objectives.
- There should be no preemption of, or adverse impacts on, land specially designated for environmental, recreational, or other special purposes.
- There should not be destabilizing impacts on terrestrial and aquatic ecosystems, including wetlands that are unique to the resource area.
- There should not be other significant issues (e.g., historic and cultural resources, traditional cultural properties, cemeteries, burials) that preclude the use of the site.

9.3.5 Proposed and Alternative Sites

The proposed site is the candidate site identified by the applicant as the proposed location for a new nuclear power plant. Alternative sites are those candidate sites that are compared to the proposed site to determine if there is an environmentally preferable site.

The ER should provide a sufficient description of the alternative sites to allow for an evaluation of the environmental impacts of building and operating the proposed project at each site. A figure showing the proposed plant on each alternative site with the footprint and the environmental interfaces such as cooling-water intakes and discharges should be included.

The evaluation and comparison of the proposed and alternative sites should be performed for each resource area for which an assessment was performed for the proposed site, should consider cumulative impacts and be presented in tabular form. The potential impacts of climate change should be considered under cumulative impacts for alternative sites.

The evaluation of the cumulative impacts at the alternative sites should be similar to that for the proposed site, except that reconnaissance-level information is used for the alternative sites. If, however, the initial review appears to indicate that an alternative site is environmentally preferable to, or even obviously superior to, the proposed site, then additional reconnaissance-level information can be gathered to further assess whether the alternative site is obviously superior.

An applicant can propose to build a new nuclear power plant at a site that was not selected on the basis of a systematic site-selection process (e.g., at the site of an existing nuclear power plant or a site identified by the State). In such a case, the applicant can simply choose the site it is proposing. However, the applicant should still follow the process shown in Figure 9-1 for the selection of alternative sites. The site comparison should be performed in such a case by comparing each of the alternative sites to the proposed site.[18]

In general, the applicant should consider the same plant design (e.g., cooling system design and transmission-line voltage) at all of the alternative sites. However, changes to the design may be considered on a site-specific basis if the proposed design could not be used at the alternative site. The applicant's review should also take account of the reactor site criteria in 10 CFR Part 100 and RG 4.7.

The applicant should state in the ER whether any of the alternative sites would be environmentally preferable to the proposed site, and provide an explanation for the determination. An environmentally preferred site is a site for which the environmental impacts are sufficiently less than for the proposed site, so that environmental preference for the alternative site can be established. For any environmentally preferable site, the applicant should indicate whether it is obviously superior to the proposed site. See, for example, *New England Coalition on Nuclear Pollution v. NRC*, 582 F.2d 87, (1st Cir. 1978). Whereas the evaluation for an environmentally preferable site considers only environmental impacts, the determination whether a site is obviously superior also considers costs and institutional constraints.

Costs should include any additional costs associated with building and operating the proposed unit(s) at the environmentally preferable site. These costs could include items such as the cost of (1) modifying the plant design, (2) additional grading and fill, (3) ecological and cultural resource surveys, (4) the ongoing cost of establishing and operating a new emergency plan (if the proposed site already has such a plan in place), (5) the cost of obtaining the alternative site, and (6) the cost of any delay associated with changing sites. Institutional constraints could include items such as (1) known objections of regulatory agencies, (2) grid stability issues at the alternative site, (3) lack of franchise privileges and eminent domain powers, (4) the need to restructure existing financial and business arrangements, and (5) the feasibility of obtaining the alternative site. The Commission discussed the standards for conducting a cost-benefit analysis related to alternatives in the following cases: Consumers Power Co. (Midland Plant Units 1 and 2), ALAB-458, 7 NRC 155 (1978), Public Service Company of New Hampshire et al. (Seabrook Station Units 1 and 2), ALAB-471, 7 NRC 477 (1978).

If the applicant were to determine that an alternative site was obviously superior to the proposed site, then the NRC staff expects that the applicant would modify its choice of the site. If the applicant determines that an environmentally preferable site is not obviously superior to the proposed site, then the ER should explain in detail the bases for that conclusion.

If the proposed action requires an individual permit from the USACE, then USACE will perform its own analysis to determine whether the proposed site is the least environmentally damaging practicable alternative (LEDPA) using criteria in 40 CFR, Part 230, Section 404(b)(1), "Guidelines for Specification of Disposal Sites for Dredged or Fill Material." While the USACE evaluation of the LEDPA site and the NRC staff's evaluation as to whether there is an obviously superior alternative site considers similar factors, there are some differences in the focuses of the two evaluations. Regardless, experience has

[18] This approach still involves the applicant identifying alternative sites that are among the best that can be identified in the ROI, and comparing those alternative sites to the proposed site to determine if any is obviously superior. As such, the final result of this approach is the same as the determination between the proposed and alternative sites.

shown that early coordination with the USACE on issues related to siting and LEDPA will reduce the likelihood of significant problems and delays during the review. In addition, because the NRC staff and USACE staff will both review the information in the applications to the NRC (the ER) and the USACE, the applicant should ensure that the information provided in these documents is consistent.

The impacts described in Chapter 6 of the ER (e.g., nuclear fuel cycle, decommissioning), would not vary significantly from one site to another. Typically, all of the alternative sites and the proposed site are in low-population areas, and the review team assumes the same reactor plant design is applicable for each of the sites. Therefore, the same fuel cycle technology, transportation methods, and decommissioning methods would be used. Because of this, these impacts would not differentiate between the sites and would not be useful in the determination of whether an alternative site is environmentally preferable to the proposed site. For this reason, these impacts are not discussed in the evaluation of the alternative sites.

Similarly, the nonradiological waste impacts described in Chapters 4 and 5, and the radioactive waste impacts in Chapter 5.0, would not vary significantly from one site to another. The types and quantities of nonradiological and radioactive waste would be about the same at any of the alternative sites. For each alternative site, all wastes destined for land-based treatment or disposal would be transported offsite by licensed contractors to existing, licensed disposal facilities operating in compliance with all applicable Federal, State, and local requirements. All nonradioactive liquid discharges would be discharged in compliance with the provisions of an applicable NPDES permit. Also, the amount of nonradioactive, nonhazardous municipal solid waste to be generated annually by the plant would be a relatively small percentage of the total solid waste generated within the geographic area of interest of any of the alternative sites.

The following sections describe the specific resource area information that should be provided for each alternative site.

Cumulative Impacts

The applicant should provide a description of any past, present, and reasonably foreseeable future actions in the general area surrounding the alternative sites that would affect the same resources impacted by the proposed units as was prepared for the preferred site (Section 7.0 of this RG). The applicant should use the same approach to establish the resource impact area for each resource area as described in Figure 7-1.

Land Use

The characterization and discussion of possible land use impacts should follow the same guidance used in Chapters 2.0, 4.0, 5.0, and 7.0 of this RG, using reconnaissance-level information.

Hydrology

A reconnaissance-level discussion of surface-water and groundwater features, and availability should be made using available water-management-agency information, aerial photographs, maps, and GIS layers, if available. The characterization and discussion of possible effects to surface-water and groundwater should follow the same guidance used in Chapters 2.0, 4.0, 5.0, and 7.0 of this RG, using reconnaissance-level information.

Terrestrial Ecology

A reconnaissance-level baseline characterization of terrestrial resources on alternative sites can be expected to rely heavily on aerial photographs, maps, and GIS layers published by Federal and State natural resource management agencies. The characterization and discussion of possible impacts should follow the same guidance used in Chapters 2.0, 4.0, 5.0, and 7.0 of this RG, using reconnaissance-level information. Adequate information on the possible occurrence of important species and habitats can be obtained from discussions with, or online databases maintained by, the FWS, and State natural heritage programs.

Aquatic Ecology

A reconnaissance-level baseline characterization of aquatic resources on alternative sites can be expected to rely heavily on aerial photographs, maps, and GIS layers published by Federal and State natural resource management agencies. The characterization and discussion of possible impacts should follow the same guidance used in Chapters 2.0, 4.0, 5.0, and 7.0 of this RG, using reconnaissance-level information. Adequate information on the possible occurrence of important species and habitats can be obtained from discussions with, or online databases maintained by, the FWS, NMFS, and State natural heritage programs. Guidance on sources and use of aquatic reconnaissance-level information for alternative sites is found in RG 4.24.

Socioeconomics

For the alternative sites, an applicant should address the same socioeconomic issues that were addressed for the proposed site. The characterization and discussion of other impact areas should be performed using reconnaissance-level information.

Historic and Cultural Resources

Applicants should provide reconnaissance-level information on historic and cultural resources for each of the alternative sites being considered. There is a difference between reconnaissance-level information and reconnaissance activities. The applicant should gather information on known historic and cultural resources at the alternative sites, and within the vicinity through a comprehensive literature review. Survey and site information (e.g., historic and cultural resources that are listed on or eligible for the NRHP) should be obtained through the SHPO, as well as local historical societies within the vicinity of the alternative site locations, and GIS tools (e.g., NEPAssist).

Because detailed cultural resource field investigations are not generally performed on alternative sites, there is uncertainty about the direct or indirect effects on historic and cultural resources that may or may not be located at or in the vicinity of the alternative site. The applicant should, when determining impacts, base them on known resources and the probability of the area containing resources. For example, if an adjacent area has been surveyed and resources have been found or in the opinion of the qualified professional there are likely to be resources located on the site, then that information should be considered in determining the impact level. The characterization and discussion of possible impacts should follow the same guidance used in Chapters 2.0, 4.0, 5.0, and 7.0 of this RG, using reconnaissance-level information with the understanding that the NRC does not perform NHPA consultation for alternative sites.

Air Quality

Applicants should provide reconnaissance-level information related to air quality for the region around each alternative site. For criteria pollutants, this is the local/regional area and is generally the

county in which the alternative site is located. The characterization and discussion of possible impacts should follow the same guidance used in Chapters 2.0, 4.0, 5.0, and 7.0 of this RG, using reconnaissance-level information.

Nonradiological Health

Applicants should provide reconnaissance-level information for the region around each alternative site. The characterization and discussion of possible impacts should follow the same guidance used in Chapters 2.0, 4.0, 5.0, and 7.0 of this RG, using reconnaissance-level information.

Radiological Health

Applicants should provide reconnaissance-level information for the region around each alternative site. The characterization and discussion of possible impacts should follow the same guidance used in Chapters 2.0, 4.0, 5.0, and 7.0 of this RG, using reconnaissance-level information.

Postulated Accidents

The applicant should evaluate the impacts of postulated accidents at alternative sites using a qualitative analysis to characterize and discuss possible impacts as in Chapters 5.0 and 7.0 of this RG.

9.4 System Alternatives

The ER should include information on system design alternatives for the heat-dissipation and circulating-water systems. Specific information to include in the ER is covered in the following subsections.

9.4.1 Heat Dissipation

The applicant should discuss alternatives to the proposed heat-dissipation system at the proposed site. Alternatives that should be considered include once-through cooling, mechanical draft wet cooling towers, natural draft cooling towers (including fan assisted towers), wet/dry cooling towers, dry cooling towers, cooling ponds, and spray ponds. The applicant should assess, and document in the ER, whether each alternative (1) is feasible and practical given conditions at the proposed site, and (2) could meet the requirements of Section 316 of the Federal Water Pollution Control Act and associated Federal and State implementing regulations. For alternatives which satisfy those two criteria, information should be included in the ER that compares the environmental impacts of the proposed heat-dissipation system with the alternative system(s). If an alternative system is found to be environmentally preferable to the proposed system, comparative information on the estimated capital and operating cost of the proposed system vs. the estimated capital and operating cost of the environmentally preferable system should be included in the ER. The applicant should state the basis for choosing the proposed system over the environmentally preferable system.

9.4.2 Circulating-Water System Alternatives

The applicant should discuss alternatives to the proposed circulating-water system at the proposed site. The evaluation should address alternatives for the intake, discharge, and water-supply portions of the system. Applicants should assess and document in the ER whether each alternative (1) is feasible and practical given conditions at the proposed site, and (2) could meet the requirements of Section 316 of the Federal Water Pollution Control Act and associated Federal and State implementing regulations. For alternatives which satisfy those two criteria, information should be included in the ER that compares the

environmental impacts of the proposed system with the alternative system(s). If an alternative system is found to be environmentally preferable to the proposed system, comparative information on the estimated capital and operating cost of the proposed system vs. the estimated capital and operating cost of the environmentally preferable system should be included in the ER. The applicant should state the basis for choosing the proposed system over the environmentally preferable system.

9.4.3 Other System Alternatives

In unusual circumstances, an applicant may find that consideration of alternative designs for other systems (e.g., the cooling system specific to the service water system) may be warranted. This situation could arise if a system other than the cooling-water system for the main condensers (already addressed above) (1) would have unavoidable environmental impacts from construction (as defined in 10 CFR 51.4) or operations that are greater than SMALL; and (2) the use of an alternative system design would possibly reduce those impacts to a lower significance level. In such cases, the applicant should develop and compare appropriate alternatives to determine if any is environmentally preferable to the proposed system. This portion of the guidance should not be used if the significant environmental impacts are caused by the project as a whole, as opposed to a discrete system.

Chapter 10

10.0 Conclusions

10.1 Impacts of the Proposed Actions

The applicant should summarize and reference the impacts of the proposed action from Chapters 4.0, 5.0, and 7.0.

10.2 Unavoidable Adverse Environmental Effects

As required by 10 CFR 51.45(b)(2), an ER shall discuss "Any adverse environmental effects which cannot be avoided should the proposal be implemented." Unavoidable adverse environmental impacts are those impacts of the NRC action and the USACE action (if it is a cooperating agency), that cannot be avoided in the use of the site and associated offsite facilities. The applicant should provide two tables listing the resource area, impacts, mitigation measures, and the unavoidable adverse impacts left after mitigation. One table should list the unavoidable adverse impacts from building, and the other should list the unavoidable adverse impacts from operation.

10.3 Relationship between Local Short-Term Use of the Environment and Long-Term Productivity

As required by 10 CFR 51.45(b)(4), an ER shall discuss "The relationship between local and short-term uses of man's environment and the maintenance and enhancement of long-term productivity." The short-term uses of the human environment by the proposed project can be summarized in terms of the unavoidable adverse environmental impacts of building and operation and the irreversible and irretrievable commitment of resources. The applicant should describe the principle short-term benefit of the project (typically, the production of electricity) against the long-term uses of the site (agriculture or other productive uses of the site).

10.4 Irreversible and Irretrievable Commitments of Resources

As specified by 10 CFR 51.45(b)(5), an ER shall discuss "Any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented." The term "irreversible commitments of resources" refers to environmental resources that would be irreparably changed by the building and/or operation activities authorized by the NRC or USACE (if a cooperating agency) permit and licensing decisions, where the environmental resources could not be restored at some later time to the resource's state before the relevant activities. The term "irretrievable commitments of resources" refers to materials that would be used for or consumed by the new units in such a way that they could not, by practical means, be recycled or restored for other uses. The applicant should discuss the irreversible and irretrievable commitment of resources for each resource area in Chapters 4.0, 5.0 and 6.0. The applicant should indicate if there is no irreversible or irretrievable commitment of resources for a particular resource area.

10.5 Alternatives to the Proposed Action

As specified by 10 CFR 51.45(b)(3), an ER shall discuss "Alternatives to the proposed action." The applicant should summarize and reference the Chapter 9 analysis of the alternatives to the proposed action.

10.6 Benefits and Costs

As required in 10 CFR 51.45(c), the ER should include information on the estimated benefits and costs associated with the applicant's proposed project. The NRC staff will review this information and use it, as deemed appropriate, in the NRC staff's balancing of the costs (including environmental costs) against the anticipated benefits of the proposed action. To the extent possible, the estimated benefits and costs should be quantified. For all qualified and quantified benefit and cost categories, the applicant should provide a discussion commensurate with the importance of the category to the application process.

The applicant should provide separate tabular summarization of the benefits and the costs of the proposed action. This information will be gleaned from building and operations impacts (i.e., Chapters 4.0, 5.0, and 7.0), the analysis of need for power (i.e., Chapter 8), and the alternatives analysis (i.e., Chapter 9.0). Benefits and costs should be quantified to the extent practicable and presented using standard units for the domain of the resource being quantified (e.g., dollars, acres, and kilowatt-hours [kWh]).

10.6.1 Benefits

The ER should include information on the estimated benefits of the proposed project in accordance with the project's stated purpose and need (i.e., Chapter 1.0). Benefits can include, but are not limited to the following:

- net electrical generating benefits of the proposed plant
- fuel diversity in the generation fleet
- State or public utility commission GHG emission goals and how the project contributes to the goal
- energy independence and national security
- price stabilization and reduction
- demonstration of technological capabilities
- compliance with environmental regulations and the reduction of air pollution (e.g., criteria, hazardous, and GHG emissions)
- by-production of other commercial products (e.g., steam)
- expected annual tax payments to local and State governments for the building period and during operation of the proposed plant
- any estimated incremental increase in regional productivity during building and operating period
- any nonmonetary benefits (e.g., new recreational facilities and improved road conditions).

10.6.2 Costs

The ER should include information on the estimated internal and external costs of building- and operations-related activities. The negative environmental impacts described in the ER may be expressed as external or societal costs and should be quantified in the units appropriate to the resource domain estimating the impact.

Financial costs help the public evaluate the financial benefits of the proposed project in light of its costs. The applicant should provide the same level of cost information to the NRC as would typically be provided to other regulators (e.g., utility commissions). At a minimum, the following internal financial cost information should be provided:

- Overnight capital cost of the proposed action, including the following:
  - all building activities at the site and offsite areas
  - acquisition and placement of all plant structures and components
  - installation of transmission lines, pipelines, access routes, rail spurs, and other utility corridors.
- Financing and other costs, including the following:
  - expected financing costs including provisions for the allowance for funds used during building
  - other costs the applicant will be required to disclose to other regulators to provide a complete picture of the financial cost of the project.
- Operations costs, including the following:
  - fuel costs
  - plant operations and maintenance costs including maintenance and outage costs
  - waste disposal and plant decommissioning costs
  - additional regulatory compliance costs, taxes, fees, and environmental costs
  - other costs the applicant will be required to disclose to other regulators to provide a complete picture of the financial cost of the project.

10.6.3 Benefit-Cost Balance

A key component of the applicant's ER will be comparison of benefits and costs for the proposed action. The applicant should clearly enumerate and explain how the benefits of the proposed action outweigh the expected internal and external costs.

Chapter 11

11.0 Reference Guidance

The applicant should provide a bibliography of sources used in preparation of the ER. References should be cited and listed at the end of the chapter to which they refer. The applicant should have all reference material used in the ER available for the NRC staff's review.

D. IMPLEMENTATION

The methods described in this RG will be used in reviewing applications for CPs, OLs, ESPs, COLs, and LWAs, which include information under 10 CFR 51.45, 51.49, 51.50, 51.51, and 51.52, with respect to compliance with applicable regulations governing the environmental review of new nuclear power plants, unless the applicant proposes an acceptable alternative method for complying with those regulations. Backfitting, issue finality, and forward-fitting considerations do not apply to the NRC's use of this RG to support these NRC reviews.

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CFR, "Compensatory Mitigation for Losses of Aquatic Resources," Part 332, Title 33, "Navigation and Navigable Waters."

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[19] Publicly available NRC published documents are available electronically through the NRC Library on the NRC's public website at http://www.nrc.gov/reading-rm/doc-collections/ and through the NRC's Agencywide Documents Access and Management System (ADAMS) at http://www.nrc.gov/reading-rm/adams.html. For problems with ADAMS, contact the Public Document Room staff at 301-415-4737 or (800) 397-4209, or email pdr.resource@nrc.gov. The NRC Public Document Room (PDR), where you may also examine and order copies of publicly available documents, is open by appointment. To make an appointment to visit the PDR, please send an email to PDR.Resource@nrc.gov or call 1-800-397-4209 or 301-415-4737, between 8 a.m. and 4 p.m. eastern time (ET), Monday through Friday, except Federal holidays.

[20] Copies of American National Standard Institute (ANSI)/American Nuclear Society (ANS) standards may be purchased from the website (http://www.ans.org/store/); or by writing to: American Nuclear Society, 555 North Kensington Avenue, La Grange Park, Illinois 60526, U.S.A., Telephone 800-323-3044.

[21] Printed copies of *Federal Register* notices are available for a fee from the U.S. Government Publishing Office, 732 N Capitol Street, NW Washington, DC 20401, telephone (866) 512-1800, or they may be downloaded for free from the Government Publishing Office website: https://www.govinfo.gov/.

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[23] Copies of EPA publications can be obtained from the EPA Library Services through their website: http://www.epa.gov/libraries/library_services.html.

[24] Accessible from EPA's website at: http://www.epa.gov/oecaerth/nepa/nepassist-mapping.html.

[25] Copies of International Atomic Energy Agency (IAEA) documents may be obtained through their website: WWW.IAEA.Org/ or by writing the International Atomic Energy Agency P.O. Box 100 Wagramer Strasse 5, A-1400 Vienna, Austria. Telephone (+431) 2600-0, Fax (+431) 2600-7, or email at Official.Mail@IAEA.Org.

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APPENDIX A

Part 50 and Part 52 Licenses and Authorizations

The information provided in Section C of this Regulatory Guide (RG) is for environmental reports (ERs) for combined license (COL) applications that do not reference an early site permit (ESP). This appendix provides information for the development of ERs for other authorizations and licenses that can be granted by the U.S. Nuclear Regulatory Commission (NRC) under Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, and Part 52.

A.1 Early Site Permits

Before the ESP process was promulgated in 1989, the licensing process required large expenditures of time and money by applicants well before key site-specific environmental, safety and emergency planning issues could be resolved. The ESP process is meant to resolve these issues well in advance of any decision to build a nuclear power plant. The requirements for the information to be included in ERs for an ESP application are set forth in 10 CFR 51.45 and 51.50(b).

An ESP application requires a determination by the NRC as to the suitability of a site for the construction and operation of one or more nuclear reactors. It is not an authorization to construct and / or operate the nuclear reactor referenced in the ESP application or, in the case of a plant parameter envelope (PPE) design, a reactor that fits inside the bounding characteristics of the PPE. A PPE is a set of plant-design parameter values that an ESP applicant expects will bound the design characteristics of a reactor or reactors that might be constructed at a given site. Therefore, the PPE serves as a surrogate for reactor design information that is not available or for a reactor design that is not final. Use of this approach allows an ESP applicant to defer the decision on what reactor design to build to the COL stage. An applicant may use a PPE to support demonstration of compliance with 10 CFR 52.17. The combination of site characteristics and PPE values will comprise the ESP bases that will be the focus for comparison in the event a COL application is submitted for the site. At the COL stage, the applicant would determine if the design-specific vendor information for the selected reactor design fits within the PPE values and, if not, would appropriately address these environmental impacts in the COL application.

Nuclear Energy Institute (NEI) publication NEI 10-01, Revision 1, "Industry Guideline for Developing a Plant Parameter Envelope in Support of an Early Site Permit," describes the development and use of an ESP application from the industry's perspective, including the development of a PPE to bound multiple reactor designs. The PPE in NEI 10-01 is an example of the parameters needed for a PPE. However, not all parameters apply to all designs and additional parameters may be needed depending on the reactor designs that the PPE is bounding.

An applicant for an ESP should review previous applications along with associated requests for additional information to gain an understanding of the level of detail needed to receive an ESP. However, an applicant should only include in its ER information that is needed to analyze the environmental impacts for its project. The applicant should also review NUREG-1555 and this RG for guidance regarding the level of detail expected in the application. In addition, the applicant can discuss with the NRC any questions regarding level of detail during pre-application interactions. For example, if a PPE is used for an ESP review, the applicant should address the assumptions for the reactor designs being evaluated and whether the designs are within the bounds of the Nuclear Reactor Generic Environmental Impact Statement for Licensing of New Nuclear Reactors (NR GEIS). Finally, an applicant can refer to

RG 4.27, "Use of Plant Parameter Envelope in Early Site Permit Applications," for additional information.

All the information described in Section C of this RG will be required for an ESP application with the following exceptions based on 10 CFR 51.50(b)(2):

- the ER need not include an assessment of the economic, technical, or other benefits (e.g., need for power) and costs of the proposed action
- the ER need not include an evaluation of alternative energy sources
- the ER need not include an evaluation of severe accident mitigation design alternatives (SAMDAs) because this is a benefit-cost evaluation.

However, the applicant can, at its discretion, provide in the ESP ER the economic, technical, or other benefits (e.g., need for power) and costs of the proposed action, an evaluation of SAMDAs and an analysis of alternative energy. An applicant might choose to address any or all of these issues in its ESP application in order to gain early resolution of the issues.

A.2 Combined License Referencing an Early Site Permit

A COL referencing an ESP is a combined construction permit (CP) and operating license (OL) with conditions for a nuclear power plant issued under 10 CFR Part 52, Subpart C at the site that was found suitable in the ESP and referencing either a 10 CFR Part 52 certified design or providing all the required design information for a non-certified design. ER information requirements for a COL referencing an ESP application are set forth in 10 CFR 51.45 and 51.50(c)(1).

As stated in 10 CFR 51.50(c)(1), if the COL application references an ESP, then the "Applicant's Environmental Report—Combined License Stage" need not contain information or analyses submitted to the Commission in "Applicant's Environmental Report—Early Site Permit Stage," or resolved in the Commission's ESP environmental impact statement (EIS), but must contain, in addition to the environmental information and analyses otherwise required:

- Information to demonstrate that the design of the facility falls within the site characteristics and design parameters (i.e., the PPE) specified in the ESP.
- Information to resolve any significant environmental issue that was not resolved in the ESP proceeding.
- Any new and significant information for issues related to the impacts of construction and operation of the facility that were resolved in the ESP proceeding.
- A description of the process used to identify new and significant information on the NRC's conclusions in the ESP EIS. The process must use a reasonable methodology for identifying such new and significant information.
- A demonstration that all environmental terms and conditions that have been included in the ESP will be satisfied by the date of issuance of the COLs. Any terms or conditions of the ESP that could not be met by the time of issuance of the COLs must be set forth as terms or conditions of the COLs.

All the information described in Section C of this RG, with the exception of alternative sites, should be reviewed by the COL applicant to determine if any new and significant information has become available since the issuance of the ESP EIS. If new and significant information has become available, the applicant must include it in the ER for the COL referencing the ESP. The applicant's process for identifying new and significant information must be described in the ER. If SAMDAs, alternative energy sources and the economic benefits and costs were not evaluated in the ESP, then that information should be submitted in the COL application referencing the ESP. Any unresolved issues in the ESP must be addressed in the COL application.

A.3 Construction Permits and Operating Licenses

Construction Permit. A CP is an authorization from the Commission for the analysis, design, manufacture, fabrication, quality assurance, placement, erection, installation, modification, inspection or testing of a facility or activity. It is not an authorization to operate the plant. The requirements for the information to be included in the ER or ERs for a CP application are set forth in 10 CFR 51.45 and 51.50(a). All the information described in Section C of this RG should be considered for a CP application. While a complete reactor design may not be developed at the CP stage, an applicant should consult with the NRC staff in accordance with 10 CFR 51.40, "Consultation with NRC staff" to discuss the appropriate level of information which is required for severe accident mitigation alternatives (SAMAs), including available probabilistic risk assessment information, procedures, training activities, and plant-design alternatives (i.e., SAMDAs), that could significantly reduce the environmental risks from a severe accident.

Enclosure 1 of SECY-15-0002, "Proposed Updates of Licensing Policies, Rules, and Guidance for Future Reactor Applications," discusses unique challenges to assessing risks and SAMAs/SAMDAs. The 10 CFR Part 52 requirements to provide a description of a design-specific probabilistic risk assessment (PRA) do not apply to new reactor license applications submitted under 10 CFR Part 50, such as a CP, as of the time of this revision. However, the Staff Requirements Memorandum for SECY-15-0002 sets an expectation that licensing under 10 CFR Part 50 be performed consistently with 10 CFR Part 52, including how risk and severe accidents are addressed. Therefore, a CP application should provide information derived from the preliminary design to address these topics. A CP application should provide the best available information to assess SAMAs/SAMDAs. Since a PRA is not a regulatory requirement for a CP, the necessary supporting information to assess the environmental impacts from severe accidents and assess SAMAs/SAMDAs may not be provided in the CP application. In such a case, the evaluation of the environmental impacts of severe accidents and assessing SAMAs/SAMDAs may be deferred to the OL stage. The applicant of an OL referencing the CP is required in the OL application to provide new and significant information, including any such information related to SAMAs/SAMDAs or the evaluation of severe accidents and SAMAs/SAMDAs if not provided at the CP stage. Therefore, the staff recommends that any prospective applicant for a CP engage with the staff during pre-application activities in accordance with 10 CFR 51.40 regarding the extent to which it plans to address SAMAs/SAMDAs at the CP and OL stages.

During pre-application interactions, CP applicants should inform the staff if they plan to use Title 41 of the Fixing America's Surface Transportation (FAST) Act (42 U.S.C. 4370m).

Operating License. An OL is an authorization from the Commission to operate a plant specified in a related CP. The requirements for the information to be included in ERs for an OL application are set forth in 10 CFR 51.45 and 51.53(b). No discussion of need for power, alternative energy sources or alternative sites for the facility is required. All the information described in Section C of this RG should be reviewed by the applicant to determine if any new information has become available for each resource area since the issuance of the CP EIS. In the OL ER, the applicant shall discuss matters only to the extent

that they differ from those discussed previously or reflect new information in addition to that discussed in the final EIS prepared by the NRC in connection with the CP. Any new information identified, such as design information for SAMAs, will be required by the NRC staff for the review of the ER for the OL application.

To this end, it is important for potential new reactor applicants considering a CP and the subsequent OL under 10 CFR Part 50 to be aware of the process for engaging the staff on environmental matters, as described in 10 CFR 51.40.

A.4 Limited Work Authorizations and Site Redress

A Limited Work Authorization (LWA) is an authorization by the Commission to construct certain safety-related structures, systems, or components before issuance of a CP or COL. The requirements for the information to be included in ERs for an LWA application are set forth in 10 CFR 51.45 and 51.49. Requirements are provided for multiple cases including where (1) the LWA is submitted as part of a complete CP or COL application, (2) as a phased application for LWA and CP or COL, (3) as part of an ESP, (4) following receipt of an ESP, and (5) where the Commission previously prepared an EIS for construction and operation and the CP was issued, but facility construction was not completed. Only the first case (submitted as part of a complete CP or COL application) and the third case (as part of an ESP) are discussed in this appendix.

In accordance with 10 CFR 51.49(a) and (c), any ER prepared to support an LWA application under those regulations must include, which is in addition to the environmental report required by 10 CFR 51.50:

- a description of the activities that would be conducted under the LWA,
- a statement of the need for the activities,
- a description of the environmental impacts that may be reasonably expected to result from the activities, and
- the mitigation measures the applicant proposes to implement to achieve the level of environmental impacts described, and a discussion of the reasons for rejecting any mitigation measures that could be employed to further reduce environmental impacts.

In accordance with 10 CFR 51.49(d), an ER prepared to support an LWA application submitted by the holder of an ESP must include:

- a description of the activities proposed to be conducted under the LWA;
- a statement of the need for the activities;
- a description of the environmental impacts that may be reasonably expected to result from the activities;
- the mitigation measures the applicant proposes to implement to achieve the level of environmental impacts described, and a discussion of the reasons for rejecting any mitigation measures that could be employed to further reduce environmental impacts;

- any new and significant information for issues related to the impacts of construction of the facility that were resolved in the ESPs proceeding with respect to the environmental impacts of the activities to be conducted under the LWAs; and

- a description of the process used to identify new and significant information regarding NRC's conclusions in the ESPs EISs; the process must be a reasonable methodology for identifying this new and significant information.

The applicant should determine which resource areas will be affected by LWA activities and provide information on the impacts on those resource areas consistent with the information provided in Section C of this RG.

In accordance with 10 CFR 51.49(b), an ER prepared to support an LWA application submitted as part of a phased application in accordance with § 2.101(a)(9), may be limited to a discussion of the activities proposed to be conducted under the limited work authorization. If the scope of the environmental report for part one is so limited, then part two of the application must include the information required by § 51.50, as applicable.

The requirements of 10 CFR 50.10(d)(3)(iii) state that the application for an LWA must also include a plan for redress of activities performed under the LWA in the case where the activities associated with the LWA are terminated by the holder of the permit or license, if the LWA is revoked by the NRC, or if the associated CP or COL application is denied by the Commission. The plans for redress should be consistent with the regulations in 10 CFR 50.10(g) that the holder of the LWA must complete the redress of the site no later than 18 months after termination of construction, revocation of the LWA, or the effective date of the Commission's final decision to deny the associated CP or COL application as appropriate.

A.5 Standard Design Certification

The applicant for a standard design certification (DC), in accordance with 10 CFR 51.55, shall "submit with its application a separate document entitled "Applicant's Environmental Report – Standard Design Certification." The ER must "address the costs and benefits of severe accident mitigation design alternatives, and the bases for not incorporating severe accident mitigation design alternatives in the design to be certified." The NRC staff will develop an environmental assessment (EA) based on the information provided in the ER for the DC. The requirements for the information to be included in an ER for a DC application are set forth in 10 CFR 51.55.

To perform the necessary offsite consequence analysis in support of the SAMDA assessment, the applicant should develop the necessary site data (population distribution, meteorological data, land use data, etc.) in order to apply a severe accident consequence code, such as MACCS. Since a DC licensing action is not tied to a specific site selection, the applicant has flexibility to choose the source for this site data. This forms a "surrogate or representative" site, since it is likely for a location where they have no plans to build the reactor design that is the subject of the DC and that may or may not rely on real-world data. Therefore, the staff recommends that any prospective applicant for a standard DC engage with the staff during pre-application activities in accordance with 10 CFR 51.40 regarding the development of the site data.

For additional information on SAMDAs see Chapter 5 of Section C of this RG.

A.6 COL Application Referencing Standard Design Certification

As stated in 10 CFR 51.50(c)(2), if the COL references a DC, then the COL ER may incorporate by reference the EA previously prepared by the NRC for the referenced DC. If the DC EA is referenced, then the COL ER must contain information to demonstrate that the site characteristics for the COL site fall within the site parameters in the DC EA.

A.7 Manufacturing License

The applicant for a manufacturing license, in accordance with 10 CFR 51.54, shall "submit with its application a separate document entitled "Applicant's Environmental Report – Manufacturing License." The ER must "address the costs and benefits of severe accident mitigation design alternatives, and the bases for not incorporating severe accident mitigation design alternatives into the design of the reactor to be manufactured." The NRC staff will develop an EA based on the information provided in the ER for the manufacturing license. The requirements for the information to be included in an ER for a manufacturing license application are set forth in 10 CFR 51.54.

For additional information on SAMDAs, see Chapter 5 of Section C of this RG.

A.8 References

CFR, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions," Part 51, Chapter I, Title 10, "Energy."

CFR, "Licenses, Certifications, and Approvals for Nuclear Power Plants," Part 52, Chapter I, Title 10, "Energy."

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NRC, (Regulatory Guide 4.27), "Use of Plant Parameter Envelope in Early Site Permit Applications," Washington, DC (ADAMS No. ML23010A004).

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U.S. Code of Federal Regulations (CFR), "Domestic Licensing of Production and Utilization Facilities," Part 50, Chapter I, Title 10, "Energy." [33]

[32] The United States Code (USC) can be obtained electronically from the Office of the Law Revision Counsel of the House of Representatives at http://uscode.house.gov/.

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U.S. Nuclear Regulatory Commission (NRC), NUREG-1555, "Environmental Standard Review Plan: Standard Review Plans for Environmental Reviews for Nuclear Power Plants," Washington, DC.

APPENDIX B

Consultations

The U.S. Nuclear Regulatory Commission (NRC), as a Federal agency, is required to consult with other Federal agencies under several Federal laws. While this is the responsibility of the NRC, applicants, as the proponent of the action, should provide the information that the NRC will need to complete the consultation process in an efficient manner. Applicants should be aware of NRC's interagency consultation requirements, and environmental reports (ERs) should contain the information necessary for NRC to support completion of the consultation process. The NRC may or may not jointly perform consultations in conjunction with one or more other agencies who cooperate on the EIS; this, however, does not affect the information the NRC will need in order to perform such consultations.

B.1 Endangered Species Act

Congress enacted the Endangered Species Act (ESA) in 1973 (16 U.S.C. 1531 et seq.) to protect and recover imperiled species and the habitats upon which they depend. The U.S. Fish and Wildlife Service (FWS) and the National Oceanographic and Atmospheric Administration's (NOAA's) National Marine Fisheries Service (NMFS) jointly administer the ESA.

The NRC must comply with the ESA. Section 7 of the ESA (16 U.S.C. 1536) requires that each Federal agency ensure that any action authorized, funded, or carried out by an agency is not likely to jeopardize the continued existence of any endangered or threatened species (jeopardy), or destroy or adversely modify any critical habitat for such species (adverse modification). "Action," for the purposes of NRC activities, may include licensing, rulemaking, and/or other regulatory activities. Federal agencies should act, where they have the legal authority to do so, to prevent endangered species and their habitats from being threatened or destroyed. If an action may affect any federally listed endangered or threatened species or critical habitat, the NRC must consult with the Secretary of the Interior (for freshwater and terrestrial species through the FWS) or the Secretary of Commerce (for marine and anadromous species through the NMFS). Depending on the specific resources involved, the NRC consults with the FWS or NMFS (collectively referred to as "the Services") for all major Federal actions under the National Environmental Policy Act of 1969, as amended (NEPA) that require the preparation of an EIS. The NRC also may have to consult with the Services for actions that may affect a listed species or habitat but for which it does not prepare an EIS.

The Services' joint regulations implementing the ESA at 50 CFR, "Wildlife and Fisheries" Part 402 "Interagency Cooperation—Endangered Species Act of 1973, as amended," allows for two types of consultations: informal and formal. Informal consultation is a less structured approach than formal consultation and may include phone calls, email, letters, and meetings between the NRC and the Services. Informal consultation is typically initiated early in the application review process and may be the only type of consultation needed if the Services concur with the NRC that a proposed action is "not likely to adversely affect" listed species or critical habitat. The formal consultation process is a more structured approach to meeting ESA Section 7 requirements. Formal consultation is required if the NRC determines that a proposed action "may adversely affect" listed species or the action will result in adverse modification of designated critical habitat. Formal consultation may also be required if the Services do not concur with the NRC's conclusion that the action is "not likely to adversely affect" listed species or critical habitats. Consultation is not required should the applicant and NRC conclude that the licensed action would have "no effect" on any threatened or endangered species or critical habitat.

As a result of formal consultation, the Services may issue a Biological Opinion, a document that states the opinion of the Service as to whether the Federal action is likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of critical habitat. The Biological Opinion may include an incidental take statement, reasonable and prudent measures to reduce impacts on species or habitats, and terms and conditions. The Biological Opinion may also contain conservation recommendations, which are voluntary actions that the applicant or licensee can take that benefit the species or critical habitat.

The NRC may prepare a Biological Assessment to support informal or formal consultation. A Biological Assessment is a document that evaluates the potential effects of the action on listed and proposed species and critical habitats potentially affected by the action, and determines whether any species or habitats are likely to be adversely affected by the action. The "Consultation Handbook," prepared by the Services, discusses the Section 7 consultation process, which includes a discussion of the information to be included in a Biological Assessment, as required by 50 CFR Part 402.

Applicants can help the NRC complete its ESA consultation requirements in an efficient and timely manner. When preparing an application, applicants should identify which listed species or critical habitats may be present in the affected area. Applicants can obtain this information directly from the FWS and NMFS or through their websites. Applicants should present a detailed description of their proposed action in Chapter 3 of the ER. Applicants should then describe how their proposed action might potentially affect each listed species or critical habitat known to potentially be present in the area of their project. Applicants can provide this information in the terrestrial and aquatic sections of the ER or in a separate attachment.

B.2 Magnuson-Stevens Fishery Conservation and Management Act

The Magnuson-Stevens Fishery Conservation and Management Act of 1996 (MSA) ensures that renewable fishery resources are not exhausted by overharvesting or other environmental damage. Section 305 of the MSA (16 U.S.C. 1855) requires Federal agencies to consult with the Secretary of Commerce through NMFS before authorizing any action which may adversely affect essential fish habitat (EFH) identified under MSA. The Fishery Management Councils, in conjunction with NMFS, designate EFH, which can consist of both the water column and the seafloor of an aquatic area needed to support one or more life stages of a managed fish species.

The NRC will typically initiate such EFH consultations and prepare any necessary EFH assessment in conjunction with its NEPA review. The staff will document the status or outcome of the EFH consultation in the EA or EIS. If no change to any aspect of aquatic resources is anticipated, then an evaluation of EFH should not be necessary.

However, if a change to any aspect of aquatic resources is anticipated, then the NRC staff must determine if the requested action will result in any adverse effects to designated EFH, and if so, contact NMFS to initiate EFH consultation. The consultation process for an environmental review requiring an EFH assessment can be found in "Essential Fish Habitat Consultation Guidance," Version 1.1.

Applicants can help NRC complete its EFH consultation requirements in an efficient and timely manner. When preparing an application, applicants should identify whether any EFH may be present in potentially affected areas. Applicants can obtain this information directly from the NMFS or through its website. Applicants should present a detailed description of their proposed action in Chapter 3 of the ER. Applicants should then describe how their proposed action might potentially affect each area of EFH present in the area of their project. Applicants can provide this information in the aquatic sections of the ER or in a separate attachment.

B.3 National Historic Preservation Act

The National Historic Preservation Act of 1966, as amended (NHPA), was promulgated to coordinate public and private efforts to preserve significant historic and cultural resources. Section 106 of the NHPA directs Federal agencies to take into account the effects of their "undertakings" on historic properties and allow the Advisory Council on Historic Preservation (ACHP) an opportunity to review and comment on the undertaking. The ACHP is an independent Federal agency charged with implementing Section 106 throughout the Federal government; NHPA Section 106 implementing regulations are at 36 CFR Part 800, "Protection of Historic Properties." "Undertakings" (36 CFR 800.16(y)) denotes a broad range of Federal activities, including the issuance of NRC licenses and permits. "Historic property" (36 CFR 800.16(l)(1)) is any prehistoric or historic district, site, building, structure, traditional cultural property, or object included in or eligible for inclusion in the National Register of Historic Places (NRHP or National Register).

Applicants should be aware that the NRC staff will, in accordance with NHPA, consult with the State Historic Preservation Officer (SHPO), Tribal Historic Preservation Officer (THPO), Indian Tribes, and interested parties. Applicants are encouraged to engage with these parties when developing its ER.

When engaging these parties, the applicant should clarify that the NRC, as a Federal agency, is responsible for initiating and conducting government-to-government consultation with Indian Tribes once the application is submitted. An Indian Tribe is not obligated to consult with an applicant or share information about properties of religious and cultural significance with an applicant, and may prefer to communicate directly with NRC at the government-to-government level.

Face-to-face interactions with the SHPO will generally prove beneficial as a supplement to written correspondence, especially when agency feedback is requested on the scope and methodology for conducting cultural resource investigations. The applicant should also work with the SHPO to identify Indian Tribes that have ancestral ties to the proposed project area, and determine if/when to initiate outreach with THPOs and Indian Tribes. The applicant should not view the described initial outreach activities as merely "checking a box" to meet the NRC's expectations for an ER. Rather, such interactions will provide useful information for developing the scope of field surveys, identifying criteria for plant design or layout (e.g., impact avoidance or mitigation), and assessing resources of concern in the ER.

B.4 References

CFR, "Protection of Historic Properties," Part 800, Title 36 "Parks, Forests, and Public Property."

Endangered Species Act of 1973, 16 U.S.C. 1531 et seq. [34]

Magnuson-Stevens Fishery Conservation and Management Act of 1996, 16 U.S.C. 1801 et seq.

[34] The *Code of Federal Regulations* may be obtained electronically from the U.S. Government Publishing Office at: https://www.govinfo.gov/app/collection/cfr/.

National Historic Preservation Act of 1966, 54 U.S.C. 300101 et seq.

U.S. Code of Federal Regulations (CFR), "Interagency Cooperation—Endangered Species Act of 1973, as amended," Part 402, Chapter IV, Title 50, "Wildlife and Fisheries."[35]

U.S. Fish and Wildlife Service (FWS) and U.S. National Marine Fisheries Service (NMFS) 1998. "Consultation Handbook."[36]

U.S. National Marine Fisheries Service (NMFS). 2004. "Essential Fish Habitat Consultation Guidance," Version 1.1. National Marine Fisheries Service, Office of Habitat Conservation, Silver Spring, MD. [37]

[35] The *Code of Federal Regulations* may be obtained electronically from the U.S. Government Publishing Office at: https://www.govinfo.gov/app/collection/cfr/.

[36] Copies of National Marine Fisheries Service documents can be obtained electronically from their website: https://www.fisheries.noaa.gov/.

[37] Copies of the Essential Fish Habitat Consultation Guidance can be obtained electronically from their website: https://www.fisheries.noaa.gov/topic/habitat-conservation.

APPENDIX C

Reactor Applications that Reference the Generic Environmental Impact Statement for the Licensing of New Nuclear Reactors

C.1 Introduction

This appendix provides guidance in addition to that of Section C of this Regulatory Guide (RG) for preparation of environmental reports (ERs) for licensing actions for new nuclear reactors that reference the Generic Environmental Impact Statement for the Licensing of New Nuclear Reactors (NR GEIS, NUREG-2249). Multiple technologies may be able to apply the NR GEIS, including light-water reactors (LWRs), non-LWRs, and small modular reactors (SMRs). These reactor technologies vary with respect to the fuel used, neutron moderators employed, cooling processes, and other factors. New reactors might serve various possible purposes, such as generating power for (1) sale on a public electric grid, (2) a specific facility or installation such as a military base, or (3) a specific purpose, such as desalinating water.

SMRs are generally defined as reactor units that have an electrical output of less than 300 megawatts-electric (MW(e)) and are produced using modular fabrication and construction techniques. The terms "unit" and "module" refer to a reactor and are used interchangeably in this appendix. A non-LWR is generally defined as a nuclear power reactor that uses a coolant other than light water. SMRs can be a LWR or a non-LWR. New reactors may also be microreactors recognized by the U.S. Department of Energy (DOE) as generating less than 20 MWe.

This appendix is being updated to provide guidance to applicants on the use of NUREG-2249 *Generic Environmental Impact Statement for Licensing of New Nuclear Reactors* (NR GEIS), and to include applicable guidance from interim staff guidance COL-ISG-029, *Environmental Considerations Associated with Micro-Reactors* (ML20252A076). The purpose of the NR GEIS is to present impact analyses for the environmental issues common to many new reactors that can be addressed generically, thereby eliminating the need to repeatedly reproduce the same analyses each time a licensing application is submitted and allowing applicants and NRC staff to focus future environmental review efforts on issues that can only be resolved once a site or design is identified. The GEIS is intended to improve the efficiency of licensing new reactors by (1) identifying the possible types of environmental impacts of constructing, operating and decommissioning a new reactor, (2) assessing impacts that are expected to be generic (the same or similar) for many new reactors, and (3) defining the environmental issues that will need to be addressed in site-specific supplemental environmental impact statements (SEISs) addressing specific projects. COL-ISG-029 provided guidance on scaling analyses for microreactors commensurate with the significance of the impact on the resource area being addressed.

There are two approaches to developing an ER to support environmental reviews of new reactor applications. The first approach would be for the ER and the associated SEIS to incorporate by reference the applicable findings from the NR GEIS. The second approach would be for an applicant to prepare its ER without referencing the NR GEIS, and the staff would, in its associated environmental impact statement (EIS), evaluate all of the issues without relying on the analysis in the NR GEIS.

Non-LWR designs (e.g., high-temperature gas-cooled, liquid-metal, molten salt, and fusion reactors) will present some unique issues associated with environmental analyses of the impacts of operation. While Sections A through D of this RG do not specifically address non-LWRs, most of the guidance contained in them could be used for such reactors. Exceptions would include areas such as accidents, fuel cycle, transportation of radioactive materials, and decommissioning. An applicant for a

non-LWR should consult with the NRC staff in accordance with Title 10 of the *Code of Federal Regulations* Section 51.40 (10 CFR 51.40) to discuss the appropriate level of environmental studies or information that should be provided for a non-LWR design (e.g., additional information about the fuel cycle, radiological effluents, transportation of fuel and waste, and accidents). The ER for a non-LWR may reference the NR GEIS in accordance with the guidance related to the GEIS. The guidance in Section C.3 of this appendix highlights areas for consideration when developing ERs that reference the NR GEIS.

C.2 Additional Guidance for New Reactor Applications that Reference the NR GEIS

The additional guidance below specifies how a new reactor application that references the NR GEIS differs in terms of the information that should be provided in ERs supporting license or permit applications that are discussed in Section C of this RG.

C.2.1 Introduction/Purpose and Need

In general, the introduction to the ER should follow the guidance in Chapter 1.0 of this RG; however, the purpose and need statement may be different for some new reactors. In addition, as noted in Chapter 1.0 of this RG, the purpose and need statement may address additional needs other than the production of electricity. For example, a new reactor could be used to provide process steam to an industrial facility or for area heating.

C.2.2 Description of the Proposed Project and Alternatives

In general, the applicant should follow the guidance in Chapter 3.0 of this RG for the description of the proposed project. However, the applicant should also describe any unique features of a new reactor facility, including a site utilization plan that shows the location of the proposed plant (or modules if an SMR is proposed) and the locations of environmental interfaces. The site layout and plant description should clearly describe the scope of the project as proposed in the license application, including, for SMRs, the total number of modules requested to be licensed and the proposed operational date for each module. The applicant should also include any information known about the planned installation of future units.

In general, the applicant should follow the guidance in Chapter 9.0 of this RG for the development of a discussion of the project alternatives. The applicant should discuss which alternatives will be compared to the proposed action, and briefly describe why other alternatives were determined to not be reasonable. The applicant should include a description of the process it used to identify and select alternatives.

For large LWRs, reasonable energy alternatives to the proposed action may be limited because of the plant's large installed capacity. Because many new reactors may have a much smaller generating capacity, installations of individual renewable energy technologies (or combinations of renewable and nonrenewable energy technologies), conservation, and/or energy efficiency could potentially meet the project's purpose and need.

An alternative is not reasonable if it does not meet the purpose and need of the proposed action as defined in Chapter 1 of the ER. For example, a reasonable alternative power source would be able to generate the same amount of electrical energy (i.e., MWh/yr) with the same reliability as that generated by the proposed new reactor, as well as satisfy any additional purposes identified in the purpose and need statement in Chapter 1.0. For SMRs, the amount of power would be based on the total number of SMR modules for which the applicant has requested licenses. As another example, if the purpose and need are to demonstrate a new reactor technology, alternative energy sources such as coal, natural gas,

wind, solar, or hydro would not meet the need for the project. As such, these alternative energy sources would not be reasonable alternatives and would be eliminated from detailed analysis.

For the site-selection process for SMRs, the applicant should consider sites that could support all the modules for which licenses or permits are being requested, plus any planned future modules that the applicant concludes are reasonably foreseeable. Because SMRs are expected to require a smaller site footprint than large LWRs, a larger set of potential sites may need to be included in the site-selection process.

An applicant may request construction at a specific location to meet its purpose and need for a new reactor facility. For example, an applicant may propose to use excess heat for industrial processes or station heating as an additional purpose for the proposed project, or provide a secure energy source for military, government, or critical industrial facilities. In these cases, the applicant must still submit alternative sites. However, the region of interest (ROI) used for the site-selection process may be much smaller than is typical for large LWRs (e.g., the ROI may be limited to areas on or adjacent to the facility to which heat or power is being provided).

C.2.3 Affected Environment, Environmental Consequences of Construction and Operation

This section addresses the affected environment and the environmental consequences of construction and operation. In general, the applicant should follow the guidance in Chapters 2.0 and 4.0 through 7.0 of this RG for the description of the affected environment and the impacts of construction and operations. Construction as used in this RG includes construction and preconstruction.

C.2.3.1 Affected Environment

The description of the affected environment should generally follow the guidance in Section C of this RG. The description of the affected environment should be provided in sufficient detail to support the evaluation of the environmental impacts of the proposed action. Applicants should describe only the affected environment for those areas within which the resource could potentially be subject to direct or indirect impacts from the action. For smaller projects, the areal extent of potential impacts may be smaller than for large LWRs.

C.2.3.2 Construction Impacts at the Proposed Site

For SMRs, because modules may be installed over time to meet the demand for electricity, the applicant should describe and evaluate construction impacts over the timeframe specified in the application. For example, the construction workforce may be smaller but may be present over a longer period of time.

As part of the proposed action for an SMR, the applicant may install infrastructure and facilities that could be used to support additional reactor modules. These activities should be evaluated as part of the construction impact analysis in the ER.

C.2.3.3 Operational Impacts at the Proposed Site

For SMRs, because modules may be installed over time to meet the demand for electricity, the applicant should evaluate operational impacts over the timeframe specified in the application. For example, water use would increase as additional modules are installed.

Specific new reactor designs may have features that differ from large LWR designs. For example, dry cooling may be proposed, resulting in significantly less consumptive water use. In such cases, an applicant would not need to evaluate impacts from entrainment or impingement, or impacts from thermal discharges to a waterbody. The ER should include a short statement that environmental impacts in these areas are not expected because of the design features of the proposed plant.

C.2.4 Air Resources

While onsite data are preferred, some new reactors may not have an onsite meteorological tower, so the applicant may have to use other sources of climate and meteorological information, such as nearby National Weather Service (NWS) stations, Federal Aviation Administration stations, U.S. Environmental Protection Agency (EPA)-endorsed measurement programs, U.S. Department of Defense or DOE facilities, or non-NWS or non-EPA-endorsed measurement programs.

The minimum amounts of onsite meteorological data to be provided at the time of application are as follows:

- for a construction permit or limited work authorization – a representative consecutive 12-month period.

- for an operating license – a representative consecutive 24-month period, including the most recent 1-year period.

- for an early site permit (ESP) or a combined license that does not reference an ESP – a consecutive 24-month period of data that are defendable, representative, and complete, but not older than 10 years from the date of the application. However, 3 or more years of data are preferable and, if available, should be submitted with the application.

The applicant should provide baseline air quality conditions in their location and provide details about attainment status of the relevant air quality region at the time of application. The applicant may choose to perform its own air monitoring program or obtain data from nearby Federal and State monitoring sites. Air monitoring data for criteria pollutants and hazardous air pollutants are available in the EPA database (https://www.epa.gov/outdoor-air-quality-data). NRC staff expects that the applicant will determine the potential emission estimates for their project to determine if the project meets the PPE/SPE requirements.

C.2.5 Fuel Cycle

If the project does not meet the values and assumptions for any of the issues under the fuel cycle in Table C-1-1 in Addendum C.1, the applicant should follow the guidance in Section 6.1 of this RG when preparing a discussion of the fuel cycle. For a non-LWR design that is not bounded by the NR GEIS, the applicant should provide the information for their particular fuel cycle as discussed in PNNL-29367 Rev. 2, *Non-LWR Fuel Cycle Environmental Data*.

C.2.6 Transportation of Fuel and Waste

If the project does not meet the values and assumptions for any of the issues under the transportation of fuel and waste in Table C-1-1 in Addendum C.1, the applicant should follow the guidance in Section 6.2 of this RG when preparing a site-specific analysis of the transportation of fuel and waste. For a non-LWR design that is not bounded by the NR GEIS, the applicant should apply the

guidance provided in PNNL-29365, *Environmental Impacts from Transportation of Fuel and Wastes to and from Non-LWRs*.

C.2.7 Postulated Accidents

As noted in Section 5.10.2 of this RG, applicants can address the environmental impacts from severe accidents by applying information from a Level 1 and Level 2 PRA. However, an applicant may apply a deterministic accident analysis methodology (e.g., RG 4.7 Appendix A) to demonstrate the low consequences of a design's severe accident environmental impacts. This section provides guidance when applying the values and assumptions under the postulated accidents in Table C-1-1 in Addendum C.1 for severe accidents.

If utilized for supporting the severe accident determination, the Level 1 and Level 2 PRAs should be consistent with NRC staff's safety review guidance for PRAs (see SRP Chapter 19 of NUREG-0800, RG 1.233). The site-specific environmental risks of severe accidents (i.e., Level 3 PRA) should consider all severe accident types from the Level 1 PRA and apply all source terms from the Level 2 PRA. The Level 2 PRA information for the transition from radioactive material release to Level 3 PRA needs to have clear traceability of the release category quantifications back to the radioactive material release analysis. This would ensure that the necessary event information (e.g., event frequencies, source term release fractions and plume segments) from internally initiated events, fire events, flooding events, low power and shutdown events, and externally initiated events that could affect the Level 3 PRA analysis is provided in a suitable form for the NRC staff environmental review.

For the specific PPE selected, the applicant should provide a description of the methodology used to estimate site-specific environmental severe accident risks (e.g., Level 3 PRA or a deterministic method), including any computer code(s) to be used in the analyses, such as MELCOR Accident Consequence Code System (MACCS) code package (see NUREG/CR-6613, "Code Manual for MACCS2: Users Guide, Volume 1, and NUREG/CR-7270, "Technical Bases for Consequence Analyses Using MACCS (MELCOR Accident Consequence Code System), or related updated documentation) or with a similar functioning computer code package. The applicant should consider the following information to support the NRC staff's environmental review of severe accidents:

<u>For the population dose risk PPE determination:</u>

- Apply the appropriate information guidance in Section 5.10.2 of this RG and, when appropriate, extend the near field safety consequence calculation under RG 1.233 or RG 4.7 Appendix A out to 50 mi (80 km) accounting for the local site conditions (e.g., meteorological data along with population distribution, land use and economic input factors using the code SecPop (see NUREG/CR-6525, Rev. 2, "SecPop Version 4: Sector Population, Land Fraction, and Economic Estimation Program") along with other local site data).

<u>For Exposure Index 10 mi and 150 mi PPE determination:</u>

- Multiply the wind direction frequency (fraction of the time per year) for each of 16 (22.5°) compass sectors times the population in that sector for a given distance (i.e., 10 mi and 150 mi) from the site and sum all products.

<u>For a total effective dose equivalent (TEDE) PPE determination:</u>

- Apply the methodology and the related guidance in Appendix A in Revision 4 of RG 4.7, "General Site Suitability Criteria for Nuclear Power Stations." Appendix A of Revision 4 of RG

4.7 provides guidance for three different approaches for estimating TEDE consequences to inform the alternative population-related siting considerations for advanced reactors.

- Apply the methodology and related guidance of Appendix A, "General Methodology for Establishing Plume Exposure Pathway Emergency Planning Zone Size," of RG 1.242 for estimating TEDE consequences related in the analysis to establish an EPZ size.

For demonstrating the mitigation of severe accidents

The applicant provides a summary description of meeting the safety requirements in 10 CFR 50.155, Mitigation of Beyond-Design-Basis Events, and by incorporating by reference the appropriate section in the FSAR/PSAR. Applicants also have the option of discussing their intent of volunteering for the FLEX program in a similar manner as denoting in the environmental report implementation of the voluntary groundwater protection program. Applicants can also select performing a cost-screening analysis based on the SAMA guidance of Section 5.10.2 of this RG to determine if the maximum benefit monetary value of avoiding an accident is so small that mitigation is not justified. The NRC staff may also perform such a cost-screening as a confirmatory calculation.

C.2.8 Decommissioning

If the project does not meet the values and assumptions for the issue of decommissioning in Table C-1-1 in Addendum C.1, the applicant should follow the guidance in Section 6.3 of this RG when preparing a discussion of decommissioning impacts.

C.2.9 Cumulative Impacts

In general, the applicant should follow the guidance in Chapter 7.0 of this RG when preparing a discussion of the cumulative impacts. For an SMR, the applicant should consider impacts from the total number of modules being proposed in the licensing action, in addition to impacts from past, present, and reasonably foreseeable actions.

For SMRs using licensing Scenarios 1 and 3 described in Section C.4, the impacts of all the modules for which licenses have been requested would be direct impacts, and cumulative impacts for all modules should be addressed in the ER. Under Scenario 2, the ER should address cumulative impacts for those modules for which licenses have been requested plus future modules that the applicant considers reasonably foreseeable. Under Scenario 4, the additional modules considered in the ER and EIS for the early site permit (ESP) should be considered reasonably foreseeable actions for the evaluation of cumulative impacts of the modules considered in the initial COL applications.

C.2.10 Need for Power

If the need for the project is to provide electricity to the grid, the applicant should follow the guidance in Chapter 8.0 of this RG when preparing a discussion of the need for electrical power. If there are other proposed needs for the new reactor's power, such as area heating or desalinating water, the applicant should demonstrate those needs in sufficient detail for the NRC staff to determine whether the needs serve the public interest. Greenhouse gas reduction goals, fleet diversity, and other non-power goals of the proposed project are separate from the need for power, and their discussion can be qualitative and presented in the context of the benefits such goals would produce. For all licensing scenarios described in Section C.4, the analysis of the need for power and the cost-benefit, the ER should only consider the modules for which licenses are being requested.

C.2.11 Alternatives

In general, the applicant should follow the guidance in Chapter 9.0 of this RG for the development of a discussion of the project alternatives.

In the ER the applicant should compare the environmental impacts of the alternatives, including the no-action alternative that the applicant has determined are reasonable (see Section C.2.2).

C.2.12 Conclusion and Recommendation

Chapter 10.0 of this RG should provide sufficient guidance for preparing concluding remarks and discussing the project's benefits and the environmental costs for the proposed action for which a license or permit is being requested. However, the applicant should note that any additional purposes and needs that are unique to the proposed new reactor project should be accompanied by a description (quantified or qualified as the subject permits) of the benefits of each additional purpose in sufficient detail so that a fully informed benefit-cost conclusion can be reached.

C.3 Environmental Reports Referencing the NR GEIS – General Guidance

A new reactor ER may reference the NR GEIS. This section discusses the methodology the NRC staff used to develop the NR GEIS. The NR GEIS evaluated the impacts of building, operating, and decommissioning a new reactor sited within the United States and its territories that is bounded by the parameters and assumptions in Appendix G and the analyses in the GEIS. In addition, the NR GEIS considered fuel cycle impacts and the impacts of continued storage of spent fuel after operations. The term building, as used in the GEIS, includes the full range of preconstruction, construction, and installation activities. The term construction worker includes a worker engaged in building activities, and the term construction equipment includes equipment used for building activities.

For the NR GEIS, the staff made the assumption that the U.S. Army Corps of Engineers (USACE) would be a cooperating agency for all new reactor applications, in accordance with the Memorandum of Understanding between the two agencies. Because the USACE is assumed to be a cooperating agency on SEISs that would rely on the GEIS, preconstruction activities are addressed in Chapter 3.0 along with the impacts of NRC-authorized construction. The values and assumptions in the PPE and SPE also include, and do not differentiate between, the impacts of NRC-authorized construction and preconstruction. If, for a particular new reactor review, the USACE is not a cooperating agency, then the impacts of preconstruction would be considered cumulative impacts. However, the applicant must still include both NRC-authorized construction and preconstruction to demonstrate whether the values and assumptions in the PPE and SPE have been met.

Because new reactors are not limited to only one reactor design and could be sited anywhere in the United States and its territories that meets NRC siting requirements as set forth in 10 CFR Part 100, the NRC decided to pursue a technology-neutral, performance-based approach using a plant parameter envelope (PPE). The PPE consists of bounding values for specific reactor design features regardless of the site. Examples of parameters include the footprint of disturbance, building height, water use, air emissions, employment levels, and noise levels. For each PPE parameter, the staff developed a set of bounding values and assumptions. In addition, the staff developed a set of site parameters termed the site parameter envelope (SPE). Examples of PPE and SPE parameters include site size, size of water bodies supplying water to the reactor, and the characteristics of the region surrounding the site. For each SPE parameter, the staff developed a set of bounding values and assumptions related to the condition of the affected environment, such as the extent and occurrence of wetlands and floodplains, position near aquatic features, and proximity to sensitive noise receptors. The NR GEIS presents generic analyses that

evaluate the possible impacts of a reactor that fits within the bounds of the PPE on a site that fits within the bounds of the SPE.

The analysis in the NR GEIS identifies specific types of impacts relevant to each of 16 environmental resource areas, described in Chapter 3 of the GEIS, including multiple issues within each resource area. Each of the 119 issues corresponds to a specific type of environmental impact that could potentially result from building, operating or decommissioning a new reactor. The staff determined that 100 of the issues could be addressed generically, 17 require site-specific evaluation, and 2 could not be categorized. For each issue, the subject matter experts (SMEs) determined whether it would be possible to identify values and assumptions in the PPE and SPE that could effectively bound a meaningful generic analysis and provided the basis for each value and assumption. The staff then performed and described their generic analyses for each issue for a hypothetical reactor/site that meets the PPE and SPE assumptions. For the NR GEIS, the values and assumptions were set such that the SMEs could reach a generic conclusion of SMALL impacts, which are designated as Category 1 issues.

For some of the environmental impact issues, the staff could not reach a generic conclusion, even after considering potential values and assumptions for the PPE and SPE. In some cases, this was due to requirements of other statutes, such as the National Historic Preservation Act (NHPA) (54 U.S.C. 300101 et seq.) and the Endangered Species Act (ESA) (16 U.S.C. 1531 et seq.). In other cases, the wide range of potential reactor designs and potential site locations made it impossible for the staff to reach a generic conclusion. These issues are designated as Category 2 issues.

The SMEs drew conclusions about each analysis using one of the three significance levels that the NRC staff typically uses in EISs for new reactors, including the following:

- SMALL – Environmental effects that 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.

These significance levels follow the definitions presented in the footnotes in Table B–1 in Appendix B of Subpart A of 10 CFR Part 51. They are the same environmental significance levels and definitions used in the License Renewal GEIS and in recent EISs prepared by the NRC staff for COLs and ESPs for new LWRs. The discussion of each Category 1 environmental impact issue in the NR GEIS includes an explanation of how the significance category of SMALL was determined. For issues for which the probability of occurrence may be a key consideration (i.e., postulated accidents), the probability of occurrence has been factored into the determination of significance. Possible mitigation measures that could be used to avoid, minimize, rectify, reduce, eliminate, or compensate for adverse impacts are discussed where appropriate.

The SMEs assigned each issue to one of two categories depending on the potential utility of the generic analysis to applicants preparing specific new reactor licensing applications and to the NRC staff when completing environmental reviews of those applications. In summary, the categories are as follows:

- Category 1 issues – environmental issues for which the NRC has been able to make a generic finding of SMALL adverse environmental impacts, or beneficial impacts, provided that the applicant's proposed reactor facility and site meet or are bounded by the relevant values and assumptions in the PPE and SPE that support the generic finding for that Category 1 issue.[38]

- Category 2 issues – environmental issues for which a generic finding regarding the environmental impacts cannot be reached because the issue requires the consideration of project-specific information that can only be evaluated once the proposed site is identified. The impact significance (i.e., SMALL, MODERATE, or LARGE) for these issues will be determined in a project-specific evaluation.

Category 1 issues include one or more PPE/SPE parameters with associated values and assumptions; these values and assumptions are set to define a SMALL adverse impact or a beneficial impact.

An applicant addressing a Category 1 issue in its ER may refer to the generic analysis in the NR GEIS for that issue without further analysis, provided that it demonstrates that the relevant values and assumptions of the PPE and SPE used in the resource analysis are met and there is no new and significant information that would require site-specific analysis. The applicant will have to document how the values and assumptions are met, unless this is made clear in other information provided in the application package. The extent of the information necessary to demonstrate that a value or assumption is met will vary. In some cases, the demonstration may only require showing that the project falls within a parameter value or assumption (e.g., building height). But in other cases, analysis may be required to demonstrate that a value or assumption has been met. Addendum C.1 to this appendix provides guidance for demonstrating that values and assumptions have been met.

If the relevant values and assumptions for a Category 1 issue are not met, the applicant would have to supply the requisite information specified in Section C of this RG in its ER. The applicant may, however, be able to incorporate by reference all or part of the generic analysis provided in the NR GEIS and focus on providing the additional site-specific information needed. Applicants addressing Category 2 issues in an ER would have to provide all of the information typically needed by the staff to perform a site-specific analysis and may rely on guidance available in Section C of this RG.

It is possible that applicants for certain new reactors that were carefully designed to minimize environmental impacts may be able to demonstrate that their projects fall within all or most of the values and assumptions and may be able to reference the generic analyses in the GEIS for all or most of the Category 1 environmental issues. Also, as has always been the case, if the design of a project is such that an environmental issue (or group of environmental issues) is not applicable, then the applicant need not analyze the issue(s). For example, if the new reactor design does not use cooling water, then the impact issues associated with the use of cooling water do not need to be analyzed. However, the applicant must briefly describe its basis for concluding that the issue(s) is/are not applicable.

The NRC cannot rely on the GEIS alone to analyze the environmental impacts of the building, operation or decommissioning of any new reactors. For example, the staff would still have to conduct the consultations required by Section 106 of the NHPA and Section 7 of the ESA and include the documentation in the SEIS for each application. Therefore, these consultations are not part of the NR GEIS. The NRC staff will still have to complete other site-specific analyses upon receiving a new reactor

[38] Beneficial impacts may include increased tax revenues associated with the increased assessed value of new reactor projects, and other economic activity such as increases in local employment, labor income, and economic output.

application. An applicant for a new reactor permit should provide the information described in Section C and Appendix B of this RG for consultation.

The NRC staff has evaluated fuel cycle impacts for LWRs, as documented in 10 CFR 51.51, Table S-3, Table of Uranium Fuel Cycle Environmental Data. However, in accordance with 10 CFR 51.51, only an ER for LWRs can include Table S-3. For reactors other than LWRs, the application must contain the basis for evaluating the contribution of the environmental effects of fuel cycle activities for the reactor (10 CFR 51.50(b)(3) and 10 CFR 51.50(c)). Section 3.14 of the GEIS evaluated the fuel cycle impacts for new reactor fuel and determined that data from Table S-3 could bound the impacts of the fuel cycle for certain non-LWRs. An applicant for a non-LWR license could meet the requirements of 10 CFR 51.50(b)(3) and 10 CFR 51.50(c) by demonstrating that their fuel falls within the fuel cycle analysis in the NR GEIS. If the fuel cycle or parts of the fuel cycle do not fall within the analysis in the GEIS, then the applicant would need to provide the analysis of the parts of the fuel cycle that are not bounded.

The NR GEIS incorporates by reference NUREG-2157, in which the NRC evaluated the environmental impacts of the continued storage of spent nuclear fuel beyond the licensed life of the operation of LWRs. In 10 CFR 51.23, "Environmental impacts of continued storage of spent nuclear fuel beyond the licensed life for operation of a reactor," the NRC specifies that NUREG-2157 is deemed to be incorporated into the EIS for a new reactor. However, NUREG-2157 did not evaluate the storage of spent nuclear fuel from non-LWRs. The staff expects that many new reactors will not be LWRs. Section 3.14.2.6 of the GEIS therefore evaluated the applicability of NUREG-2157 and determined that the findings were applicable to non-LWR fuel, provided that the non-LWR fuel is stored in a manner that meets the regulatory requirements for spent fuel storage cask approval and fabrication in accordance with 10 CFR Part 72, Subpart L – "Approval of Spent Fuel Storage Casks," as was the LWR spent fuel evaluated in NUREG 2157.

The NR GEIS incorporated by reference NUREG-0586, Supplement 1, in which the NRC evaluated the environmental impacts of the decommissioning of nuclear power reactors. The NRC staff's evaluation of the environmental impacts of decommissioning presented in NUREG 0586, Supplement 1, considered environmental issues for LWRs and three permanently shutdown facilities that included a fast breeder reactor and two high-temperature gas-cooled reactors. Therefore, in Section 3.16.2 of the NR GEIS, the NRC staff evaluated the applicability of NUREG-0586, Supplement 1 (Decommissioning GEIS). The Decommissioning GEIS identified whether the environmental issues were considered generic to all decommissioning sites or project-specific. For the environmental issues assessed in the Decommissioning GEIS, most impacts were considered generic and SMALL for all plants, regardless of the activities and identified variables. This is because the impacts would be limited to operational areas, would not be detectable or destabilizing, and are expected to have a negligible effect on the impacts of terminating operations and decommissioning.

Threatened and endangered species was an issue that was determined to require a project-specific review. Four issues in the Decommissioning GEIS were considered to be conditionally project-specific:

- land use involving offsite areas to support decommissioning activities
- aquatic ecology for activities beyond the licensed operational area
- terrestrial ecology for activities beyond the licensed operational area

- historic and cultural resources (archaeological, architectural, structural, historic) for activities within and beyond the licensed operational area with no current (i.e., at the time of decommissioning) evaluation of resources for NRHP eligibility[39]

The NRC has generically evaluated the environmental impacts of the transportation of fuel and waste in 10 CFR 51.52, "Environmental effects of transportation of fuel and waste –Table S-4, "Environmental Impact of Transportation of Fuel and Waste to and from One Light-Water-Cooled Nuclear Power Reactor," for LWR fuel that meets certain entry conditions specified in 10 CFR 51.52(a). The staff evaluated the impacts of transportation of non-LWR fuel and waste in Section 3.15 of the NR GEIS and determined that the shipment of unirradiated and irradiated new reactor fuel and radioactive waste would be a Category 1 issue. The applicant can rely on the generic analysis as long as the PPE values are met.

In summary, the general analytical approach used by the NRC staff in the GEIS to evaluate environmental impacts was to (1) describe each environmental issue relevant to each of the 16 environmental resources considered; (2) categorize each issue as Category 1 or Category 2; (3) identify for each Category 1 issue the relevant values and assumptions in the PPE and SPE; and (4) assess the significance of the environmental impact on the Category 1 issue.

The ER should provide sufficient information to support each environmental impact assessment made by the applicant and the basis for findings (conclusions). Other documents may be incorporated by reference in the ER following the guidance in Section C.5 of this appendix. In preparing the ER, the applicant must meet the general requirements set forth in 10 CFR 51.45, "Environmental Report," 10 CFR 51.49, "Environmental Report – Limited Work Authorization," and/or 10 CFR 51.50, "Environmental Report – construction permit, early site permit, or combined license stage." Provisions specific to new reactors that reference the NR GEIS are set forth in 10 CFR 51.50(d).

C.3.1 Treatment of Category 1 Issues

In accordance with 10 CFR 51.50(d)(1), for any Category 1 issue for which the applicant relies on the generic analysis in the NR GEIS, the ER is required to demonstrate that the project is bounded by the values and assumptions in Table C-1, "Summary of Findings on Environmental Issues for Issuing a Permit or License for a New Nuclear Reactor," in Appendix C, "Environmental Effect of Issuing a Permit or License for a New Nuclear Reactor," to Subpart A, "National Environmental Policy Act—Regulations Implementing Section 102(2)," of 10 CFR Part 51. In accordance with 10 CFR 51.50(d)(2), the ER for a new reactor is not required to contain detailed analyses of the environmental impacts of the issues identified as Category 1 in Appendix C to Subpart A of Part 51 for which the proposed facility falls within the applicable values and assumptions of Table C-1. The ER should describe the affected environment and any environmental resources pertinent to those Category 1 issues that apply to the plant and identify Category 1 issues that do not apply to the plant (e.g., air-cooled design; no water use). The applicant should describe the affected environment in sufficient detail to demonstrate that the project meets the values and assumptions in the NR GEIS for a particular issue. The applicant is also required to determine whether there is any new and significant information about the issue. Once the applicant has demonstrated for a Category 1 issue that the project meets the values and assumptions in the GEIS, and that there is no new and significant information, then the ER can incorporate the findings in the GEIS and

[39] In some cases, the nuclear power plant itself may be considered a historic property for its unique design or contribution to a significant historic or engineering achievement. Ultimately, historic and cultural resources at each site can be quite different and must be assessed at a plant-specific level and in consultation with SHPOs, Tribal representatives, and other interested parties.

no further analysis is required for that issue. See further guidance below related to new and significant information.

In accordance with 10 CFR 51.50(d)(3), the ER for a new reactor is required to contain detailed analyses of the environmental impacts of any issues identified as Category 1 in Appendix C to Subpart A of Part 51 for which the proposed facility does not fall within the applicable values and assumptions of Table C-1. Section C of this RG discusses an acceptable method for fulfilling this requirement.

In accordance with 10 CFR 51.50(d)(4), the ER must contain a consideration of alternatives for reducing adverse impacts, as required by 10 CFR 51.45(c), for any issues identified as Category 1 in Appendix C to Subpart A of 10 CFR Part 51 for which the proposed facility does not fall within the applicable values and assumptions of Table C-1. No such consideration is required for Category 1 issues that meet the applicable values and assumptions of Table C-1.

See Addendum C.1 to this appendix for guidance related to demonstrating that values and assumptions have been met.

C.3.2 Treatment of Category 2 Issues

In accordance with 10 CFR 51.50(d)(3), the ER must contain analyses of the environmental impacts of the issues identified as Category 2 issues in Appendix C to Subpart A of 10 Part 51. Section C of this RG discusses an acceptable method for fulfilling this requirement.

In accordance with 51.50(d)(4), the ER must contain a consideration of alternatives for reducing adverse impacts, as required by § 51.45(c), for the issues identified as Category 2 in Appendix C to Subpart A of Part 10 CFR 51.

C.3.3 New and Significant Information

In accordance with 10 CFR 51.50(d)(5), for each Category 1 issue, the ER must contain any new and significant information regarding the environmental impacts of the new reactor of which the applicant is aware. For a Category 1 issue, new and significant information is information not available or considered in the assessment of impacts evaluated in the NR GEIS that could lead to a seriously different picture of the environmental consequences of the action than previously considered, such as an environmental impact finding different from that codified in Table C-1 of Appendix C to Subpart A of 10 CFR Part 51. New and significant information may also be information that identifies a significant environmental impact issue that was not available or considered and not addressed in the NR GEIS and, consequently, not codified in Table C-1. An applicant should state in the ER whether it is aware of any new and significant information and describe any actions taken to identify new information and evaluate its significance. This information will assist the NRC in fulfilling its responsibilities under 10 CFR 51.70(b), which states, in part, “The NRC staff will independently evaluate and be responsible for the reliability of all information used in the draft environmental impact statement.” Other interested parties, as well as the NRC, may also identify new and significant information during the scoping and public comment periods.

While new and significant information can be identified during the scoping process, during site visits, and from public comments on the draft SEIS, the applicant should identify new and significant information prior to the beginning of the environmental review. For each Category 1 issue, the applicant must determine whether any new and significant information, as defined above, exists. If new and significant information is identified, the applicant should describe the information that it found and assess relevant environmental impacts. In accordance with 10 CFR 51.50(d)(6), applicants must describe the

methods used to identify potential new and significant information. The ER will provide the following information:

- Describe the process for gathering and reviewing new and significant information for the ER. Explain how the process resulted in the identification of new and significant information for Category 1 issues and any other issues. The explanation should address (1) the process used to identify new information and (2) the process for determining the significance of any new information. The process for identifying new information could include the review of environmental monitoring reports, scientific literature, interviews with applicant staff, discussions with licensees and other peer groups and industry organizations, consultations with experts knowledgeable about the local environment, and consultations with other Federal, State, local, and Tribal environmental, natural resource, permitting, and land use agencies. If the applicant determines that no new and significant information exists, the applicant should state this determination in the ER.

- Describe any new and significant information and any associated environmental impacts.

- For each adverse impact, describe mitigation measures that were considered and those that could be implemented.

The applicant need not include detailed supporting documentation in the ER about the discovery of new and significant information, but such information should be available for review by the NRC staff.

C.3.4 Impact Findings

For Category 2 issues and for new and significant information, applicants should assess environmental impact issues in proportion to their significance as prescribed in 10 CFR 51.45(b)(1). In assessing the significance of environmental impacts, the applicant should conform to the definitions of significance level used by the NRC in the NR GEIS and codified in a footnote to Table B-1 in Appendix B to Subpart A of 10 CFR Part 51.

C.3.5 Alternative Sites

The NR GEIS did not evaluate alternative sites. However, the applicant can use the GEIS for both the proposed and alternative sites to address Category 1 issues for which it can show that the values and assumptions are met. If for example, the applicant demonstrates that both the proposed and alternative sites meet the values and assumptions for a Category 1 issue, then for that issue the impact on both the proposed and alternative sites would be SMALL. The Category 2 issues, and Category 1 issues for which the values and assumptions are not met require a site-specific analysis following the guidance in Section C of this RG. The comparison of proposed and alternative sites would follow the guidance in Chapter 9 of Section C and would be based on the differences in impacts for each issue.

C.4 Licensing Scenarios for SMRs

There are several possible scenarios for SMR applications (both LWR and non-LWR). The information provided in the ER would depend on the types of applications submitted and the timing of actions proposed in the application. The most likely licensing scenarios for SMR applications are described below. It is possible these scenarios could be applied to other types of new reactors.

C.4.1 Scenario 1: All Modules in One Application

A potential applicant could request licenses for multiple modules installed over time. Under this scenario, the proposed action would include licenses for all the modules that would be constructed at the proposed site. The applicant should provide a schedule indicating when each module would be constructed and operated to inform the NRC staff of the timing of impacts. The information submitted to support the NRC's cumulative impact analysis should follow the guidance in Chapter 7.0 of this RG. In Chapter 9 of the ER, the analysis should compare the impacts of constructing and operating all of the modules at the alternative sites to the cumulative impacts of Chapter 7 of the ER to determine if an environmentally preferable or obviously superior site exists. The information submitted by the applicant to support the need-for-power analysis, alternative energy analysis, and benefit-cost analysis should be based on an accounting of the full capacity of all the modules for which licenses are being requested.

C.4.2 Scenario 2: Two or More Separate License Applications (Subsequent application considered an expansion of the existing site)

An applicant could request licenses for one or more modules and inform the NRC that it intends to request licenses for additional modules in the future. Under this scenario, the proposed action would include only the modules for which licenses are requested. The applicant should indicate to the NRC how many additional modules will be treated as reasonably foreseeable for the purposes of evaluating cumulative impacts. For the additional modules to be treated as reasonably foreseeable, the siting study submitted with the original application should include consideration of all the modules.

The information requested in Chapters 4 (construction) and 5 (operations) of this RG would apply to the modules for which licenses have been requested. This would also include the construction of any infrastructure meeting the NRC's definition of "construction" in 10 CFR 51.4 that is proposed to be built with the initial units. The information requested in Chapter 7.0 (cumulative impacts) of this RG should include the impacts of the additional modules deemed to be reasonably foreseeable. The information requested in Chapter 9.0 (alternatives) of this RG for the alternative sites should also include consideration of the additional future modules that are considered reasonably foreseeable. The information requested for the need-for-power analysis in Chapter 8, alternative energy analysis in Chapter 9.0, and benefit-cost analysis in Chapter 10.0 of this RG would be based on only the modules for which licenses were being requested.

If an applicant subsequently requests licenses for additional modules, the ER for the additional modules should address all the issues except alternatives sites. The ER should use the EIS for the original group of modules as a starting point and evaluate any new and significant information relevant to environmental concerns similar to an ER for a COL referencing an ESP. The NRC staff would develop a SEIS based on the information provided in the new ER.

C.4.3 Scenario 3: Two or More Separate License Applications (Subsequent applications not considered an expansion of the existing site)

In certain circumstances, a licensee or applicant may identify the need for additional modules that were not identified as reasonably foreseeable in a previous application, and therefore were not addressed in the in the previous application (e.g., siting, alternative energy). In such a case, the ER (and the NRC's EIS) for the subsequent application must address all of the issues in this RG including alternative sites and alternative energy.

C.4.4 Scenario 4: ESP and COL Application

An applicant may request an ESP for all planned modules and then request COLs for only the modules it plans to build in the short term. In this scenario, the information that should be supplied in the ER for the ESP review should include consideration of all of the modules that are planned. If the proposed site is found to be acceptable by the NRC staff, the issue of alternative sites would be resolved for any future COLs referencing the ESP. The issues of alternative energy and need for power (if addressed in the ESP application and EIS) would also be resolved unless the NRC staff identified new and significant information about these issues in its review of the COL application referencing the ESP. Consideration of the various modules (i.e., those for which licenses are requested and those planned in the future) in the COLs would follow the same steps described above for Scenario 2.

C.4.5 Summary of Licensing Scenarios

All of the scenarios described above are valid approaches. The outcome of Scenario 1 is that the NRC staff would have completed its environmental analysis for all modules, the licensing action would have been taken, and no further environmental analysis would be required.

The outcome of Scenario 2 is that, if the applicant applies for licenses for future modules, the NRC would prepare a SEIS that would tier off the EIS prepared for the initial modules in which the cumulative impacts for the future modules were assessed. The SEIS would evaluate any new and significant information, need for power, and the cost-benefit for the additional modules being licensed. The SEIS would not evaluate alternative sites.

Under Scenario 3 the NRC would evaluate only the requested number of modules and any subsequent application for additional modules at that site would need to address all environmental review areas including alternative sites and alternative energy.

Under Scenario 4, the NRC would prepare a SEIS for each COL application referencing the ESP. Key differences between Scenarios 2 and 4 are that, in Scenario 4, an applicant would be resolving siting issues in the ESP and could maintain flexibility in selecting the design until submittal of the COL application. All issues resolved in the ESP EIS would be considered resolved for the COL EIS unless the NRC staff identified new and significant information.

ESP EISs are intended to facilitate early resolution of siting issues. ESP applications can, but are not required to, include need for power or alternative energy.

C.5 Licensing Scenarios for New Reactors

Some proposed new reactor designs allow for incremental additions to a single facility, similar to SMR designs. For applications with these characteristics, the applicant shall submit an application for each planned reactor, regardless of when each reactor is planned to be added to the facility. If the applicant applies for licenses for future modules, the applicant would apply for a license for each subsequent reactor at the facility and NRC would prepare a SEIS that would tier off the EIS prepared for the initial modules. The SEIS would evaluate any new and significant information, the need for power, and the cost-benefit for the additional modules being licensed, but it would not evaluate alternative sites. For a situation where the applicant submits an ESP, the applicant maintains flexibility in selecting the design of the new reactor until submittal of the COL application. All issues resolved in the ESP EIS would be considered resolved for the COL EIS unless the NRC staff identified new and significant information. Because ESP EISs are intended to facilitate early resolution of siting issues, ESP applications are not required to include the need for power and alternative energy.

Addendum C.1

Guidance Related to Demonstrating that Values and Assumptions Have Been Met

An applicant addressing a Category 1 issue in its environmental report (ER) may refer to the generic analysis in the *Generic Environmental Impact Statement for Licensing New Nuclear Reactors* (NR GEIS; NUREG-2249) for that issue without further analysis, provided that it demonstrates that the relevant values and assumptions of the plant parameter envelope (PPE) or site parameter envelope (SPE) used in the resource analysis are met or are shown to be bounding and there is no new and significant information that would require project-specific analysis.[40] The applicant will have to document how the assumptions are met, unless this is made clear in other information provided in the application package. The extent of the information necessary to demonstrate that an assumption is met will vary, depending on the assumption. In some cases, the demonstration may only require showing that the project falls within a parameter value or assumption (e.g., building height). But in other cases, analysis may be required to demonstrate that a value or assumption has been met.

Table C-1-1 lists each of the values and assumptions, along with guidance related to demonstrating that the value or assumption has been met.

[40] As used in this document, when the staff states that the project meets a value or assumption of the PPE or SPE, it should be read as to mean that the project meets or is bounded by the value or assumption.

Table C-1-1. Guidance Related to Demonstrating That the Value or Assumption Has Been Met

PPE/SPE Values and Assumptions	Method of Demonstration
Reactor Site Criteria	
10 CFR 100.20, Factors to be considered when evaluating sites	Compliance must be demonstrated in the applicant's final safety analysis report (FSAR) using the guidance in the Standard Review Plan (SRP, NUREG-0800).
10 CFR 100.21, Non-seismic siting criteria	Compliance must be demonstrated in the applicant's FSAR using the guidance in the SRP
10 CFR 100.23, Geologic and seismic siting criteria	Compliance must be demonstrated in the applicant's FSAR using the guidance in the SRP
Site Size and Location	
100 ac (40 hectare)	Document site acreage and include a scaled map or drawing outlining the site boundaries. Demonstrate that the site is large enough to accommodate the proposed reactor and supporting facilities, the exclusion area as defined in 10 CFR Part 100, and any lands (other than offsite rights-of-way [ROWs]) permanently or temporarily needed for construction and operation of the proposed reactor and supporting facilities.
Complies with applicable zoning	Indicate the zoning for all lands encompassed by the site and explain how the proposed project complies with the zoning. Briefly explain whether any variances would be required.
Consistent with the objectives of any relevant land use plans	Indicate what, if any, comprehensive land use plans or other land use plans pertain to the site. Briefly summarize the land use objectives expressed in the plan(s) for the area containing the site and explain how the proposed reactor is consistent with those objectives.
Complies with the Coastal Zone Management Act (CZMA, 16 U.S.C. 1451 et seq.) and the Farmland Protection Policy Act (FPPA, 7 U.S.C. 4201 et seq.), if applicable	CZMA: Indicate whether any part of the site lies within or adjoins the coastal area of any State or other jurisdiction. If so, provide a copy of the jurisdiction's coastal zone consistency determination or a letter indicating that a consistency determination will not be required. If the State has not yet reached a determination, provide copies of communication with the jurisdiction's agency responsible for administering the CZMA, indicate when the State is expected to reach a determination, and briefly explain why the State is expected to reach a favorable determination. FPPA: If any part of the site is owned or controlled by a Federal agency, provide evidence that the responsible agency has consulted with the Natural Resources Conservation Service (NRCS) in accordance with the requirements of the FPPA. If the consultation is not yet completed, provide copies of NRCS communication to date, any Farmland Conversion Impact rating forms that have been completed, and briefly explain them.
Completed structures would not be sited within 1 mi (1.6 km) of and would not be visible from Federal or State parks or wilderness areas, areas designated as Class I under Section 162 of the Clean Air Act (42 U.S.C.	Provide a scaled map showing the site and any Federal or State parks, wilderness areas, Class I areas under Section 162 of the Clean Air Act, Wild and Scenic Rivers, Natural Heritage Rivers, or State-designated rivers of conservation concern within 2 mi (3.2 km) of the site perimeter; or provide a statement that none of these types of areas occurs within 2 mi (3.2 km) of the site perimeter. Note that the assumption is that no such areas occur within 1 mi (1.6 km) of the site perimeter; coverage for the additional distance is requested solely for verification purposes.

PPE/SPE Values and Assumptions	Method of Demonstration
7401 et seq.), or a Wild and Scenic River (Wild and Scenic River Act (16 U.S.C. 1271 et seq.), or a National Heritage River, or a river of similar State designation.	
No existing residential areas within 0.5 mi (0.8 m) of site	Provide a scaled map showing the site and any existing residential land uses within 1 mi (1.6 km) of the site perimeter, or provide a statement that no existing residential land uses occur within 1 mi (1.6 km) of the site perimeter. Note that the assumption is that no such areas occur within 0.5 mi (0.8 m) of the site perimeter; coverage for the additional distance is requested solely for verification purposes.
Permanent Footprint of Disturbance	
30 ac (12 hectare) of vegetated lands	Provide a scaled basemap of existing land cover on the site that at a minimum distinguishes between vegetated cover (such as forest, scrub, lawn, and cropland) and non-vegetated cover (such as buildings, pavement, gravel, or unvegetated dirt surfaces). Existing land cover may be based on aerial photography or satellite imagery that is no more than 1 year old at the time of submittal, or may be developed using another mapping procedure where land cover boundaries can be estimated to an accuracy of at least plus-or-minus 10 ft (3.048 m). To the basemap, add an overlay depicting the perimeter of all areas(s) of disturbance, including separate perimeters for areas of permanent disturbance and areas of temporary disturbance. When considering disturbance, account for areas of grading and other vegetation disturbance and not just for the position of actual structures. Indicate the acreage included in the perimeters for permanent and temporary disturbance.
Counts only land that supports vegetation as of project baseline	When demonstrating that the proposed footprint of disturbance does not encompass more than 30 ac (12 hectare) of vegetated land, do not count areas of unvegetated land encompassed therein, such as areas of pavement, rooftops, or exposed soils deliberatively maintained free of vegetation. The generic analysis does not rely on any assumed maximum of disturbance to lands that are not vegetated at the time of application. However, do count as "vegetated" lawns, landscaped areas, and areas of sparse or weedy vegetation.
No prime or unique farmland, or other farmland of statewide or local importance	Provide a scaled map depicting the NRCS soil survey mapping units on the site (available online from the NRCS website) and indicate which mapping units are designated as prime or unique farmland or farmland of State or local importance. Provide the total acreage of all NRCS soil mapping units designated in each farmland category.
No floodplains, surface-water features, riparian habitat, late successional vegetation, or dedicated conservation land	Provide a scaled map depicting the proposed permanent and temporary footprints of disturbance and the following features: • 100-Year Floodplain boundaries. Use data based on Flood Insurance Rate Maps developed by the Federal Emergency Management Agency, State agencies, or onsite hydrological modeling using widely accepted modeling procedures such as those of TR-55 developed by the NRCS. Account for riverine, coastal, and lacustrine floodplains. Depiction of "floodway" boundaries is not necessary, and depiction of "floodways" by themselves is insufficient. In areas where published floodplain data are not available, use hydrological modeling data but only for oceans and estuaries, lakes over 100 ac (40 hectare) in area, and second-order or larger perennial

PPE/SPE Values and Assumptions	Method of Demonstration
	streams and rivers (i.e., those downstream of the junction of two solid "blue-line" perennial streams on 7.5-minute U.S. Geological Survey (USGS) topographical quadrangles). • Riparian Habitat: Unless the project is downstream of major dams, identify any habitat within the 100-year floodplain as riparian habitat. If the project is downstream of major dams, identify as riparian habitat any areas whose vegetation is dominated by the same plant species predominant at the shoreline (or explain and justify any other approach used to bound riparian habitat). Other considerations might include the presence of alluvial deposits, watermarks on trees, and the presence of wracklines or other evidence of debris deposited by recent flooding. • Late Successional Habitat: Identify any areas containing what appears to be "old growth" vegetation that has not experienced significant human or natural disturbance for several decades. Consider what the expected old growth vegetation might be for the geographic region and landscape settings involved. For difficult or questionable determinations, consult with an ecologist who has regional experience. While the late successional vegetation of many well-drained, deep-soiled humid areas of the United States is forest containing a mix of large and smaller trees, that of other more arid, poorly drained, cold, or thin-soiled areas may be grassland (prairie), shrub-shrub, or tundra. • Dedicated Conservation Land: Identify any public or private land specifically targeted for conservation by Federal, State, or local agencies or by widely recognized conservation organizations. If any or all of the above features are not present within or adjacent to the proposed footprint of disturbance, state so and indicate what sources of information support that statement.
No more than 0.5 ac (0.2 hectare) of wetlands in permanent or temporary disturbance on the site or ROWs	Provide a scaled map of the site and each offsite ROW depicting the boundaries of wetland areas delineated using a wetland delineation methodology acceptable to the U.S. Army Corps of Engineers (USACE) for the applicable region. Depict all wetlands delineated using the methodology, regardless of anticipated jurisdictional status under the Clean Water Act (CWA). Provide a copy of a Jurisdictional Determination (JD) or preliminary JD from the USACE, if available. Otherwise, provide a copy of the wetland delineation report, including field data sheets. If the State recognizes a wetland delineation methodology other than that recognized by USACE, additionally depict the wetland boundaries delineated using the State methodology. Provide a copy of the State's concurrence with the delineation, if available, or otherwise provide a copy of the State wetland delineation report and field data sheets. Overlay the perimeter of the permanent and temporary footprints of disturbance on the scaled wetland map. Calculate the total of all wetlands within either footprint of disturbance, including wetlands potentially under CWA jurisdiction and any other wetlands meeting the Federal or State delineation criteria. The assumption is met if the total, regardless of jurisdiction, does not exceed 0.5 ac (0.2 hectare).
The site and ROWs do not have a history of past industrial use capable of leaving a legacy of contamination	Provide a review of the site and ROWs using current methodologies in ASTM E 1527, Standard Practice for Environmental Site Assessments, completed within the past year. The assumption is met if the review indicates no evidence of known potential environmental contamination.

PPE/SPE Values and Assumptions	Method of Demonstration
requiring cleanup to protect human health or the environment.	
No Individual Permits required under Section 404 of the CWA	Indicate that no permits are required under Section 404 of the CWA, or demonstrate that the project could meet all such permitting requirements using one or more general permits established by the USACE or State wetland agencies.
Use of best management practices (BMPs) for soil erosion, sediment control, and stormwater management	List specific measures that will be taken to minimize soil erosion and sedimentation, or provide copies of plans prepared for approval by local authorities. Reference to existing guidance documents or plans previously approved for similarly scaled industrial land developments (not necessarily nuclear) in the region is acceptable. If approved, provide copies of the approvals. If not yet approved, briefly explain how the measures or plans will comply with applicable regulations or ordinances. If no relevant regulations or ordinances exist for the region, briefly explain how the proposed measures are comparable to those currently used for nuclear or other industrial projects in similar regions.
Implementation of mitigation specified in CWA permits	Provide copies of (or reference to) the applicable permits and briefly explain how each of the associated mitigation requirements will be met.
Habitat is not known to be potentially suitable for one or more Federal or State threatened or endangered species.	Provide letters or database information from the U.S. Fish & Wildlife Service (FWS), National Marine Fisheries Service (NMFS; commonly referred to as National Oceanographic and Atmospheric Administration or NOAA Fisheries), and applicable State agencies documenting the absence of records for areas within 1 mi (1.6 km) of the site and any offsite ROWs. If a State has a natural heritage database, include information from that database. The assumption is met if there are no species designated as threatened or endangered or using similar State terminology. Designations such as "proposed," "candidate," or "special concern" do not count against the assumption. Designations of "extinct" or "extirpated" similarly do not count. If a database provides species conservation "ranks," consider only species bearing the designation of G1 or G2, S1 or S2, or the highest State designations suggestive of being endangered or threatened within the State.
Temporary Footprint of Disturbance	
Additional 20 ac (8 hectare) of vegetated land	As described above for the Permanent Footprint of Disturbance, provide a scaled basemap of existing land cover on the site that at a minimum distinguishes between vegetated and non-vegetated cover. To the basemap, add an overlay depicting the perimeter of all areas(s) of disturbance, permanent and temporary.
Count only land that supports vegetation as of project baseline	When demonstrating that the proposed footprint of temporary disturbance does not encompass more than 20 ac (8 hectare) of vegetated land, do not count areas of unvegetated land encompassed therein, such as areas of pavement, rooftops, or exposed soils deliberatively maintained free of vegetation.
Restored to original grade and seeded or planted with indigenous vegetation once construction is complete.	Briefly explain how original grade will be restored, topsoiled, and revegetated. Identify possible source(s) for topsoil and the proposed depth of topsoiling. Propose a seed mix and/or develop a planting plan consisting mostly of regionally indigenous plant species. Identify seeding rates and the size, spacing, and quantities of tree or shrub seedlings and nursery-grown seedlings, if used. Identify possible sources of seeds and other plant material. If seeds of non-indigenous grasses or forbs are needed for initial soil stabilization, briefly explain how those species are expected to be displaced by indigenous species. Provide a brief explanation of measures to monitor, maintain, and rectify the planted material and exclude invasive vegetation for at least 5 years after planting.

PPE/SPE Values and Assumptions	Method of Demonstration
Offsite Rights-of-way (ROWs)	
No longer than 1 mi (1.6 km) and no wider than 100 ft (30.48 m), but allows for unlimited additional mileage for linear features built within existing ROWs or directly adjacent to existing ROWs or public highways	Provide scaled maps or drawings outlining the boundaries of each proposed new offsite ROW or widening of existing ROWs. If existing ROWs or public roads border the proposed ROWs, depict these adjacent features on the maps or drawings.
Does not cause the total project-wide wetland fill to exceed 0.5 ac (0.2 hectare)	Provide a scaled map of each offsite ROW depicting the boundaries of wetland areas delineated using a wetland delineation methodology acceptable to the USACE for the applicable region. Depict all wetlands delineated using the methodology, regardless of anticipated jurisdictional status under the CWA. Provide a copy of a JD or preliminary JD from the USACE, if available. Otherwise, provide a copy of the wetland delineation report, including field data sheets. If the State recognizes a wetland delineation methodology other than that recognized by USACE, depict also the wetland boundaries delineated using the State methodology. Provide a copy of the State's concurrence with the delineation, if available, or otherwise provide a copy of the State wetland delineation report and field data sheets. Overlay the perimeter of the permanent and temporary footprints of disturbance on the scaled wetland map. Calculate the total of all wetlands within either footprint of disturbance, including wetlands potentially under CWA jurisdiction and any other wetlands meeting the Federal or State delineation criteria. The assumption is met if the total, regardless of jurisdiction, does not exceed 0.5 ac (0.2 hectare). For offsite transmission-line ROWs greater than 1 mi (1.6 km) in length, another suitable approach would be to provide a basemap depicting wetland boundaries based on National Wetland Inventory (NWI) maps or other wetland mapping developed by Federal or State agencies, and indicate placement of new poles or towers and access roads (and other areas of proposed physical ground disturbance).
Would not involve ground disturbance to streams greater than 10 ft (3.048 m) in width	Using the maps or drawings noted above, identify each perennial stream crossing and estimate its width. Alternatively, trace the centerline of each ROW on 7.5-minute USGS topographical coverage and identify each crossing of blue water features. Features depicted as intermittent streams or using solid blue lines lacking a width dimension may be assumed to be under 10 ft (3.048 m) in width. Using the USGS map coverage, record the width of any blue features containing a width dimension. Alternatively, provide field-measured width data.
Does not cross or pass within 1 mi (1.6 km) of parks, wildlife refuges, or conservation lands	If these features occur within 1 mi (1.6 km) of any offsite ROW, provide a scaled map or drawing depicting the distance from the ROW boundary.
Does not cross or pass within (1 mi (1.6 km) of, or is not visible from, Federal or State parks or wilderness areas, areas designated as Class I	If these features occur within 1 mi (1.6 km) of any offsite ROW, provide a scaled map or drawing depicting the distance from the ROW boundary.

PPE/SPE Values and Assumptions	Method of Demonstration
under Section 162 of the Clean Air Act, or a Wild and Scenic River or a National Heritage River, or a river of similar State designation	
May span wetlands, waters of the United States, floodplains, shoreline, or riparian lands	No demonstration needed.
Any new transmission poles or towers would be constructed outside of wetlands and floodplains	Overlay any offsite ROWs on basemaps depicting wetlands (such as the NWI coverage available from FWS) and floodplains (such as 100-year floodplain data available from Flood Insurance Rate Maps). Use of wetland delineation maps and/or floodplain modeling maps is acceptable but not necessary. Roughly estimate the approximate locations for transmission-line poles or towers. Confirm that any proposed spans exceeding 2,000 ft (609.6 m) are feasible, considering voltage, pole/tower height, and site conditions.
Pipelines or buried utilities would be directionally drilled under surface waters to avoid physical disturbance of shorelines or bottom substrates	For all surface-water features depicted as crossed by the proposed utility centerlines on USGS 7.5-minute topographic coverage, other than intermittent streams, confirm the feasibility of construction methods that do not physically disturb the shorelines or bottom substrates, such as directional drilling or elevated construction.
Use of BMPs for soil erosion, sediment control, and stormwater management	List specific measures that will be taken to minimize soil erosion and sedimentation, or provide copies of plans prepared for approval by local authorities. Reference to existing guidance documents or plans previously approved for similarly scaled industrial land developments (not necessarily nuclear) in the region is acceptable. If approved, provide copies of the approvals. If not yet approved, briefly explain how the measures or plans will comply with applicable regulations or ordinances. If no relevant regulations or ordinances exist for the region, briefly explain how the proposed measures are comparable to those currently used for nuclear or other industrial projects in similar regions.
Implementation of mitigation specified in CWA permits	Provide copies of (or reference to) the applicable permits and briefly explain how each of the associated mitigation requirements will be met.
No physical disturbance to streams greater than 10 ft (3.048 m) in width below the ordinary high-water mark	Depict the centerline of each proposed ROW and indicate each crossing of surface-water features on USGS 7.5-minute topographic coverage (or other surface-water mapping of similar or greater accuracy). For purposes of this analysis, any streams depicted as intermittent or as solid blue lines without a width dimension may be assumed to be under 10 ft (3.048 m) in width. Alternatively, provide field measurements of the width of each perennial stream crossing. For each crossing, describe or show on a drawing any unavoidable encroachment below the ordinary high-water mark.
Access roads crossing non-jurisdictional surface-water features meet the substantive requirements of Nationwide Permits 12 or 14 regarding limits on disturbance and requirements for mitigation	Depict the centerline of any proposed access roads and indicate each crossing of surface-water features on USGS 7.5-minute topographic coverage (or other surface-water mapping of similar or greater accuracy). Briefly explain how the indicated crossings meet the substantive requirements of Nationwide Permits 12 or 14, including any project-wide cumulative maximums. For purposes of this analysis, count all surface-water features regardless of CWA jurisdiction.

PPE/SPE Values and Assumptions	Method of Demonstration
Maximum Building and Structure Height	
50 ft (15.24 m), except 200 ft (60.96 m) for meteorological towers and transmission towers and 100 feet for mechanical draft cooling towers	Verbally or using drawings, indicate the height above ground level of each proposed building or structure exceeding 50 ft (15.24 m) in height. If no proposed structures exceed 50 ft (15.24 m) in height above ground level, indicate this as well.
None of the structures would be built within or be visible from Federal or State parks or wilderness areas, other areas designated as Class I under Section 162 of the Clean Air Act (42 U.S.C. 7472(a)), or designated Wild and Scenic Rivers	Verbally explain whether any proposed structures might be visible from any of the indicated land features. Consider factors such as distance, topography, vegetation, existing structures, atmospheric conditions, and other factors that might substantially affect visibility. Consider also visibility at substantially differing times of a normal year, such as leaf-on (generally mid spring to mid fall) and leaf-off (generally mid fall to mid spring) conditions and times of the year when relevant atmospheric conditions such as fog and haze may substantially differ. While visual simulations using quantitative data would be ideal, brief qualitative descriptions of visibility are acceptable.
No transmission poles or towers over 100 ft	Verbally or using drawings, indicate the height above ground level of each proposed transmission pole or tower exceeding 50 ft (15.24 m) in height. If no such structures exceed 50 ft (15.24 m) in height above ground level, indicate this as well.
Intake and Discharge	
Adhere to the best available technology requirements of CWA 316(b)	List each applicable requirement, and briefly explain how the proposed project will comply with each.
Operated in compliance with CWA Section 316(b) and 40 CFR 125.83, including compliance with monitoring and recordkeeping requirements in 40 CFR 125.87 and 40 CFR 125.88, respectively	Provide a copy of any relevant permits, permit applications, or ongoing discussion with permitting agencies that demonstrate applicable requirements and how the proposed project will comply with each. Briefly explain how monitoring and recordkeeping requirements will be met.
Best available technologies are employed in the design and operation of intake and discharge structures to minimize alterations due to scouring, sediment transport, increased turbidity, and erosion	List each proposed technology and briefly explain how it will help minimize scouring, sedimentation, turbidity, and erosion.
Adherence to requirements in National Pollutant Discharge Elimination System (NPDES) permits issued by the U.S.	Provide a copy of any NPDES permit or permit application, or estimate what the proposed discharge concentrations and monitoring requirements will be for each proposed outfall.

PPE/SPE Values and Assumptions	Method of Demonstration
Environmental Protection Agency (EPA) or a given State	
In-Water Structures (including intake and discharge structures)	
Constructed in compliance with provisions of the CWA Section 404 and Section 10 of the Rivers and Harbors Appropriation Act of 1899 (33 U.S.C. 401 et seq.)	Indicate which permits are required and provide copies of the permits or briefly explain why the proposed project meets the requirements for each permit.
Adverse effects of building activities controlled and localized using BMPs such as installation of turbidity curtains or installation of cofferdams	List each proposed technology and briefly explain how it will help minimize aquatic impacts.
Any shorelines or other areas temporarily disturbed to build intake and discharge structures would be restored using regionally indigenous vegetation	Briefly explain how the shoreline will be restored, topsoiled, and revegetated. Identify possible source(s) for topsoil and the proposed depth of topsoiling. Propose a seed mix and/or develop a planting plan consisting mostly of regionally indigenous plant species. Outline any proposed actions such as installation of biodegradable netting or silt fences to minimize erosion and sedimentation until seeding becomes adequately established. Identify seeding rates and the size, spacing, and quantities of tree or shrub seedlings and nursery-grown seedlings, if used. Identify possible sources of seeds and other plant material. If seeds of non-indigenous grasses or forbs are needed for initial soil stabilization, briefly explain how those species are expected to be displaced by indigenous species. Provide a brief explanation of measures to monitor, maintain, and rectify the planted material and exclude invasive vegetation for at least 5 years after planting.
Construction duration would be less than 7 years	Provide documentation about the duration of construction.
Cooling Towers	
No natural draft cooling towers	Characterize any proposed cooling towers as natural draft or mechanical draft, or provide other classification.
Would be equipped with drift eliminators	Indicate whether drift eliminators would be used for each cooling tower, if any.
Makeup water would be fresh (salinity less than 1 ppt)	Indicate the location for each proposed intake, if any.
Other Cooling Features	
No once-through cooling	State whether or not once-through cooling is proposed.
No new cooling ponds	State whether or not cooling ponds are proposed.
No new reservoirs	State whether or not any new reservoirs are proposed.
No spray irrigation ponds	State whether or not any new spray irrigation ponds are proposed.

PPE/SPE Values and Assumptions	Method of Demonstration
Copper Alloy Tubes	
No use of copper alloy tubes	State whether or not copper alloy tubes are proposed.
Criteria Pollutant and Hazardous Air Pollutant Emissions	
Criteria pollutants emitted from vehicles and standby power equipment during construction and operations are less than Clean Air Act de minimis levels set by the EPA if located in a nonattainment or maintenance area.	Applicants should demonstrate the attainment status in the region for all the criteria pollutants. If the proposed project is in an attainment area, then the applicant does not need to provide estimates of criteria pollutants emitted for the project. Applicants should provide an applicability analysis that contains the estimates of potential emissions of criteria pollutants to demonstrate emissions would be below de minimis level thresholds provided in 40 CFR 93.153(b) for nonattainment and maintenance areas. Potential emissions from stationary sources could be calculated using EPA AP-42 methods that use potential power output or heat input capacity and operating hours for natural gas and diesel fired engines. EPA model Motor Vehicle Emission Simulator (MOVES) could be used to calculate emissions from construction equipment (non-road) and vehicular traffic (on-road).
Hazardous Air Pollutant (HAP) emissions will be within regulatory limits.	Applicants should provide estimates of potential emissions of HAPs from combustion engines, construction equipment, and standby power generators to demonstrate compliance with Federal (New Source Performance Standards, National Emissions Standards for Hazardous Air Pollutants) and State regulatory standards as promulgated in 40 CFR Part 63. If the applicant is considered a major source, the applicant must demonstrate Maximum Achievable Control Technologies (MACT) standards in compliance with Federal and State agencies regulations. Emissions for stationary sources could be calculated using EPA AP42 emission factors. EPA model MOVES could be used to calculate emissions from construction equipment (non-road) and vehicular traffic (on-road).
Construction and operation activities meet the permitting requirements of applicable State and local agencies.	Applicants should provide copies of air permits containing information about emissions, equipment certification, emission controls, and any State-regulated maximum allowable limits. Applicants should provide additional air modeling analyses if required to meet State or local air quality standards. If the applicant does not have a permit, then provide a status of obtaining these permits and potential mitigation measures the applicant will employ for the project.
Use of BMPs for dust control	Applicant should describe the BMPs, such as watering, chemical stabilization, and seeding to control fugitive dust emissions, that will be implemented in compliance with State and local air permitting programs. Applicant should provide estimates of fugitive dust emissions with controls from building and road construction activities. Such emissions can be calculated using the EPA AP-42 method for heavy construction operations
Greenhouse Gas Emissions	
New reactor construction and operation, including uranium fuel cycle activities, transportation of fuel and waste, and decommissioning will emit no more than 2,534,000 MT CO_2(e) for the lifespan of the project of 97 years.	Applicant should provide information to demonstrate that the greenhouse gas (GHG) footprint emissions from various project activities over the lifespan of 97 years will be less than the threshold of 2,534,000 MT CO_2(e). The NRC staff developed a report that calls out the significant activities contributing to GHG emissions that were considered in developing the PPE value. The applicant must demonstrate they meet or are under all five of the significant activities outlined in the report. An applicant may meet an equivalent for construction and operation workforce traffic, for example, operation workforce traffic could be 550 workers traveling 80 miles a day. If the applicant does not meet the five activities shown below, then they must provide an estimate of the total GHG emissions for the life-cycle of the proposed project. The applicant can use the methods in RG 4.2 and ISG-26 to determine this estimate.

PPE/SPE Values and Assumptions	Method of Demonstration
	The significant activities in the report are uranium fuel cycle, plant operations, operation workforce traffic, construction workforce traffic, and construction equipment activities. The following must be demonstrated to meet the PPE value: • Uranium fuel cycle – 25 million Separative Work Units or 32,230 metric tons of natural uranium • Plant operations – 560,000 MWh total energy output from onsite generators • Operation workforce traffic – 1,100 onsite staff driving 40 miles per day • Construction workforce traffic – 2,000 onsite staff driving 40 miles per day • Construction equipment activities – 281,800 MWh total energy output
Cooling System Air Quality	
Hazardous Air Pollutant emissions will be within regulatory limits	Applicants should provide estimates of potential emissions of HAPs from cooling towers to demonstrate compliance with Federal and State regulatory standards as promulgated in 40 CFR Part 63. If the applicant is considered a major source, the applicant must demonstrate (MACT) standards in compliance with Federal and State agencies regulations. Emissions from wet coolers could be calculated using the EPA AP42 method based on drift rate and total dissolved solids concentration. Applicants should provide information about any other method used to compute emissions for their relevant cooling system.
Subject to State permitting requirements	Applicants should provide new source air permits containing information about emissions and approvals for State and local regulatory compliance. If the applicant does not have a permit, then provide a status of obtaining these permits and potential mitigation measures the applicant will employ for the project.
Ozone and NOx Emissions	
Transmission-line voltage no higher than 1,200 kV	Applicants should provide the potential voltage in the transmission lines.
Total Plant Water Demand	
Total plant water demand is less than or equal to a daily average of 6,000 gpm	From information provided as described in Sections 2.2, 3.3, and 3.4 of this RG, list the normal and maximum flow rates of water required for each plant water need. Group plant needs by water quality criteria and/or potential water-supply source. Estimate the total plant water demand that accounts for the maximum flow rate of water supply required for all plant water needs. Demonstrate that the total plant water demand is less than or equal to a daily average of 6,000 gpm.
Municipal Water Availability	
The amount available from municipal water systems exceeds the amount of municipal water required by the plant.	From information provided as described in Sections 2.2, 3.3, and 3.4 of this RG, if municipal water is used for plant water supply, provide (1) the amount of municipal water needed for plant uses and (2) the amount of municipal water available accounting for all existing and planned future uses. Demonstrate that the amount of available municipal water exceeds the plant's municipal water needs. Provide a description of past or ongoing negotiations including information regarding the likelihood of reaching an agreement for the stated quantity of water from the municipal source or sources.
Surface-Water Availability – Flowing (Stream or River) (not applicable if plant does not use cooling water)	

PPE/SPE Values and Assumptions	Method of Demonstration
Average plant water withdrawals do not reduce discharge from the flowing waterbody by more than 3 percent of the 95 percent exceedance daily flow and do not prevent the maintenance of applicable instream flow requirements.	From information provided as described in Sections 2.2, 3.3, and 3.4 of this RG, use daily flow data obtained from agencies that collect, quality control, and distribute flow data (e.g., USGS) to estimate the 95 percent exceedance daily flow using standard statistical techniques or obtain the 95 percent exceedance daily flow estimates from the same agency or agencies. Calculate the reduction in the 95 percent exceedance daily flow by subtracting the daily average plant withdrawal from it. Calculate the percent reduction in the 95 percent exceedance daily flow. Demonstrate that the percent reduction is 3 or less. Compare the reduced 95 percent exceedance daily flow with applicable instream flow requirements to demonstrate that all instream flow requirements are met.
The 95 percent exceedance daily flow accounts for existing and planned future withdrawals.	From information provided as described in Sections 2.2, 3.3, and 3.4 of this RG, demonstrate how the estimate of the 95 percent exceedance daily flow accounts for existing and planned withdrawals between the point where flow data are collected and the proposed plant withdrawal location.
Water availability is demonstrated by the ability to obtain a withdrawal permit issued by State, regional or Tribal governing authorities.	From information provided as described in Sections 2.2, 3.3, and 3.4 of this RG, describe past or ongoing negotiations to demonstrate the likelihood of obtaining a water withdrawal permit from the appropriate State, regional, local, and/or Tribal authorities.
Water rights for the withdrawal amount are obtainable, if needed.	From information provided as described in Sections 2.2, 3.3, and 3.4 of this RG, describe applicable water rights related to the proposed plant withdrawal and a description of past or ongoing negotiations to demonstrate the likelihood of obtaining any needed water rights.
Changes in littoral zone water levels and hydroperiod resulting from surface-water withdrawals are within historical annual or seasonal fluctuations.	From information provided as described in Sections 2.2, 3.3, and 3.4 of this RG, estimate historical annual and seasonal fluctuations in littoral zone water levels and hydroperiod. Using the plant water withdrawal rates, estimate the changes in littoral zone water levels and hydroperiods and demonstrate that the changes are within historical variations.
If withdrawals are from an estuary or intertidal zone, then changes in salinity gradients are within the normal tidal or seasonal movements that characterize the waterbody.	From information provided as described in Sections 2.2, 3.3, and 3.4 of this RG, if plant water withdrawals are from an estuary or an intertidal zone, estimate historical tidal and seasonal movements of salinity gradients. Using the plant water withdrawal rates, estimate the changes in tidal and seasonal movements of salinity gradients and demonstrate that the changes are within historical variations.
Surface-Water Availability – Non-Flowing (not applicable if plant does not use cooling water)	
Water availability of the Great Lakes, the Gulf of America, oceans, estuaries, and intertidal zones exceeds the amount of water required by the plant.	From information provided as described in Sections 2.2, 3.3, and 3.4 of this RG, demonstrate that the source of plant water withdrawal is one of the Great Lakes, the Gulf of America, an ocean, an estuary, or an intertidal zone.

PPE/SPE Values and Assumptions	Method of Demonstration
Water availability is demonstrated by the ability to obtain a withdrawal permit issued by State, regional or Tribal governing authorities.	From information provided as described in Sections 2.2, 3.3, and 3.4 of this RG, describe past or ongoing negotiations to demonstrate the likelihood of obtaining a water withdrawal permit from the appropriate State, regional, local, and/or Tribal authorities.
Water rights for the withdrawal amount are obtainable, if needed.	From information provided as described in Sections 2.2, 3.3, and 3.4 of this RG, describe applicable water rights related to the proposed plant withdrawal and a description of past or ongoing negotiations to demonstrate the likelihood of obtaining any needed water rights.
Changes in littoral zone water levels and hydroperiod resulting from surface-water withdrawals are within historical annual or seasonal fluctuations.	From information provided as described in Sections 2.2, 3.3, and 3.4 of this RG, estimate historical annual and seasonal fluctuations in littoral zone water levels and hydroperiod. Using the plant water withdrawal rates, estimate the changes in littoral zone water levels and hydroperiods and demonstrate that the changes are within historical variations.
If withdrawals are from an estuary or intertidal zone, then changes in salinity gradients are within the normal tidal or seasonal movements that characterize the waterbody.	From information provided as described in Sections 2.2, 3.3, and 3.4 of this RG, if plant water withdrawals are from an estuary or an intertidal zone, estimate historical tidal and seasonal movements of salinity gradients. Using the plant water withdrawal rates, estimate the changes in tidal and seasonal movements of salinity gradients and demonstrate that the changes are within historical variations.
Municipal Systems' Available Capacity to Receive and Treat Plant Effluent	
The available capacity of the municipal systems to treat effluent exceeds the expected amount of plant effluent.	From information provided as described in Sections 2.2, 3.3, and 3.4 of this RG, provide the available capacity of municipal system or systems to treat the amount of plant effluent discharged to the system(s) accounting for all existing and planned future effluent amounts for other users of the system or systems. Demonstrate that the available capacity exceeds the amount of plant effluent. Provide a description of past or ongoing negotiations including information regarding the likelihood of reaching an agreement for the stated quantity of plant effluent discharge to the municipal source or sources.
Groundwater Withdrawal for Plant Uses	
Less than or equal to 50 gpm	From the information provided in Sections 3.3 and 3.4 of the RG, identify plant water uses (excluding dewatering) that will be supplied by groundwater and the estimated (average and maximum) rates of use. Estimate the groundwater withdrawal for plant uses (gpm) as the sum of the average rates of use and confirm that this estimate is less than or equal to 50 gpm. Provide separate estimates for building activities and for operational activities.
Withdrawal results in no more than 1 ft (0.3 m) of drawdown at the site boundary.	Provide an analysis of the expected changes in groundwater heads resulting from the withdrawal of groundwater at the site for plant uses (excluding dewatering). This analysis should use information from the FSAR related to the site hydrogeology and the occurrence of groundwater, groundwater characterization information provided in Section 2.2.1 of the RG, information provided in Section 3.2 of the RG related to well structures, and the estimate(s) of groundwater withdrawal for plant uses (confirmed above to be less than or equal to 50 gpm). The type of analysis and the level of detail will depend on project-specific characteristics (e.g., site size, well location, aquifer characteristics). Confirm that

PPE/SPE Values and Assumptions	Method of Demonstration
	groundwater withdrawals for plant uses are projected to result in no more than 1 ft (0.3 m) of drawdown at the site boundary during the life of the plant.
Withdrawals are not derived from an EPA-designated Sole Source Aquifer, or from any aquifer designated by a State, Tribe, or regional authority to have special protections to limit drawdown.	Provide a map showing the plant site and the surrounding region that includes the locations of EPA-designated Sole Source Aquifers (SSAs) and any other aquifers with special protections to limit drawdown. If the site overlies an SSA or other protected aquifer, use information from the FSAR related to the site hydrogeology and the occurrence of groundwater, and information provided in Section 3.2 of the RG related to well structures, to demonstrate that groundwater withdrawals for plant uses are not derived from the underlying SSA or protected aquifer. SSA data may be available from the EPA and other protected aquifer data from the applicable State, Tribe, or regional authority.
Withdrawals meet the permitting requirements of applicable State and local agencies.	The status of compliance with applicable State and local groundwater withdrawal requirements should be provided as part of the information described in Section 1.4 of the RG.
Changes in wetland water levels and hydroperiod resulting from groundwater use are within historical annual or seasonal fluctuations.	Using results from the analysis of changes in groundwater heads resulting from the withdrawal of groundwater at the site for plant uses (see above), evaluate the expected changes in water levels and hydroperiod for potentially affected wetlands. From the information provided in Section 2.2 of this RG, estimate historical annual and seasonal fluctuations in the water levels and hydroperiod of these wetlands. Demonstrate that the expected changes in wetland water levels and hydroperiod resulting from plant groundwater withdrawals are within historical fluctuations.
Groundwater Withdrawal for Excavation or Foundation Dewatering	
The dewatering rate less than or equal to 50 gpm.	Information provided in Sections 3.2, 3.3, and 3.4 of the RG identifies the structure foundation elevations, depths of excavations, and the potential need for dewatering during building and operations. From this information and the description of groundwater provided in Section 2.2.1 of the RG and related information from the FSAR describing site hydrogeology and the occurrence of groundwater, estimate the long-term rate of groundwater withdrawal for dewatering and confirm that this estimate is less than or equal to 50 gpm. Provide separate estimates for building (excavation dewatering) and for operational (foundation dewatering) activities, if applicable.
Dewatering results in negligible drawdown at the site boundary.	Provide an analysis of the expected changes in groundwater heads resulting from dewatering of excavations and/or foundations. This analysis should use information relied on to evaluate the dewatering rate (confirmed above to be less than or equal to 50 gpm). The type of analysis and the level of detail will depend on project-specific characteristics (e.g., site size, dewatering locations, aquifer characteristics). Confirm that dewatering is projected to result in negligible drawdown at the site boundary during the duration of dewatering activities.
Dewatering discharge has minimal effects on the quality of the receiving waterbody (e.g., as demonstrated by conformance with NPDES permit requirements).	Identify the receiving waterbody for dewatering discharge. Using information relied on to evaluate the dewatering rate (above) and information provided in Section 2.2.3 of this RG, estimate the effect of the discharge on the water quality of the receiving waterbody. Demonstrate that the discharge conforms to the requirements of an existing discharge permit, if applicable. Otherwise, describe past or ongoing negotiations to demonstrate the likelihood of obtaining a discharge permit from the appropriate State or Tribal authority.
Changes in wetland water levels and hydroperiod resulting from	Using results from the analysis of changes in groundwater heads resulting from dewatering (see above), evaluate the expected changes in water levels and hydroperiod for potentially affected wetlands. From the information provided in Section 2.2 of this RG, estimate historical annual and seasonal fluctuations in the water levels and hydroperiod of these

PPE/SPE Values and Assumptions	Method of Demonstration
dewatering are within historical annual or seasonal fluctuations.	wetlands. Demonstrate that the expected changes in wetland water levels and hydroperiod resulting from dewatering activities are within historical fluctuations.
Groundwater Quality	
The plant is outside the recharge area for any EPA-designated Sole Source Aquifer or any aquifer designated to have special protections by a State, Tribal, or regional authority	Provide a map showing the plant site and the surrounding region that includes the locations of EPA-designated SSA, any other aquifers with special protections designated by a State, Tribal, or regional authority, and the recharge areas of these aquifers. SSA data may be available from the EPA and other protected aquifer data from the applicable State, Tribal, or regional authority.
The plant is outside the wellhead protection area or designated contributing area for any public water-supply well.	Provide a map showing the plant site and the surrounding region that includes the locations of wellhead protection areas or designated contributing areas for public water-supply wells. Wellhead protection and designated contributing area data may be available from the applicable State or local authority.
No planned plant discharges to the subsurface (by infiltration or injection), including stormwater discharge	Using information provided in Sections 3.2, 3.3, and 3.4 of the RG, identify receiving water bodies for plant liquid discharges and confirm that there are no discharges to the subsurface (by infiltration or injection).
Applicable requirements and guidance on spill prevention and control are followed, including the relevant BMPs and Integrated Pollution Prevention Plan.	The status of compliance with applicable requirements for spill prevention and control should be provided as part of the information described in Section 1.4 of the RG. Describe the elements of the plant's procedures for spill prevention and control, including applicable BMPs.
A groundwater protection program conforming to NEI 07-07 is established and followed	Describe the elements of the plant's groundwater protection program in sufficient detail to demonstrate that the program meets the applicable objectives described in NEI 07-07 (Revision 1).
Impacts on Aquatic Biota	
Adherence to regulatory limits in 40 CFR 125.84	List each applicable requirement, and briefly explain how the proposed project will comply with each. Briefly explain how monitoring and recordkeeping requirements will be met.
Adherence to requirements in NPDES permits issued by the EPA or a given State	Provide a copy of any NPDES permit or permit application, or estimate what the proposed discharge concentrations and monitoring requirements will be for each proposed outfall. Explain how each concentration will be met.
Radiological Environmental Hazards	
Less than the radiation dose and effluent limits for protection against radiation during construction and operation	The applicant must demonstrate compliance with the following regulatory requirements: • 10 CFR 20.1101, Radiation Protection Programs • 10 CFR 20.1201, Occupational dose limits for adults • 10 CFR 20.1301, Dose limits for individual members of the public

PPE/SPE Values and Assumptions	Method of Demonstration
	• Appendix B of 10 CFR Part 20, Annual Limits on Intake (ALIs) and Derived Air Concentrations (DACs) of Radionuclides for Occupational Exposure; Effluent Concentrations; Concentrations for Release to Sewerage • 10 CFR 50.34a Design objectives for equipment to control releases of radioactive material in effluents—nuclear power reactors10 CFR 50.36a Technical specifications on effluents from nuclear power reactors **Note:** The application should contain sufficient technical information for the staff to complete the detailed technical safety review. or The application should be found to be in compliance by the staff with the above regulations through a radiation protection program and an effluent release monitoring program.
Less than criteria established in International Atomic Energy Agency (IAEA) and National Council on Radiation Protection & Measurements (NCRP) guidelines for protection of nonhuman biota	Applicants would demonstrate in their application that any radiological effluent releases and annual doses would be within regulatory limits to ensure that nonhuman biota doses would be below IAEA and NCRP guidelines as demonstrated in Tables 3-5 and 3-6 of the NR GEIS.
Nonradiological Environmental Hazards	
The applicant must adhere to all applicable Federal, State, local, or Tribal regulatory limits and permit conditions for chemical hazards, biological hazards, and physical hazards from a proposed nuclear reactor.	Provide a table that lists all the permits received or to be applied for regarding nonradiological environmental hazards. The table should provide the name of the permit, agency granting the permit, regulation the permit is required by, the dates the permit is applicable, and whether or not the permit is publicly available. Provide a copy of the permit or an electronic link to the permit, if the permit is publicly available on a website. Provide a description of management plans, programs, or processes that either will be implemented or are implemented to meet applicable Federal, State, local, or Tribal regulations and permit conditions in regard to nonradiological environmental hazards. The description should include specific elements of the plant's procedures necessary to demonstrate that the management plan, program, or process meets the applicable objectives required by the regulation or permit condition.
The applicant will follow nonradiological public and occupational health BMPs and mitigation measures, as appropriate, to govern building and operations-related activities.	Include a description of BMPs and mitigation measures that will be implemented or are implemented in the description of management plans, programs, or processes set in place to meet applicable Federal, State, local, or Tribal regulations and permit conditions.
Wildlife-Related Noise Generation	
85 dBA 50 ft (15.24 m) from the source	Provide the results of any ambient noise studies that have been conducted, including the locations of noise sources and measurements, and corresponding noise levels, including meteorological conditions during the measurement period and the resulting effects on the measured noise levels.

PPE/SPE Values and Assumptions	Method of Demonstration
Human-Related Noise Generation	
65 dBA at site boundary	Provide the results of any ambient noise studies that have been conducted, including the locations of noise sources, receptor locations, and corresponding noise levels. Studies should be conducted at each receptor location twice, once during winter (leaf-off) and late summer (leaf-on) and should include the closest inhabited structure and any reasonably close areas of human activity (parks, offices, etc.)
Project will comply with State and local noise-abatement laws and ordinances, or the applicant will pursue a variance or an exception with the State or local regulator, or will be able to mitigate the noise sufficient to satisfy the regulator.	Provide documentation of compliance with applicable State and/or local noise-abatement laws and ordinances, including any variances or mitigation required.
Project will implement BMPs, including modeling, foliage planting, construction of noise buffers, and the timing of construction and/or operation activities.	Provide descriptions of any BMPs implemented to minimize impacts.
Radiological Waste Management	
Meets the criteria of regulations and low-level radioactive waste (LLRW) generation is less than 21,200 ft^3 (600 m^3) and 2,000 Ci (7.4×10^{13} Bq) per year.	Applicants should demonstrate that the generation and management of radiological waste meet the regulatory requirements of 10 CFR Part 20 Subpart K, 10 CFR Part 61, 10 CFR Part 71, and 10 CFR Part 72. Applicants should demonstrate that the quantities of LLRW generated would be less than the quantities of LLRW generated at existing nuclear power plants, which generate an average of 21,200 ft^3 (600 m^3) and 2,000 Ci (7.4×10^{13} Bq) per year.
Meets criteria for mixed waste Small Quantity Generator.	Applicants should demonstrate that the generation of mixed waste meets the criteria of a Small Quantity Generator in the Resource Conservation and Recovery Act (RCRA).
Nonradiological Waste Management	
Applicants must meet all applicable permit conditions, regulations, and BMPs related to solid, liquid, and gaseous nonradiological waste management.	Provide a table that lists all the permits received or to be applied for regarding nonradiological waste. The table should provide the name of the permit, agency granting the permit, regulation the permit is required by, the dates the permit is applicable, and whether or not the permit is publicly available. Provide a copy of the permit or an electronic link to the permit, if the permit is publicly available on a website. Provide a description of management plans, programs, or processes that either will be implemented or are implemented to meet applicable Federal, State, local, or Tribal regulations and permit conditions in regard to solid, liquid, or gaseous nonradiological waste management would include specific elements of the plant's procedures, including BMPs, necessary to demonstrate that the management plan, program, or process meets the applicable objectives required by the regulation or permit condition.

PPE/SPE Values and Assumptions	Method of Demonstration
Perform mitigation measures, to the extent practicable, such as recycling, process improvements, or using a less hazardous substance.	Include a description of mitigation measures that will be implemented or are implemented in the description of management plans, programs, or processes set in place to meet applicable Federal, State, local, or Tribal regulations and permit conditions.
Postulated Accidents	
For design-basis accidents, the exclusion area boundary maximum total effective dose equivalent (TEDE) for any 2-hour period and the low-population zone maximum TEDE for the duration of the accident release	Calculate the maximum exclusion area boundary TEDE for any two-hour period and calculate the TEDE for the low-population zone for the duration of the accident release (i.e., 30 days, or other duration as justified), and compare this to the dose criteria given in regulations related to the application (e.g., 10 CFR 50.34(a)(1), 10 CFR 52.17(a)(1) and 10 CFR 52.79(a)(1)), SRPs (e.g., SRP criteria, Table 1 in SRP Section 15.0.3 of NUREG-0800), and RGs, (e.g., RG 1.183), as applicable.
For accidents involving hazardous chemicals, the reactor hazardous chemical inventory is less than their Threshold Quantities (TQs) and Threshold Planning Quantities (TPQs).	Compare the reactor inventory of a regulated substance to its TQ; and compare the reactor inventory of an extremely hazardous substance to its TPQ. **Note:** TQs are found in 40 CFR 68.130, Tables 1, 2, 3, and 4; and TPQs are found in 40 CFR Part 355, Appendices A and B.
Within the maximum Population Dose Risk 95th confidence bounding value of 9.727×10^3 person-rem per reactor year (i.e., Indian Point 2 and 3) specified in the 1996 LR GEIS and demonstrating the utilization of 10 CFR 50.155 or FLEX to address mitigation of beyond-design-basis events; or	Compare the population dose risk for the nuclear reactor design at the specific site to the 1996 LR GEIS population dose risk 95th confidence bounding value of 9.727×10^3 person-rem per reactor year. The population dose risk can be determined, for example, by extending the consequence calculation from an RG 1.233 safety analysis out to 50 mi and multiply this value by the total release probability or total core damage frequency. Discuss how the regulations specified in 10 CFR 50.155 are being met or implemented or how FLEX would be implemented to address mitigation of beyond-design-basis-events.
Within the maximum 10 and 150 mi Exposure Index at the 95th confidence bounding value of 1.896 × 104 and 2.864 × 106, respectively (i.e., Indian Point 2 and 3) specified in the 1996 LR GEIS and demonstrating the utilization of 10 CFR 50.155 or FLEX to address mitigation of beyond-design-basis events; or	Compare the Exposure Index for the nuclear reactor design at the specific site to the 1996 LR GEIS 10 and 150 mi Exposure Index at the 95th confidence bounding values of $1.896 \times 10^{+}$ and 2.864×10^6, respectively. Discuss how the regulations specified in 10 CFR 50.155 are being met or implemented or how FLEX would be implemented to address mitigation of beyond-design-basis-events.

PPE/SPE Values and Assumptions	Method of Demonstration
Utilizing the source term from 10 CFR 50.34(a)(1)(ii)(D), or the equivalent 10 CFR Part 52 regulation, with a non-intact containment or confinement for population density assessments under 10 CFR 100.21(h) to demonstrate a calculated total effective dose equivalent (TEDE) of no greater than 1 rem over a period of 30 days and that no further mitigation is necessary because health effects are shown not to be significant or a new reactor that is co-located with an existing LWR may compare its source terms to demonstrate that the LWR's severe accident risks bounds the new reactor's risks; or	Utilize the results from one of the RG 4.7, Appendix A, calculations when assessing alternative approaches to addressing population-related siting considerations for new reactors to demonstrate no significant human health effect with a calculated TEDE of no greater than 1 rem over a period of 30 days. A co-located new reactor may demonstrate that its 10 CFR 50.34(a)(1) source term is lower than the existing nuclear power plant's severe accident source term. Thus, the co-located new reactor's severe accident analysis would be bounded by the existing nuclear power plant's severe accident analysis. By demonstrating a TEDE value of no greater than 1 rem over a period of 30 days, there are no significant human health effects. Thus, further mitigation is not necessary to reduce the severe accident risks to a lower impact value.
Utilizing 10 CFR 50.33(g)(2) to demonstrate there is no plume exposure pathway emergency planning zone where the projected total effective dose equivalent exceeds 1 rem over 96 hours (i.e., 10 CFR 50.33(g)(2)(i)(A)) and no further mitigation is necessary because health effects are shown not to be significant.	Utilize the results from assessing the emergency planning zone size under 10 CFR 50.33(g)(2) to demonstrate no significant human health effect with a calculated TEDE of no greater than 1 rem over a period of 96 hours. By demonstrating a TEDE value of no greater than 1 rem over a period of 96 hours, there are no significant human health effects. Thus, further mitigation is not necessary to reduce the severe accident risks to a lower impact value.
Acts of terrorism	The NRC staff has determined that the environmental impacts of acts of terrorism and sabotage only need to be addressed if a reactor facility is subject to the jurisdiction of the U.S. Court of Appeals for the Ninth Circuit. Because the environmental impacts of a facility subject to the jurisdiction of this court cannot be determined without the consideration of project-specific factors, the potential impacts of terrorism and sabotage for these facilities would require a project-specific analysis. The necessary environmental evaluation would be performed based on the design features that provide for physical protection of the reactor from acts of terrorism and sabotage. The impacts of acts of terrorism can be mitigated by complying with the physical protection requirements under 10 CFR Part 73, Physical Protection of Plants and Materials.

PPE/SPE Values and Assumptions	Method of Demonstration
Site Employment	
The peak project-related in-migrating workforce including families does not exceed established local planning and growth projections for infrastructure and service demands.	Provide a monthly construction schedule for the project, including, as much as possible, the identification of skilled craft worker participation. Estimate the number of in-migrating workers expected at the peak employment period disaggregated by worker craft and by whether the workers come alone or bring their families.
Community Services and Infrastructure (e.g., housing availability; school capacities)	
Housing vacancy rate in the affected economic region does not change by more than 5 percent, or at least 5 percent of the housing stock remains available.	Based on the in-migrating worker estimates from above, estimate how many vacant family and non-family housing units would be needed to house the in-migrating workforce. Provide and defend the assumptions used to derive these values. For the project's identified Economic Impact Area, provide recent local housing analyses from readily accessible sources (e.g., U.S. Census American Community Survey data, state college and university data, or local realtor reports), including the most recent estimate of the total number of habitable dwellings, including single-family dwellings, multi-family dwellings, and apartments. Provide the most recent estimates of occupied and vacant habitable dwellings. Provide the most recent estimates of the capacity and available amenities for RVs and recreational trailers in the Economic Impact Area.
Student:Teacher ratios in the affected economic region do not change by more than 5 percent (e.g., 1 child per class of 20).	For the peak employment period estimate of in-migrating workers bringing their families above, provide and defend an estimate of the number of children that would be in those families, disaggregated by pre-school, elementary, middle, and high school age groups. Provide the most recent teacher and student numbers for each of the school age groups in the school district(s) in the Economic Impact Area. Provide any applicable student-teacher thresholds mandated by the State, county, of local governments.
Assumes housing and education resources would be the only ones where noticeable impacts might occur	Provide the total capacity and average usage rates for local water and sewer services, the current hospital and clinic capacities and occupancy rates, and the most recent estimates of the ratio of first responders to population size (e.g., the number of firemen per capita).
Transportation Systems and Traffic	
The Level of Service (LOS) determination for affected roadways does not change.	Provide the most recent traffic study that contains the routes at least 90 percent of the construction and operations workers would use to travel to and from the plant, including traffic counts, analyses of traffic conditions at key intersections, and the study's determination of LOS at each of these intersections. Provide an estimate of the number of commuting construction or operations workers for each of the key traffic routes. Estimate the increase in daily traffic during commuting times, based on the traffic study baseline.

PPE/SPE Values and Assumptions	Method of Demonstration
Tax Revenue	
Tax revenues are beneficial and considered Category 1 issues that do not require detailed analyses.	Provide the most recent year's tax revenues for property, income, and sales taxes, as well as which governmental body receives each tax. Describe the local property tax system, including any property tax collection before completion of construction, the availability of Fees-in-Lieu of Taxes or other potential negotiated tax structure that could be applied to the proposed project.
Fuel Cycle	
Impacts bounded by Table S-3	Calculate and compare the impacts associated with the fuel cycle to demonstrate that they are bounded by the impacts of Table S-3. • Verify use of in situ uranium recovery. • Verify use of gas centrifuges for enrichment. • Verify anticipated levels of fuel burnup. • Verify less reliance on coal fired electrical generation plants.
Reprocessing capacity up to 900 MTU/yr	Demonstrate that any planned reprocessing capacity would be less than or equal to 900 MTU/yr.
Storage of spent nuclear fuel and high-level waste after cessation of operations	Demonstrate that waste and spent fuel inventories, as well as their associated certified spent fuel shipping and storage containers, are not significantly different from what has been considered for light-water reactor evaluations in NUREG 2157.
Fuel cycle facilities must satisfy NRC regulatory requirements	Verify that regulatory requirements below are met: • 10 CFR Part 40, "Domestic Licensing of Source Material" • 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities" • 10 CFR Part 70, "Domestic Licensing of Special Nuclear Material" • 10 CFR Part 71, "Packaging and Transportation of Radioactive Material" • 10 CFR Part 72, "Licensing Requirements for the Independent Storage of Spent Fuel, High-Level Radioactive Waste, and Reactor-related Greater Than Class C Waste" • 10 CFR Part 73, "Physical Protection of Plants and Materials."
Transportation of Unirradiated Fuel	
Less than the thresholds for the maximum shipment distances in Tables 3-12 and 3-13 of the NR GEIS.	Calculate the maximum annual one-way shipment distance and compare it to 59,160 km (the maximum value from Table 3-12 of the NR GEIS). Calculate the maximum annual round-trip shipment distance and compare it to the 118,320 km (the maximum value from Table 3-13 of the NR GEIS). **Note:** The above annual shipments should be normalized to a net electrical output of 880 MWe, i.e., 1,100 MWe with an 80 percent capacity factor from WASH-1238. The above PPEs do not apply to situations in which a reactor applicant proposes shipping the unirradiated reactor fuel by air, ship, or barge; or in which a reactor applicant proposes

PPE/SPE Values and Assumptions	Method of Demonstration
	that an unirradiated fuel transportation package for the new reactor be approved using the provisions of 10 CFR 71.12, 10 CFR 71.41(c), or 10 CFR 71.41(d).
Transportation of Radioactive Waste	
Less than the threshold for the maximum shipment distance in Table 3-17 of the NR GEIS	Calculate the maximum annual round-trip shipment distance and compare to 293,145 km (the maximum value from Table 3-17 of the NR GEIS). **Note:** The shipments should be normalized to a net electrical output of 880 MWe, i.e., 1,100 MWe with an 80 percent capacity factor and a shipment volume of 2.34 m^3/shipment from WASH-1238. The above PPE does not apply to situations where a reactor applicant proposes shipping the radioactive waste by air, ship or barge; or where an applicant proposes that a radioactive waste transportation package be approved using the provisions of 10 CFR 71.12, 10 CFR 71.41(c), or 10 CFR 71.41(d).
Transportation of Irradiated Fuel	
Less than the thresholds for the maximum shipment distances, and burnup included in Tables 3-18 through 3-20 of the NR GEIS	Calculate the maximum annual one-way shipment distance and compare it to 505,393 km (the maximum value from Table 3-18 of the NR GEIS). Calculate the maximum annual round-trip shipment distance and compare it to 1,010,786 km (the maximum value from Table 3-20 of the NR GEIS). **Note:** The shipments should be normalized to a net electrical output of 880 MWe, i.e., 1,100 MWe with an 80 percent capacity factor and a shipment capacity of 0.5 MTU/shipment from WASH-1238. Compare the maximum assembly averaged burnup to 80 GWd/MTU for UO_2 fuel or to a peak pellet burnup of 133 GWd/MTU for TRISO fuel (the maximum values from Table 3-19 of the NR GEIS). The above PPEs do not apply to situations where a reactor applicant proposes shipping the irradiated reactor fuel by air, ship or barge; or where a reactor applicant proposes that an irradiated fuel transportation package for the new reactor be approved using the provisions of 10 CFR 71.12, 10 CFR 71.41(c), or 10 CFR 71.41(d) such as might be applied for when shipping a complete irradiated reactor core. In addition, the irradiated reactor fuel must be shipped in a transportation package that meets all of the applicable NRC regulations.
Decommissioning	
Impacts are bounded by the Decommissioning GEIS	The environmental impacts for the following resource areas were generically addressed in NUREG-0586, Supplement 1, would be limited to operational areas, would not be detectable or destabilizing and are expected to have a negligible effect on the impacts of terminating operations and decommissioning: • Onsite land use • Water use

PPE/SPE Values and Assumptions	Method of Demonstration
	• Water quality • Air quality • Aquatic ecology within the operational area • Terrestrial ecology within the operational area • Radiological • Radiological accidents (non-spent-fuel-related) • Occupational issues • Socioeconomic • Onsite cultural and historic resources for plants where the disturbance of lands beyond the operational areas is not anticipated • Aesthetics • Noise • Transportation • Irretrievable resource The following issues were not addressed in NUREG-0586, Supplement 1, but have been determined to be Category 1 issues: • Nonradiological waste • Greenhouse gases Threatened and endangered species was an issue identified in NUREG-0586, Supplement 1, as requiring a project-specific review. Four conditionally project-specific issues identified in NUREG-0586, Supplement 1, will require a project-specific review if present: • Land use involving offsite areas to support decommissioning activities • Aquatic ecology for activities beyond the licensed operational area • Terrestrial ecology for activities beyond the licensed operational area • Historic and cultural resources (archaeological, architectural, structural, historic) for activities within and beyond the licensed operational area with no current (i.e., at the time of decommissioning) evaluation of resources for NRHP eligibility Additionally, the following two environmental resource areas are additional decommissioning impacts that require project-specific review: • Climate change: the effects of climate change are location-specific and cannot, therefore, be evaluated generically

PPE/SPE Values and Assumptions	Method of Demonstration
	• Cumulative effects: must be considered on a project-specific basis where impacts would depend on regional resource characteristics, the resource specific impacts of the project, and the cumulative significance of other factors affecting the resource.
Operational Life of the Plant	
40-year operational life, assuming a 40-year license	Describe the duration of the requested license and the operational life of the facility.

C.6 References

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