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REGULATORY GUIDE

REGULATORY GUIDE 4.24

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AQUATIC ENVIRONMENTAL STUDIES FOR NUCLEAR POWER STATIONS

A. INTRODUCTION

Purpose

This regulatory guide (RG) provides technical guidance for aquatic environmental studies and analyses supporting decisions related to new nuclear power stations by the U.S. Nuclear Regulatory Commission (NRC).

The RG focuses on compliance with Federal laws and actions, notably the National Environmental Policy Act of 1969, as amended (NEPA) (Ref. 1), among others, regarding effects to the environment from major Federal actions. For purposes of this guide, the term "aquatic" encompasses freshwater, estuarine, and marine environments. It also addresses submerged aquatic vegetation (SAV) but does not address wetlands containing emergent vegetation. RG 4.11, "Terrestrial Environmental Studies for Nuclear Power Stations" (Ref. 2), addresses such wetland features along with the terrestrial environment. Although the NRC is issuing separate RGs that address terrestrial and aquatic environmental studies, it recognizes that aquatic and terrestrial ecological issues often overlap and are often interrelated.

Applicability

This guide applies to applicants and reactor licensees subject to Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, "Domestic Licensing of Production and Utilization Facilities" (Ref. 3), 10 CFR Part 52 "Licenses, Certifications, and Approvals for Nuclear Power Plants" (Ref. 4), and 10 CFR Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants" (Ref. 5) who must meet the requirements of 10 CFR Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions" (Ref. 6). This guidance is specifically directed to applicants and prospective applicants for new reactor licensing under 10 CFR Part 50 or 10 CFR Part 52. It may also be useful to other NRC applicants or licensees performing aquatic studies.

Applicable Statutes, Rules, and Regulations

- NEPA establishes requirements for all Federal Government agencies to consider environmental impacts and alternatives to Federal actions that significantly affect the human environment.

Written suggestions regarding this guide or development of new guides may be submitted through the NRC's public Web site under the Regulatory Guides document collection of the NRC Library at http://www.nrc.gov/reading-rm/doc-collections/reg-guides/contactus.html.

Electronic copies of this RG and other recently issued guides are available through the NRC's public Web site under the RG document collection of the NRC Library at http://www.nrc.gov/reading-rm/doc- collections/reg-guides/. The RG is also available through the NRC's Agencywide Documents Access and Management System (ADAMS) at http://www.nrc.gov/reading-rm/adams.html under Accession No. ML15309A219. The regulatory analysis may be found in ADAMS under Accession No. ML13186A086, and the staff responses to public comments on DG-4023 can be found in ADAMS under Accession No. ML15309A217.

- Section 7 of the Endangered Species Act of 1973, as amended (ESA) (Ref. 7), establishes requirements for all Federal Government agencies to ensure that the actions they take do not jeopardize the continued existence of any threatened or endangered species or critical habitat.

- The Magnuson-Stevens Fishery Conservation and Management Act, as amended (Ref. 8), establishes requirements for all Federal Government agencies that take an action that may adversely affect essential fish habitats (EFHs).

- The Clean Water Act of 1977 (Ref. 9), the Rivers and Harbors Appropriation Act of 1899 (Ref. 10), and the Coastal Zone Management Act of 1972 (Ref. 11) establish additional aquatic requirements applicable to applicants and licensees.

- 10 CFR Part 50 contains the requirements for the licensing of domestic production and utilization facilities.

- 10 CFR Part 51 contains the NRC's NEPA implementing regulations for the agency's domestic licensing and related regulatory functions, as follows:

  - 10 CFR 51.45, "Environmental Report," provides the general requirements for an environmental report;

  - 10 CFR 51.49, "Environmental Report—Limited Work Authorization," provides environmental report requirements for a limited work authorization submitted as part of a construction permit or combined license application;

  - 10 CFR 51.50, "Environmental Report—Construction Permit, Early Site Permit, or Combined License Stage," provides the environmental report requirements submitted as part of an application for a construction permit, early site permit, or combined license; and

  - 10 CFR 51.53, "Postconstruction Environmental Reports," provides the requirements for environmental reports that are required following construction for an operating license.

Related Guidance

- RG 4.2, "Preparation of Environmental Reports for Nuclear Power Stations," provides guidance on preparation of environmental reports for nuclear power stations (Ref. 12).

- RG 4.7, "General Site Suitability Criteria for Nuclear Power Stations" provides guidance on addressing general site suitability criteria for nuclear power stations (Ref. 13).

- RG 4.11, as described above, is a companion guide to RG 4.24 and focuses on the terrestrial environment.

- NUREG-1555, "Standard Review Plans for Environmental Reviews for Nuclear Power Plants: Environmental Standard Review Plan" (Ref. 14), provides guidance for the NRC staff to use when conducting environmental reviews related to nuclear power plants.

This RG offers focused guidance on aquatic environmental studies and analyses supporting the broader environmental objectives of some of the RGs listed above. However, it does not cover all of the aquatic environmental information that may be required to comply with other Federal, State, or local laws and regulations.

Purpose of Regulatory Guides

The NRC issues regulatory guides to describe to the public methods that the staff considers acceptable for use in implementing specific parts of the agency's regulations, to explain techniques that the staff uses in evaluating specific problems or postulated events, and to provide guidance to applicants. Regulatory guides are not substitutes for regulations and compliance with them is not required. Methods and solutions that differ from those set forth in regulatory guides will be deemed acceptable if they provide a basis for the findings required for the issuance or continuance of a permit or license by the Commission.

Paperwork Reduction Act

This regulatory guide contains references and information collections covered by 10 CFR Part 50, 10 CFR Part 51, 10 CFR Part 52 and 10 CFR Part 54 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), control numbers 3150-0011, 3150-0021, 3150-0151 and 3150-0155.

Public Protection Notification

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

ABBREVIATIONS AND ACRONYMS

BLM	Bureau of Land Management
CFR	*Code of Federal Regulations*
COE	U.S. Army Corps of Engineers
DOI	U.S. Department of the Interior
EFH	essential fish habitat
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act of 1973
FERC	Federal Energy Regulatory Commission
FWS	U.S. Fish and Wildlife Service
GIS	geographic information system
HAPC	habitat area of particular concern
NEPA	National Environmental Policy Act of 1969
NMFS	National Marine Fisheries Service
NOAA	National Oceanographic and Atmospheric Administration
NOS	National Ocean Service (within NOAA)
NPS	National Park Service
NRC	U.S. Nuclear Regulatory Commission
OMB	Office of Management and Budget
RG	regulatory guide
SAV	submerged aquatic vegetation
USFS	U.S. Forest Service

B. DISCUSSION

Reason for Issuance

This is the initial issuance of RG 4.24. The purpose of this RG is to offer technical guidance to applicants for the development of aquatic studies involving environmental reviews that are part of NRC licensing actions related to new nuclear power stations. The staff analyzes the results of aquatic studies provided by applicants for its evaluations related to nuclear power station siting, conducting baseline investigations, identifying important species and habitats, analyzing impacts, and monitoring. Although this regulatory guide applies principally to the preparation of applications for new power facilities, the information provided may be useful whenever an aquatic study or update is required.

Background

Based on the information obtained from applicants in recent licensing reviews, the NRC staff determined that providing additional information and guidance related to the evaluation of aquatic resources could result in more efficient reviews. To address this need, the NRC is issuing this document to potential applicants to offer guidance on the collection of data and information to support the identification of aquatic resources and habitats that have the potential to be affected by the building and operation of nuclear power stations. The guidance in this RG is meant to complement aquatic aspects of the related guidance cited above in the introduction.

The technical discussions in this section are primarily best practices and recommendations, not detailed descriptions of specific sampling methods. The staff positions in Section C of this guide define general objectives for aquatic analyses but do not give stepwise instructions or technical protocols. Applicants using this RG need to apply professional judgment when identifying appropriate analytical methods and collecting associated data. In doing so, applicants will need to justify the methods that they select.

Baseline Information for Aquatic Siting Studies and Alternative Site Reviews

Aquatic ecology is one of many technical disciplines involved in the site selection (screening) process required to license (or issue an authorization or permit for) a new nuclear power plant under 10 CFR Part 50 or 10 CFR Part 52. Aquatic ecology is also a factor in evaluating alternative sites.

The discussion of site selection procedures in this RG is limited to aquatic ecological issues. The presence or absence of aquatic ecological resources contributes to screening an initial region of interest to identify potential sites, candidate sites, alternate sites, and a proposed site. Applicants can find information relevant to the site selection process in Electric Power Research Institute Report No. 3002005435, "Advanced Nuclear Technology: Site Selection and Evaluation Criteria for New Nuclear Power Generation Facilities (Siting Guide)," issued 2015 (Ref. 15). RGs 4.2 and 4.7 also provide NRC guidance for the site selection process, including aquatic ecology considerations.

Reconnaissance-level information and published data are appropriate for applicants to use to identify and describe the aquatic ecology resources for site selection or for alternative sites. Reconnaissance-level information consists of information that is available from governmental, Tribal, commercial, or public sources. The amount of information and the level of detail in a reconnaissance investigation varies by site and may include confidentiality issues. To the extent appropriate, reconnaissance investigations could primarily include a collection of data from public sources; literature; and, as appropriate, discussions with local experts, including other Federal, State, and local agencies, to

obtain an understanding of the aquatic resources and an indication of which aquatic resources could potentially be affected.

Some information sources useful for identifying aquatic ecological resources in a siting study or alternative site study area include the following:

- topographic maps (7.5 minutes) from the U.S. Geological Survey and other online mapping products;
- EFH Mapper from the National Marine Fisheries Service (NMFS);
- National Wetlands Inventory maps (which include water features in addition to wetlands);
- Federal (e.g., NMFS or U.S. Fish and Wildlife Service (FWS)) and State (e.g., Natural Heritage Program) data on potential occurrence of threatened, endangered, and other protected species and habitats;
- State coastal zone management plans;
- fishery management plans from NMFS and the regional fishery management councils;
- coastal and marine spatial plans from the National Oceanic and Atmospheric Administration (NOAA) and the regional planning bodies;
- nautical charts;
- remote sensing data from the U.S. Geological Survey (such as Landsat) and imagery from the National Aeronautics and Space Administration;
- data on marine-protected areas from the National Marine Protected Areas Center;
- Federal, State, and private land use and land cover maps;
- existing and projected future land use maps from local planning and zoning offices;
- Federal, State, and local landings data;
- academic studies of local ecology from nearby institutions; and
- other environmental documents (e.g., environmental impact statements, environmental assessments, environmental reports, biological assessments, biological opinions, and EFH assessments) from nearby facilities.

Aquatic Environmental Baseline Investigations for Proposed Sites

Aquatic environmental baseline investigations inventory and characterize freshwater; estuarine; and marine flora, fauna, and habitats in potentially affected areas on and in the vicinity of a proposed site, including associated offsite rights of way for features such as transmission lines or pipelines. Baseline investigations form a basis for assessing potential effects to aquatic resources; provide data useful for determining the environmental integrity (e.g., habitat and function) of the site in an ecoregional context; and serve as a foundation for related monitoring and mitigation required by Federal, State, or local agencies. The level of detail in a baseline investigation should be roughly proportional to the anticipated magnitude of potential effects. It is also dependent on the amount of information needed to evaluate the significance of the effects. The spatial extent of potential building and operation effects can extend beyond proposed property limits to encompass areas potentially affected by site-related activities, including surface or ground water drawdown, noise, pressure changes, scour and erosion, stormwater runoff, dredged or excavated material disposal, water discharge plumes, and cooling tower drift. Studies of aquatic resources within the area of building and operation (plus a reasonable buffer based on the imprecision of design data) generally would be more detailed than those for peripheral areas. The spatial extent and detail of baseline investigations may have to be expanded to account for cumulative effects and to address the concerns of interested Federal, State, Tribal, local agencies, and private organizations.

The amount of information needed for baseline investigations could be lower for proposed sites that have been partially developed (examples include sites within an existing nuclear power plant property or a property with other energy-production facilities), especially if the site has undergone past ecological investigation. However, it is preferable to collect ecological data recently enough to allow an accurate assessment of existing conditions and potential effects (including after any anthropogenic or natural events that may have altered habitats). Descriptive field information gathered during previous environmental reviews may be used to describe the current condition of aquatic resources when such information is updated and augmented, as appropriate. The updated data collection would address habitats lost, degraded, and created by building existing facilities (examples include loss of nearshore habitat during creation of an intake structure) and natural processes or anthropogenic activities that have taken place since collection of the earlier data. If the applicant uses historic data for comparisons or descriptive purposes, it would be helpful to document why such a method is appropriate and scientifically acceptable.

Because baseline investigations form the foundation for subsequent analyses and monitoring, it is appropriate for the applicant to initiate such investigations early in the development of the application to allow sufficient time to analyze the data and to conduct any necessary subsequent studies. Applicants performing aquatic baseline investigations could benefit from following accepted scientific design methods and seeking input from interested Federal, State, Tribal, local agencies, and private organizations when initially designing the investigations. Some baseline investigations commonly useful include the following:

- aquatic habitat identification,
- aquatic habitat mapping,
- aquatic habitat description,
- community and population studies,

- water availability studies,
- instream flow incremental methodology studies,
- functional assessment of streams and other water bodies,
- sampling of biota near intake and discharge locations,
- identification of important species and habitats,
- documentation of the seasonality of certain species, and
- targeted species surveys.

Aquatic baseline studies may be prepared as standalone reports or presented initially within an environmental report or another broadly scoped environmental document. Applicants may combine closely related baseline studies into single reports. For example, applicants can present aquatic habitat identification, mapping, and descriptions that fit together logically in a single report. Biota survey reports can be prepared separately, together, or combined with an aquatic habitat survey report and map.

Applicants may be able to draw upon existing scientific literature to obtain some of the necessary baseline data. Aquatic ecological baseline studies may already have been prepared to support other projects on or near the site. Web sites, databases, or other information sources that Federal, State, or local agencies or conservation organizations maintain also may contain useful data. Applicants should use professional judgment to evaluate the applicability or possible obsolescence or seasonality of the data. It is appropriate for the applicant to update and augment existing survey data that no longer reflect current conditions. In some cases, this task can be accomplished through limited field surveys using a lesser level of effort than that for areas with no existing site-specific data.

Aquatic Habitat Identification

The identification and description of aquatic habitats on the proposed site and adjoining property and any critical or important habitats that occur along any new or existing transmission line or pipeline corridors affected by the proposed action are important to the analysis of aquatic effects. The NRC staff recognizes that new transmission lines and corridors may not necessarily be constructed or owned by an applicant seeking a permit or license from the NRC. However, the effects of the construction and operation of proposed transmission lines and corridors are relevant to the NRC's analysis of cumulative impacts in an environmental impact statement (10 CFR 51.45(c)).

Potential effects of the proposed project can extend beyond the proposed site to encompass habitats potentially affected by surface water drawdown or ground water depletion (including dewatering for construction required to relieve pressure on temporary cofferdams during installation of intake/refill structures); thermal discharge; discharge of contaminants; siltation, noise, and pressure changes from in-water development activities; erosion, runoff, and sedimentation; cooling tower drift; habitat modification and loss; disposal of dredged material; and other activities. Cumulative effects can be determined by defining geographic scale based on aquatic ecological parameters and taking into account factors such as species migration routes (including those of diadromous species), upstream and downstream activities, locations of dams on waterways, and tidal influence. For example, a watershed scale may be appropriate.

Aquatic habitats that are in the vicinity of the proposed project may be identified according to applicable Federal, State, Tribal, regional, and local nomenclature systems. Table 1 lists some protected aquatic habitats and statutory bases for protection. In addition to the statutes included in Table 1, executive orders also address aquatic habitat protection. For example, Executive Order 13158, "Marine Protected Areas," dated May 26, 2000 (Ref. 16), requires Federal agencies whose actions affect the natural or cultural resources protected as a Marine Protected Area to avoid harm to the protected resources to the extent permitted by law and to the maximum extent practicable. Similarly, Executive Order 13089, "Coral Reef Protection," dated June 11, 1998 (Ref. 17), directs Federal agencies whose actions might affect U.S. coral reef ecosystems to identify any effects and "to the extent permitted by law, ensure that any actions they authorize, fund or carry out will not degrade the conditions of such ecosystems."

Many aquatic habitats are highly valuable and worthy of protection, particularly from an ecosystem rather than a species-specific perspective. For example, high productivity areas are integral to the integrity of a local ecosystem's food web. Executive Order 13158 does not cover some de facto marine-protected areas, such as shipping lanes or the aquatic portion of an exclusion area for a nuclear power station, but these areas still warrant inclusion in environmental analyses and studies. It is important to identify, describe, and assess all such valuable aquatic habitats that occur in the vicinity of the proposed project. Typically, applicants identify and describe aquatic habitats according to salinity, bathymetry, rugosity, substrate, flow rate and current patterns, nutrient load, turbidity, SAV, biotic community, biodiversity, tidal influence, temperature, dissolved oxygen, and other parameters appropriate for a particular site. For some assemblages or populations, aquatic habitat descriptions are based on importance for particular activities, species, or life stages. These instances include nursery grounds, breeding grounds, feeding grounds, and spawning or pupping grounds. The EFH and habitat area of particular concern (HAPC), which is a discrete subset of EFH, are often based on species-specific activities and requirements.

The degree of habitat descriptions available within differing geographic areas can vary. It is important to select the tool or combination of tools that describes the habitat at a resolution adequate to identify habitat impacts and to quantify impacts, where necessary. Other Federal and State agencies (e.g., NMFS and FWS or a State's department of natural resources) are sources of information and have online tools that can be used. For example, each NMFS region has an EFH Mapper online, which identifies EFHs that the proposed action may affect. Remote-sensing data, including satellite imagery, and a geographic information system (GIS) are very useful tools for analyzing extents and adjacency of aquatic habitats and potential effects.

Table 1. Protected Aquatic Habitats

HABITAT TYPES	STATUTES	WHAT IS PROTECTED?	AGENCIES
Critical habitat	Endangered Species Act	Habitats designated by NMFS or FWS (or both) as critical to the continued existence of federally protected species	NMFS or FWS, or both
EFH/HAPC	Magnuson-Stevens Fishery Conservation and Management Act	Important habitat for federally managed fish and shellfish species and their prey	NMFS
National Monument	Antiquities Act (Presidential proclamation)	Public natural area with historic or scientific interest	NPS, NOS, USFS, FWS, and BLM

HABITAT TYPES	STATUTES	WHAT IS PROTECTED?	AGENCIES
National Park, National Water Trail, National Seashore, National Lakeshore, and National Preserve	All National Park System units, except National Monuments (see above) have individual pieces of designating legislation.	Varies by type and legislation	NPS
National Wild and Scenic River	Wild and Scenic Rivers Act	Natural, cultural, and recreational values of rivers	Varies
National Marine Sanctuary	National Marine Sanctuaries Act	Marine areas with special national significance	NOS
National Wildlife Refuge	National Wildlife Refuge System Administration Act and individual legislation	Fish, wildlife, and plant resources	FWS
National Estuarine Research Reserve	Coastal Zone Management Act	Vital coastal and estuarine resources	NOAA/State partnership
Tribal refuge	Tribal (varies)	Varies according to Tribe; some joint refuges with FWS	Tribe (and FWS for some)
State scenic river, park, reserve, refuge, and conservation area	Varies	Varies by site and State	FWS, DOI, and appropriate State agency
Coastal zone habitats that vary by State and location	Coastal Zone Management Act	Varies according to State's enforceable policies	NOAA and State agency
Special aquatic sites and aquatic resources of national importance	Clean Water Act	Sanctuaries and refuges, wetlands, mudflats, vegetative shallows, coral reefs, and riffle and pool complexes	EPA and/or COE
Intake area, discharge area, and outfall	Clean Water Act	Dependent on site-specific parameters such as intake velocity and pollutant discharge concentrations	EPA, COE, or delegated State agency (or both); FERC
Local special habitats	Varies	Varies	County or municipal authority (or both)

* The applicant must obtain a permit and approval from the appropriate agency before the NRC can issue an authorization, permit, or license.

Table 1—Legend

BLM: Bureau of Land Management (within DOI)
COE: U.S. Army Corps of Engineers
DOI: U.S. Department of the Interior
EFH: essential fish habitat
EPA: U.S. Environmental Protection Agency
FERC: Federal Energy Regulatory Commission
FWS: U.S. Fish and Wildlife Service (within DOI)
HAPC: habitat area of particular concern
NMFS: National Marine Fisheries Service (within NOAA)
NOAA: National Oceanic and Atmospheric Administration
NOS: National Ocean Service (within NOAA)
NPS: National Park Service (within DOI)
USFS: U.S. Forest Service (within the U.S. Department of Agriculture)

Aquatic Habitat Mapping

Applicants can best map and understand habitats using a GIS based on recent sampling results, site reconnaissance, field surveys, literature, data from appropriate agencies, and remote-sensing data. Community composition, water quality, substrate, bathymetry, salinity, flow rate, presence of SAV, and other descriptors mentioned above could be shown on a comprehensive map. Map detail would appropriately focus on areas of potential aquatic impact, particularly including the extent of direct and indirect effects (e.g., the extent of the thermal discharge plume under various operating and receiving water body conditions and increased runoff resulting from new impervious surfaces). Applicants should adjust the level of detail to meet the anticipated complexity of impact assessments and to include habitats that are of concern to Federal, State, and local agencies and organizations. Table 2 provides an example of how aquatic habitats might be mapped for a new reactor application.

Habitat maps that are scaled and created from georeferenced GIS geodatabases or data layers are most effective, although applicants could also use equivalent maps. Appropriate information on the maps would include a title, date, revision number, north arrow, scale, and legend identifying each habitat type and other mapped features. Maps that show features such as existing topography, roads, water features, and buildings would be helpful for providing general spatial orientation.

Table 2. Example of an Approach to Habitat Mapping for a New Reactor Project

AREA OF COVERAGE	EXAMPLE LEVEL OF DETAIL FOR AQUATIC HABITAT MAPPING
Areas subject to in-water activities, such as proposed intake structures, discharge outfalls, barge slips, dredging activities, pipelines, and transmission towers	Map the spatial extent of in-water work and potential effects in proximity to important habitats. Include effects such as pressure effects, noise, potential collisions with barges, turbidity, runoff, drawdowns, and dewatering associated with temporary cofferdam installations and other such construction. Show temporal progression of effects through a series of maps, if appropriate.
Areas subject to habitat modification, conversion, or fragmentation because of development activities	Map the areal extent of proposed habitat disturbance, modification, conversion, fragmentation, or removal. Include the type of substrate that is removed (e.g., cobble, sand, silt, and clay), and delineate the depth of disturbance. Include a map depicting proposed structures in place. Identify all important aquatic habitats on such maps.
Areas subject to crossing by a transmission line, railroad spur, bridge, causeway, or pipeline right of way or access road to such a right of way	Map the location of aquatic habitats subject to overhead; tunnel; or other crossings of transmission lines, railroad spurs, bridges, causeways, pipelines, access roads, or other features related to the proposed power plant. Include the siting of transmission towers that are adjacent to or within aquatic habitats.
Areas subject to indirect effects from development such as runoff, noise, or atmospheric deposition	Map the potential effects to aquatic habitats located downstream or downgradient from short- and long-term development activities. For example, development in uplands could increase sediment and nutrient loads to aquatic habitats through runoff and other such nonpoint sources.
Areas subject to direct and indirect operational effects, such as impingement; entrainment; thermal, chemical, and physical effects from discharge; and other pollution (e.g., in-water noise)	Map the areal extent of anticipated effects during varying operational and seasonal conditions. For example, map the three-dimensional hydraulic zone of influence from cooling water intake operation, and map the three-dimensional spatial extent of the discharge plume to determine the types of species and proportion of population and habitat that would be affected.
Areas not subject to direct impact but for which information is needed to understand the spatial context and connectivity of affected areas	Map the existing conditions in the vicinity of the proposed sites. Contextual maps facilitate impact analysis and regional quantification. Additionally, the identification of important local and regional habitats is critical for proper cumulative impact analysis and potential mitigation activities.

Aquatic Habitat Description

The identification of aquatic habitat types is an important step in the development of a habitat description. The types of aquatic habitat include, but are not limited to, freshwater lake or reservoir, freshwater river or stream, tidal river or stream, estuary (usually including bays and sounds), and open ocean or marine environments. Freshwater or saltwater wetlands are typically described with the terrestrial environment, as outlined in RG 4.11. However, this RG addresses wetlands containing significant SAV as an aquatic resource. Information on the presence of adjacent emergent wetlands can also be useful to an evaluation of aquatic habitat quality. As noted previously, most aquatic habitats are best described by several characteristics that may include, but are not limited to, salinity, tidal range, substrate, presence of SAV, flow rate, temperature, dissolved oxygen, nutrient concentrations, energy regime, bathymetry, rugosity, stream order, geomorphology, floodplain size, quality of riparian zone, and biotic community types. A thorough description of such characteristics would also include spatiotemporal extents, patterns, gradients, and shifts.

In general, descriptions should be more detailed for areas of likely aquatic impact than for the surrounding areas. Other descriptive information that may be useful when describing aquatic habitats includes the following:

- **Presence of Invasive Species.** Executive Order 13112, "Invasive Species," dated February 3, 1999 (Ref. 18), defines invasive species as "an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health." The National Invasive Species Information Center maintains a list of known invasive aquatic plant and animal species, such as water hyacinth (*Eichhornia* spp.) and Asian clam (*Corbicula fluminea*). It is important to consider the effects of development and operation on populations of invasive species.

- **Disease Vectors, Pests, or Nuisance Species**. It is important to identify any aquatic disease vector, pest, or nuisance species that occur in the vicinity of the proposed and alternate sites. It is important to also consider and document any such species that do not yet occur in the vicinity but are anticipated to spread to the area within 40 years. Examples include harmful algal blooms (e.g., *Karenia brevis*); biofouling organisms, such as invasive nuisance species like the Asian clam and zebra mussel (*Dreissena polymorpha*); potential intake-clogging biota, such as water primrose (*Ludwigia* spp.), water hyacinth, hydrilla (*Hydrilla* spp.), jellyfish (e.g., pink comb jelly (*Beroe ovata*)), and anchovies (e.g., bay anchovy (*Anchoa mitchelli*)); and invasive species, including lionfish (*Pterois volitans* and *Pterois miles*) that alter trophic cascades.

- **Connectivity and Biogeography Information**. It is important to determine whether the habitat that will be affected currently serves, served historically, or may serve in the future as a migration corridor for highly migratory, diadromous, potadromous, or oceanodromous species. Connectivity might also occur on other spatial scales, including the movement of adult organisms or larval dispersal or by motile host species carrying larvae of invertebrates that have sessile adult stages. Examples include adult reef fish that move within a system of patch reefs, corals that spawn pelagic larvae near oceanic currents, and host fish species that transport mussel larvae within a river system.

- **Existing Natural and Anthropogenic Effects**. Past or ongoing natural and anthropogenic processes have altered many aquatic habitats and populations. It is important to consider the environmental integrity (i.e., habitat and function) of a site in an ecoregional context. Examples of natural processes include formation of oxbow lakes, flash floods, tide-driven salinity changes, and some harmful algal blooms. Examples of anthropogenic effects include increased eutrophication, overfishing, pollution, dredging, and tidal restrictions.

- **Recent or Ongoing Ecological Studies.** It is important to determine whether the aquatic habitat of study is or has been the site of ecological investigations by other organizations. Data and results of such studies could offer valuable information for a nuclear power project's aquatic review. For example, NMFS, FWS, and State agencies prepare habitat conservation plans for select habitats that could assist an applicant's analysis. Such plans and agency representatives could serve as resources for habitat descriptions and effects analyses. Consideration of FERC license conditions (i.e., seasonal flow requirements) may be important if a hydropower facility is in the vicinity of the proposed project.

Flora and Fauna Surveys

Identification of observed aquatic species greatly enhances the understanding of the habitat. It is helpful for the applicant to identify and describe the majority of aquatic species in the area of potential effects with a general focus on the higher trophic levels because they are integrators of the lower trophic levels. Field surveys are best conducted when flora and fauna are most readily detected and identified.

For example, diadromous fish species can occur in a river during certain times of year when they are migrating to or from the ocean. Various life stages of many aquatic species are present only seasonally. Sampling should be conducted during all appropriate seasons and at a frequency necessary to determine the distribution and abundance of fish and aquatic macroinvertebrate species. After the data are collected, if the applicant considers that the results are not representative of the system under normal conditions, further sampling or other targeted sampling could be necessary to characterize the aquatic resources adequately. It is appropriate to collect data that can be used to describe biophysical parameters, such as water temperature, dissolved oxygen, pH, nutrient levels, and salinity, concurrently with biotic sampling. The sampling method should be designed comprehensively to allow a description of benthic assemblages in various habitats and invertebrate and vertebrate communities in the water column and near the surface in intertidal, nearshore, and offshore environments in the vicinity of the proposed project. Sampling location, taxa targets, timing, and duration should be designed according to site-specific characteristics and in accordance with Federal, State, or local sampling methods and protocols, as available.

Before conducting surveys, the applicant should become generally familiar with the species that could occur in the planned survey areas by reviewing any existing data and reports that describe aquatic biota in the survey area or in nearby areas with similar habitats, and by contacting any Federal, State, Tribal, local, and private organizations, including academic institutions, as appropriate, to obtain data that have been previously collected. These data can identify aquatic species that could inhabit the subject areas and may help identify suitable survey methods. Moreover, it may be appropriate to follow previous methodology, if it is scientifically suitable, for the purposes of detecting and analyzing trends. Other Federal agencies such as FWS and NMFS may recommend surveys for specific listed species and other species of regional interest and may provide recommended survey timings and protocols specific to such species. Examples of potentially useful sources of information that may contain results of previous surveys include the following:

- recovery plans that FWS, NMFS, or State wildlife agencies prepared for listed species;
- habitat conservation plans that have been approved by FWS or NMFS;
- fishery landings data;
- State fish and game studies and data;
- Government ecological reports;
- academic theses and dissertations;
- surveys conducted at nearby locations, such as parks, research reserves, and institutional properties containing habitat types similar to those in the area to be surveyed;
- surveys conducted and databases maintained by nongovernmental conservation and other organizations;
- studies supporting existing power units or other industrial facilities;
- research or baseline studies for other purposes, including previous or withdrawn NRC applications; and

- field guides with range maps indicating species that could potentially occur in a geographic area.

Existing inventory data collected from the survey area may serve as a baseline for new field surveys in areas where the habitat has not changed substantially. When supplementing existing data, the applicant should consider the spatial extent, purpose, and techniques of the original data collection. Consideration of these factors may identify certain locations and groups of plants and animals omitted during the prior data collection effort that would appropriately be subsequently surveyed. Reconnaissance surveys for planning purposes, followed by detailed field surveys, could be needed when existing site-specific data no longer reflect current conditions (e.g., a habitat has substantially changed or species distribution has shifted) or in areas without existing data. Fauna surveys would appropriately use standard techniques suitable for the detection and identification of the category of wildlife (including mammals, reptiles, fish, and invertebrates) and any life stages of interest. Survey methods should appropriately be based on targeted species and the life stages to be assessed. The applicant could record the data in a table listing each observed species and its scientific name, common name, habitat location(s), and observation date. The table could also describe the abundance of each species when possible. The applicant should document its data collection methods. A map could be used to depict habitat coverages and sampling sites.

Other field observations useful in evaluating the suitability of aquatic habitats for aquatic biota include the following:

- presence of preferred prey or other food source,
- presence of SAV and refugia,
- extent and type of substrate,
- current flow rate,
- stream channel morphology,
- pH,
- water temperature,
- depth,
- turbidity.
- rugosity,
- dissolved oxygen.
- salinity or conductivity, and
- nutrient concentrations (e.g., nitrogen and phosphorus).

Summary of Common Useful Aquatic Environmental Baseline Data

Table 3 summarizes some of the types of aquatic baseline environmental data that can help support NRC new reactor licensing reviews.

Table 3. Types of Aquatic Environmental Baseline Data and Use for New Reactor Licensing or Permitting

DATA TYPE	DATA USE
Land cover and land use data (various scales and sources)	• Site selection • Habitat impacts at the proposed site
Reconnaissance-level data on species and habitats	• Site selection • Impacts to species and habitats at the proposed site
Previously collected data describing aquatic habitat and species at the proposed site (i.e., studies supporting existing power units or other industrial facilities) Research or baseline studies for other purposes, including previous or withdrawn combined licenses or other NRC applications)	• Previously collected data may be obsolete for purposes such as project impact analysis, but such data may be useful for cumulative impact analysis. • Previous data may be a partial substitute for field surveys at the proposed site if the accuracy or reusability of old data is verified. • Previous data may form a basis for design of field surveys at the proposed site.
Recent species and habitat data collected on site	Impacts to species and habitats
Site-specific federally and State-listed species and critical habitat occurrence data from recent field investigations	Impacts to federally and State-listed species and critical habitat
Site-specific federally and State-managed species and EFH data from recent field investigations	Impacts to federally and State-managed species and EFH
Distribution of various life stages of species in project area Projected intake flow rates	Impacts to aquatic biota caused by impingement and entrainment
Distribution of various life stages of species in project area Projected discharge flow rate, extent of thermal plume, and discharged pollutants	Impacts to species and habitats caused by water discharge

Identification of Important Species and Habitats

The NRC's analysis of aquatic environmental impacts generally emphasizes species and habitats that are important to the review and that are of interest to Federal and State agencies and the public. Since the 1970s, the NRC has commonly defined the types of important species and habitats that should be addressed in the evaluation of ecological effects in NRC environmental documentation. Baseline data and natural resource agency consultations form the basis for identifying specific important species and habitats. The NRC uses the following criteria to identify important species and habitats:

- **Federally listed threatened or endangered and proposed species for listing by FWS or NMFS that occupy habitat or have an ecosystem function that may be affected by the proposed project.** For most federally listed aquatic species, either NMFS or FWS maintains ESA responsibilities; however, for some species, such as sea turtles, NMFS and FWS share ESA responsibilities.

- **Candidate species of particular interest to the review that occupy habitat or have an ecosystem function that may be affected by the proposed project.** In addition to the proposed rule, informal discussions with NMFS or FWS are the best source of information on species that are proposed or that are candidates for listing as threatened or endangered under the ESA.

- **Representative State status species of particular interest to the review.** This includes State-listed threatened or endangered species and species otherwise considered rare or protected in the State (in contrast to widespread, abundant, and stable species). Coordination with State agencies is appropriate. State natural heritage programs may provide a listing of federally listed species and State-listed and rare species that occur within specified areas. The NRC staff encourages applicants to use databases but still prefers that they directly communicate with State regulators. Effects from nuclear power stations near State borders can extend to neighboring States; therefore, the NRC encourages coordination with all States whose resources may be affected. For sites near the Canadian or Mexican borders, consultation with foreign agencies may be appropriate.

- **Other species for which a Federal or State agency has established a monitoring requirement at or near the site.** An informal conversation with Federal agencies (NMFS or FWS) or State conservation officials could identify such species.

- **Representative recreationally or commercially valuable species.** Fish species targeted by recreational and commercial fisheries also are important resources to assess. An informal conversation with State game officials could identify species used for consumptive and nonconsumptive recreational and commercial uses.

- **Potentially significant nuisance or invasive species.** Invasive species are alien species whose introduction does, or is likely to, cause economic or environmental harm or harm to human health. Invasive aquatic species include, but are not limited to, plant species, such as water hyacinth, and animal species, such as lionfish and zebra mussel. Applicants can also use resources such as the National Invasive Species Information Center (at https://www.invasivespeciesinfo.gov) for this analysis.

- Other species of known or indicated interest. This category includes the following:

  - **Target species of tribal and non-tribal subsistence fishing**. Information on species can be obtained and evaluated during informal consultation with Tribes and State agencies.

  - **Species essential to the maintenance and survival of other important species**. Information may be available in scientific literature and from relevant Federal and State agencies. Consideration of habitat requirements and food web relationships is also important.

- **Species that can serve as biological indicators to monitor the effects of the proposed action on the aquatic environment.** Some species have a higher sensitivity to changes in the environment and can serve as indicators of otherwise inconspicuous adverse conditions. For example, the presence and population trends of diatoms are good indicators of water quality and environmental conditions suitable for other aquatic species.

- **Protected areas such as sanctuaries, parks, refuges, or preserves, including Marine-Protected Areas, if they may be affected.** Protected areas include national estuarine research reserves; national parks; State parks; or other marine, estuarine, riverine, or lacustrine protected areas designated as such by Federal or State agencies. Although not formally designated by Federal or State agencies, lands owned by private conservation organizations, such as The Nature Conservancy and the Isaac Walton League of America, or even privately held preserves also could be considered.

- **Federally designated or proposed critical habitat or EFH.** The habitats of Federally managed fishery species, including crustaceans and corals, have been designated EFH and sometimes HAPC, which are under the jurisdiction of NMFS. An EFH includes prey species of the managed species being evaluated. The NRC recommends early informal EFH consultation with NMFS. The NRC will conduct EFH consultations as appropriate in accordance with the Magnuson-Stevens Fishery Conservation and Management Act.

- **Habitats identified by Federal or State agencies as unique, rare or of priority for protection.** This category could include Safe Harbor Agreements and candidate conservation agreements with assurances between the FWS or NMFS and non-Federal property owners. The NRC recommends informally meeting with agencies such as NMFS, FWS, and State conservation or game agencies. Some States have unique conservation or management agencies, such as the water management districts in Florida, Outstanding Florida Waters, the Critical Areas Commission for the Chesapeake and Atlantic Coastal Bays in Maryland, and the Texas Water Development Board that works with the various river authorities in Texas. In addition, some regions have organizations that may involve more than one State, including the Delaware River Basin Commission, the Susquehanna River Basin Commission, and the Great Lakes Commission. The NRC also recommends that applicants informally consult with interested local agencies, such as county or municipal planning organizations and town conservation commissions. These agencies can be resources for the information that an applicant needs to generate an adequate environmental report.

- **Other habitats of known or indicated interest (e.g., known breeding, spawning or nursery grounds).** Informal conversation with Federal agencies (NMFS or FWS) or State conservation or game officials could identify such habitats.

The baseline studies described in the sections above would form a generally adequate basis for identifying important species and habitats. However, it may be necessary to conduct specialized field surveys to establish the presence or absence of certain important species, depending on the circumstance. FWS and NMFS have established specific field protocols for investigating sites for the presence of some threatened or endangered species and specific qualifications for field surveyors. Applicants can obtain information on suitable methods for surveying other important species from NMFS, FWS, State agencies, or the scientific literature. The goal of the surveys would be to determine the distribution and

abundance of federally listed species, species that are proposed or are candidates for Federal listing, State-listed species, and species considered to be of importance to the State.

Aquatic Environmental Impact Analyses

Professional judgment by the applicant is often necessary to determine the types of aquatic environmental impact analyses that provide sufficient information in an environmental report. Applicants may consult recent scientific literature and natural resource regulatory agencies for direction in planning and conducting impact analyses. In general, the NRC considers the following generally "good" practices for an applicant:

- Use the best available baseline data whether such data are collected specifically for the subject activity or are available from published sources, agency files, communication with regional experts, or other credible sources.
- Support findings clearly with data and logic.
- Use information that is as quantitative to the extent practicable.
- Use methods or models that are widely accepted by the scientific community, natural resource agencies, and regulatory agencies.
- Avoid experimental or unproven methodologies, assumptions, or models.
- Avoid unsupported speculation or opinion.

Habitat Modification Analyses

Intake and discharge structure installation, pipeline installation, dredging, barge slip installation, impervious surface creation, and other site-preparation and building activities could result in the modification, conversion, fragmentation, or loss of aquatic habitats. Operational activities, such as water withdrawal, thermal discharge, and discharge of chemical constituents, under certain circumstances can alter aquatic habitats through processes such as scouring and degradation of water quality. Potential modifications to aquatic habitats that may have population level and individual protected species effects include, but are not limited to, altered current or upwelling patterns, changes in salinity gradients, scouring, temperature changes, eutrophication, discharge of contaminants (e.g., biocides), and altered sediment transport patterns.

The applicant can map and analyze potential habitat modifications, including conversions, fragmentation, and losses, by considering the following:

- the spatial extent of the existing aquatic habitats,
- site-preparation and development plans for in-water activities,
- temporal variation in the use or alteration of various habitats, and
- model outputs for water withdrawal and discharge effects (e.g., thermal plume extent, scouring, and current alterations).

Distinguishing between permanent and temporary habitat losses and distinguishing among habitat losses attributable to each major project element are both important. The extent of the habitat loss is important because these losses are often localized within a larger water body. The analysis of impacts usually needs to extend beyond quantifying the areal extent of habitat losses to evaluate the potential effects of habitat losses on the distribution, movement, behavior, feeding, and reproduction of important species while taking into account the areal extent relative to the larger water body. Applicants may consider the timing of development and operational activities and their effects, as well as natural diurnal, seasonal, and long-term shifts in aquatic habitat, aquatic assemblages, important life history events, and important species distributions.

Noise and Pressure Effects Analyses

It is important to consider the possible effects of proposed underwater short-term and long-term noise and pressure on aquatic species in the vicinity of the proposed activities. The effects of underwater noise and pressure transience are emerging issues (Ref. 19 and Ref. 20) for consideration in environmental analyses and consultations on protected species with FWS and NMFS. Noise and pressure transience generated by the operation of dredging and pile-driving equipment, for example, can impair the distribution; behavior (including migration, feeding, reproduction, and communication); and even physiology and integrity of certain tissues of aquatic animals. Species noise tolerance levels, as reported in scientific literature, vary widely among species and are a function of sound level (measured in decibels), sound duration, and pattern and frequency of occurrence. If quantitative noise data are not available in the scientific literature, the applicant may substitute qualitative evaluations to account for the effects of existing background noise. Similarly, changes in pressure and resulting effects on important aquatic species may be analyzed quantitatively or qualitatively, or both, as appropriate.

Impingement and Entrainment Analyses

EPA's regulations for cooling water intake structures for new facilities define impingement as "the entrapment of all life stages of fish and shellfish on the outer part of an intake structure or against a screening device during periods of intake water withdrawal" (Clean Water Act, Section 316(b), Phase I regulations in Subpart I, "Requirements Applicable to Cooling Water Intake Structures for New Facilities under Section 316(b) of the Act," of 40 CFR Part 125, "Criteria and Standards for the National Pollution Discharge Elimination System" (Ref. 21)). Impingement occurs when the water withdrawal occurs at such a velocity that it forces an individual organism against trash racks, trash bars, intake screens, or some other physical component of the intake structure such that the individual organism cannot swim, walk, crawl, or otherwise move away from the structure. Impingement typically affects fish and positively buoyant vegetation more than other biota, and some species are more susceptible than others to impingement. Factors affecting impingement survivability include fish length; burst speed; and overall health (e.g., disease, previous injury) of the individual organism. Impingement can harm or kill an organism through physical abrasion, starvation, exhaustion, asphyxiation, descaling, drowning, or other physical harms. Through-screen velocity is an important factor affecting impingement rates and impingement survivability of fish and shellfish species.

Entrainment occurs when organisms pass through all components of the intake structure and enter the power plant with the cooling water. Entrained organisms typically are quite small because they pass through intake screens; usual entrained organisms include eggs, larvae, and juveniles. Entrainment mortality for facilities employing once-through cooling can vary widely, as noted in EPA's report entitled, "National Pollutant Discharge Elimination System: Regulations Addressing Cooling Water Intake Structures for New Facilities," published in Volume 66 of the *Federal Register*, page 65256, on December 18, 2001 (66 FR 65256) (Ref. 22), based on the species entrained, the plant design and operation, time of year, and other factors. The NRC staff, however, generally assumes complete

mortality for entrained organisms in the case of closed-cycle cooling. Based on EPA's Section 316(b) Phase I regulations, all new nuclear power facilities will likely rely on closed-cycle cooling to dissipate waste heat. A closed-cycle cooling station withdraws about 5 percent of the water of an equivalent sized once-through station.

Compliance with EPA's regulations addressing cooling water intake structures for new facilities (Subpart I of 40 CFR Part 125) is generally protective of fish and shellfish populations and does not invariably result in detectable effects to populations of aquatic organisms from impingement or entrainment. However, effects to federally protected species may still occur, and such effects would be determined through coordination with the FWS or NMFS through applicant engagement or ESA consultation, or both, between the NRC and the services. Further, the staff considers it appropriate for the applicant to review data that may be available from existing large energy-production facilities located on the same water body near the project site. The applicant could use entrainment and impingement data from collocated or nearby nuclear or fossil units, where available, to confirm the presence or absence of impingement and entrainment effects and to determine which species in the water body are most susceptible to entrainment or impingement. Such data could be informative even in cases where the existing facility uses different cooling technology from the proposed facility.

Discharge Analyses

Cooling water discharge can affect aquatic habitats and species in several ways. The distribution, abundance, and richness of species in or near the discharge area are important and need to be characterized. Physical alteration of habitat occurs through scouring or other sediment transportation processes, or both, as well as through the removal or relocation of certain substrate components and of SAV that occurs in the receiving water body. Because such alterations might be difficult to estimate quantitatively, qualitative analyses could be included when quantitative predictions are not possible. An evaluation of thermal pollution (e.g., heat shock and cold shock) in the context of species' thermal tolerance ranges and lethal temperature thresholds is important. Aquatic ecologists can work closely with hydrologists to determine the locations and physical properties of the dynamic thermal plume. A thorough analysis would include modeling of the three-dimensional thermal plume under various discharge scenarios and throughout different seasons paying particular attention to the spawning time and thermal tolerances of important resident species in the immediate area, including migratory species for which the thermal plume could be a barrier to upstream or downstream movement. Other potential effects include discharge of contaminants (sometimes including radionuclides), gas supersaturation, low dissolved oxygen concentrations, and stimulation of thermophilic nuisance organisms.

Cooling Tower Drift Analyses

Excess heat in the circulating water system is transferred to the atmosphere by evaporation and conductive cooling in the cooling tower. In addition to the evaporative losses, a small percentage of the water is in the form of droplets (drift) from the cooling towers. The drift is a very small fraction of the circulating water, and, depending on the design, it could be less than 10 gallons per minute for a new station. The drift contains approximately the same nonvolatile chemical constituents as the circulating water, and the circulating water could have several times the chemical constituents of the source water body. Drift can carry dissolved salts, biocides, and other constituents originating from the source water body from the cooling towers to the surrounding area. Salts or total dissolved solids originating from the source water body become concentrated as water evaporates inside the tower. Brackish makeup water is of greater concern than fresh makeup water because of the higher salt content. Biocides are typically used to control microorganisms in the water. Aquatic habitat and species in water bodies near cooling towers can be exposed to drift, including salts and biocides, which could alter water chemistry. Drift deposition from stations with freshwater as a source water body rarely results in a significant effect on

aquatic habitats and biota. However, an analysis of drift deposition is important at nuclear power stations located on brackish and marine water bodies or at facilities using reclaimed water where salt and chemical drift could potentially affect aquatic populations or federally protected species.

Transmission Line Water Crossings

Development, operation, and maintenance of transmission lines and towers can affect aquatic habitat and species where transmission lines cross water bodies. Vehicles, equipment, and vegetation maintenance procedures could introduce chemical contaminants into the water body either directly or indirectly through runoff; installation, maintenance, and other activities also could increase sedimentation because of increased erosion or stormwater runoff. Best management practices are often relied on to minimize or eliminate effects to nearby water bodies. However, the potential exists for federally protected species to be affected in areas where transmission lines closely follow or cross a water body.

Aquatic Environmental Monitoring

Federal, State, and local environmental permits (such as National Pollution Discharge Elimination System permits); biological opinions issued under the ESA; and other Federal and State regulations that protect rare species could result in aquatic environmental monitoring requirements. NMFS or FWS issue biological opinions that will contain terms and conditions that may call for the monitoring of areas containing federally threatened or endangered species or the evaluation of the success of reasonable and prudent measures to minimize the impacts to species or habitats listed under the ESA. The services or other agencies issuing permits may outline specific monitoring and reporting protocols.

C. STAFF REGULATORY GUIDANCE

This section provides guidance for aquatic environmental studies and analyses of aquatic resources that could be affected by the development and operation of new nuclear power stations. Studies should be designed to determine distribution and abundance of species comprising the higher trophic levels (e.g., macroinvertebrates, fish, and SAV) with an emphasis on important species and interactions between the various aquatic communities.

1. Because precise predictions and assessments of effects on aquatic ecological systems are not always possible, applicants may use reasonable professional interpretations when quantitative prediction is not practicable.

2. Applicants should exercise professional judgment to identify appropriate analytical methods to support their environmental evaluations. The NRC advises applicants to contact Federal, State, and local regulatory agencies and search recent scientific literature for specific analytical protocols.

3. Baseline investigations should be broad enough and long enough and should be completed early enough to provide an adequate understanding of the aquatic resources in the vicinity of the station to allow an adequate assessment of potential effect. Baseline investigations may be documented as separate reports or presented as part of larger documents such as environment reports. Applicants can combine closely related baseline studies and analyses into single reports.

4. Aquatic environmental impact analyses should focus primarily on species and habitats that are important to the review and that are of interest to Federal and State agencies and to the public. Analyses should also focus on water availability, current patterns, river flow, tidal flow, and effects of intake and discharge development and operation. Targeted sampling studies may need to be conducted at and near the site at specific times of the year to determine whether important species, such as migratory species, are present and, if so, could be affected by the proposed project.

5. Applicants should label aquatic habitats on maps using standardized or commonly used regional nomenclature when possible.

6. Applicants should quantify habitat modifications and losses by overlaying the estimated limits of disturbance over a habitat map. Losses of EFH include removal of water from the water column and effects on prey of species that have designated EFH. Applicants should address alterations to critical habitat in their evaluations.

7. The three-dimensional extent of the discharge thermal plume should be mapped for the receiving water body. A narrative explanation should accompany the map and should include a discussion of the amount of scouring and chemical contaminants and other constituents, in addition to heat, anticipated during various discharge scenarios.

8. Applicants should consider the deposition of salt and other chemicals from cooling towers at sites located where salt and chemical drifts could potentially affect aquatic communities, important aquatic species, or individuals of federally protected species. A base map should include isopleths showing aquatic habitats, as applicable.

9. Other aquatic environmental impact analyses that may be needed to support NRC licensing decisions include the following:

   (a) impingement and entrainment;

   (b) noise- and pressure-related effects on aquatic biota;

   (c) surface water availability and hydrology;

   (d) interruptions in species movement and migration patterns; and

   (e) introduction and expansion of the range of waterborne disease vectors, pests, or invasive species.

10. Aquatic environmental monitoring required by environmental permits or regulations should be carefully planned with responsible regulatory agencies.

D. IMPLEMENTATION

The purpose of this section is to provide information on how applicants and licensees[1] may use this regulatory guide and information regarding the NRC's plans for using this regulatory guide. In addition, it describes how the NRC staff complies with 10 CFR 50.109, "Backfitting" and any applicable finality provisions in 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants."

Use by Applicants and Licensees

Applicants and licensees may voluntarily[2] use the guidance in this document to demonstrate compliance with the underlying NRC regulations. Methods or solutions that differ from those described in this regulatory guide may be deemed acceptable if they provide sufficient basis and information for the NRC staff to verify that the proposed alternative demonstrates compliance with the appropriate NRC regulations. Current licensees may continue to use guidance the NRC found acceptable for complying with the identified regulations as long as their current licensing basis remains unchanged**.**

Licensees may use the information in this regulatory guide for actions which do not require NRC review and approval such as changes to a facility design under 10 CFR 50.59, "Changes, Tests, and Experiments." Licensees may use the information in this regulatory guide or applicable parts to resolve regulatory or inspection issues.

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1 In this section, "licensees" refers to licensees of nuclear power plants under 10 CFR Parts 50 and 52; and the term "applicants," refers to applicants for licenses and permits for (or relating to) nuclear power plants under 10 CFR Parts 50 and 52, and applicants for standard design approvals and standard design certifications under 10 CFR Part 52.

2 In this section, "voluntary" and "voluntarily" means that the licensee is seeking the action of its own accord, without the force of a legally binding requirement or an NRC representation of further licensing or enforcement action.

REFERENCES[3]

1. *National Environmental Policy Act of 1969*, as amended (NEPA), Section 42, United States Code (U.S.C.) § 4321, et seq.

2. U.S. Nuclear Regulatory Commission (NRC), Regulatory Guide (RG) 4.11, "Terrestrial Environmental Studies for Nuclear Power Stations," Washington, DC.

3. *U.S. Code of Federal Regulations*[4] (CFR), "Domestic Licensing of Production and Utilization Facilities," Part 50, Chapter I, Title 10, "Energy."

4. CFR, "Licenses, Certifications, and Approvals for Nuclear Power Plants," Part 52, Chapter I, Title 10, "Energy."

5. CFR, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants," Part 54, Chapter I, Title 10 "Energy."

6. CFR, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions," Part 51, Chapter I, Title 10, "Energy."

7. Endangered Species Act of 1973, 7 U.S.C. § 136 et seq.

8. Magnuson-Stevens Fishery Conservation and Management Act, 16 U.S.C. § 1801 et seq.

9. Clean Water Act of 1977, 33 U.S.C. § 1251, et seq.

10. Rivers and Harbors Appropriation Act of 1899, 33 U.S.C. §§ 401, 403, and 407.

11. Coastal Zone Management Act of 1972, 16 U.S.C. § 1451 et seq.

12. NRC, RG 4.2, "Preparation of Environmental Reports for Nuclear Power Stations," Washington, DC.

13. NRC, RG 4.7, "General Site Suitability Criteria for Nuclear Power Stations," Washington, DC.

14. NRC, NUREG-1555, "Standard Review Plans for Environmental Reviews for Nuclear Power Plants: Environmental Standard Review Plan," Washington, DC.

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[3] Publicly available NRC published documents are available electronically through the NRC Library on the NRC's public Web site 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. The documents can also be viewed online or printed for a fee in the NRC's Public Document Room (PDR) at 11555 Rockville Pike, Rockville, MD. For problems with ADAMS, contact the PDR staff at (301) 415-4737 or (800) 397-4209; fax (301) 415-3548; or e-mail pdr.resource@nrc.gov.

[4] The *Code of Federal Regulations* is available electronically from the U.S. Government Publishing Office at http://www.gpo.gov/fdsys/browse/collectionCfr.action?collectionCode=CFR.

15. Electric Power Research Institute (EPRI), EPRI Report No. 3002005435, "Advanced Nuclear Technology: Site Selection and Evaluation Criteria for New Nuclear Power Plant Generation Facilities (Siting Guide)," Palo Alto, CA, 2015.[5]

16. Executive Order 13158, "Marine Protected Areas," May 26, 2000.[6]

17. Executive Order 13089, "Coral Reef Protection," June 11, 1998.

18. Executive Order 13112, "Invasive Species," February 3, 1999, as amended by Executive Order 13286, February 28, 2003.

19. National Marine Fisheries Service, *Biological Opinion for the Tappan Zee Bridge Replacement*, NER-2014-11317, Greater Atlantic Fisheries Office, Gloucester, MA, September 23, 2015.[7]

20. Florida Power and Light Company, Letter from W. Maher to the NRC, dated August 12, 2014, regarding "Florida Power & Light Company Proposed Turkey Point Units 6 and 7, Docket Nos. 52-040 and 52-041, Construction Noise and Vibration Impacts Assessment Report for the Combined License Application Part 3—Environmental Report," L-2014-260, Juno Beach, FL. (ADAMS Accession No. ML14336A346)

21. CFR, "Criteria and Standards for the National Pollutant Discharge Elimination System," Part 125, Subpart I, "Requirements Applicable to Cooling Water Intake Structures for New Facilities under Section 316(b) of the Act," Chapter I, Title 40, "Protection of the Environment."

22. U.S. Environmental Protection Agency, "National Pollutant Discharge Elimination System: Regulations Addressing Cooling Water Intake Structures for New Facilities," *Federal Register*, Vol. 66, p. 65256, Washington, DC, December 18, 2001.

23. NRC, Management Directive (MD) 8.4, "Management of Facility-Specific Backfitting and Information Collection," Washington, DC.

24. NRC, "Backfitting Guidelines," NUREG–1409, Washington, DC, July 1990. (ADAMS No. ML032230247)

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5 Copies of Electric Power Research Institute (EPRI) standards and reports may be purchased from EPRI, 3420 Hillview Ave., Palo Alto, CA 94304; telephone (800) 313-3774; fax (925) 609-1310.

6 Executive Orders of the President of the United States are available electronically at http://www.whitehouse.gov/briefing-room/presidential-actions/executive-orders.

7 Copies of reports from the National Marine Fisheries Service can be obtained from the National Oceanographic and Atmospheric Administration, 1315 East-West Highway, Silver Spring, MD 20910, or at the Web site at https://www.greateratlantic.fisheries.noaa.gov/protected/section7/bo/actbiops/nmfsfinalbotappanzee09232014.pdf.