

Excerpts from “Standard Review Plans for
Environmental Reviews for Nuclear Power Plants”
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U.S. NUCLEAR REGULATORY COMMISSION
ENVIRONMENTAL
STANDARD
REVIEW PLAN
OFFICE OF NUCLEAR REACTOR REGULATION

2.4.1 TERRESTRIAL ECOLOGY

REVIEW RESPONSIBILITIES

Primary—Appendix B

Secondary—Appendix B

I. AREAS OF REVIEW

This environmental standard review plan (ESRP) directs the staff's description of the terrestrial environment and biota of the site, transmission corridors, and offsite areas likely to be impacted by the construction, maintenance, or operation of the proposed project. This review should provide input to reviews dealing with evaluation of construction or operational impacts on terrestrial ecosystems and to other reviews that are concerned with land use.

The scope of the review directed by this plan includes identification and description of species composition, spatial and temporal distribution, abundance, and other structural and functional attributes of biotic assemblages that could be impacted by the proposed action. The scope should also include the identification of any “important” terrestrial natural resources (see Table 2.4.1-1 on p. 2.4.1-7) and the location of wildlife sanctuaries and natural areas that might be impacted by the proposed action.

Review Interfaces

The reviewer for this ESRP should obtain input from or provide input to reviewers for the following ESRPs, as indicated:

- **ESRP 2.2.1.** Obtain information about land use of the site and vicinity to complete the description of the site's terrestrial ecology.

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2.4.1-1

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USNRC ENVIRONMENTAL STANDARD REVIEW PLAN

Environmental standard review plans are prepared for the guidance of the Office of Nuclear Reactor Regulation staff responsible for environmental reviews for nuclear power plants. These documents are made available to the public as part of the Commission's policy to inform the nuclear industry and the general public of regulatory procedures and policies. Environmental standard review plans are not substitutes for regulatory guides or the Commission's regulations and compliance with them is not required. The environmental standard review plans are keyed to Preparation of Environmental Reports for Nuclear Power Stations.

Published environmental standard review plans will be revised periodically, as appropriate, to accommodate comments and to reflect new information and experience.

Comments and suggestions for improvement will be considered and should be sent to the U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, Washington, D.C. 20555-0001.

- ESRP 2.2.2. Obtain information about land use of the transmission line corridors, access corridors, and other pertinent offsite areas to complete the description of the site's terrestrial ecology.
- ESRP 2.8. Provide appropriate information on the principal terrestrial ecological features of the site and vicinity in sufficient detail to allow for an evaluation of the cumulative impacts to the terrestrial ecosystems resulting from related Federal project activities.
- ESRP 4.1.1. Provide appropriate information on the principal terrestrial ecological features of the site and vicinity in sufficient detail to allow for an evaluation of land-use impacts resulting from site and vicinity construction.
- ESRP 4.1.2. Provide appropriate information on the principal terrestrial ecological features of the transmission corridors and offsite areas in sufficient detail to allow for an evaluation of land-use impacts resulting from transmission corridor and other offsite facility construction.
- ESRP 4.3.1. Provide information on the principal terrestrial ecological features of the site and vicinity in sufficient detail to allow for an evaluation of the impacts on the terrestrial ecosystems resulting from construction.
- ESRPs 5.1.1 and 5.1.2. Provide information on the principal terrestrial ecological features of the site and vicinity in sufficient detail to allow for an evaluation of land-use impacts resulting from operation of the power station.
- ESRP 5.3.3.2. Provide information on the site's terrestrial ecology so that a description of impacts on the terrestrial ecosystem from operation of the heat-dissipation systems can be completed.
- ESRP 5.4.4. Provide information on the principal terrestrial ecological features of the site and vicinity in sufficient detail to allow for the evaluation of the radiological impacts on the terrestrial ecosystem due to normal plant operation.
- ESRP 5.6.1. Provide information on the site's terrestrial ecology so that an evaluation of impacts on the terrestrial ecosystem from operation or maintenance of the transmission system can be completed.
- ESRP 6.5.1. Provide information on the principal terrestrial ecological features of the site and vicinity in sufficient detail to allow for the evaluation of the terrestrial monitoring programs.

Data and Information Needs

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 impacts. Refer to Table 2.4.1-1 (see p. 2.4.1-7) for a listing of species and habitat criteria for designation of "important" species and resources. The following data or information should be obtained:

- a map that identifies “important” terrestrial habitats on and in the vicinity of the site
- a description and map of the area occupied by each natural and man-made habitat type (from the environmental report [ER])
- U.S. Geological Survey (USGS) topographic maps of the site (7½ min. scale, when available) (from the general literature)
- list and description of “important” species and their spatial and temporal distributions on and in the vicinity of the site, including, as appropriate, their relative abundance, critical habitat, and their life histories—critical life stages, biologically significant activities, seasonal habitat requirements and population fluctuations, food chain, and other interspecific relationships (from the ER and consultation with Federal, State, regional, local, and affected Native American tribal agencies)
- list of species that are of concern as disease vectors or pests. Detailed field surveys of such species are not needed (from the ER and consultation with Federal, State, regional, local, and affected Native American tribal agencies).
- a qualitative estimate of the importance of habitat of threatened, endangered, and other “important” species on and in the vicinity of the site relative to the habitat of such species throughout their entire range (from the ER and consultation with Federal, State, regional, local, and affected Native American tribal agencies)
- locations of travel corridors for “important” terrestrial species and alternate routes for those corridors that could potentially be blocked by use of the site (from the ER and consultation with Federal, State, regional, local, and affected Native American tribal agencies)
- a description of natural and man-induced effects (e.g., farming, logging, grazing, burning), preexisting environmental stresses (e.g., infestations, epidemics, catastrophes), and the current ecological conditions that are indicative of such stresses (from the ER)
- a description and location of any ecological or biological studies of the site or its environs that are recent or currently in progress (from the ER and the general literature)
- documentation that the applicant has consulted with the appropriate Federal and State agencies (e.g., as required by the Fish and Wildlife Coordination Act) and affected Native American tribes (from the ER and consultation with Federal, State, regional, local, and affected Native American tribal agencies).

The following data and information about transmission corridors and offsite areas should be obtained:

- a list of “important” terrestrial habitats and a map that identifies these habitats along routes of transmission and access corridors from the station site to interconnecting points on the high voltage system
- major vegetation types within the proposed corridors (from the ER, site visit, and through consultation with Federal, State, regional, local, and affected Native American tribal agencies)
- a list of “important” species known to occur within and adjacent to the proposed corridors, their spatial and temporal distributions, critical habitats (as appropriate), and their life histories (including critical life stages, biologically significant activities, seasonal habitat requirements and population fluctuations, food chain and other interspecific relationships) (from the ER and consultation with Federal, State, regional, local, and affected Native American tribal agencies)
- where proposed transmission lines cross important waterfowl areas, a list of descriptions of these areas and data on the local abundance and distribution of waterfowl, their seasonal status, and local flight patterns (from the ER and consultation with Federal, State, regional, local, and affected Native American tribal agencies)
- lists of species that are of concern as disease vectors or pests. Detailed field surveys of such species are not needed (from the ER and consultation with Federal, State, regional, local, and affected Native American tribal agencies)
- a more-detailed examination of any segment of the rights-of-way determined to be particularly sensitive to impacts of construction
- a summary of any preexisting environmental stress from such sources such as pollutants, as well as pertinent ecological conditions suggestive of such stresses. A discussion of histories of any infestations, epidemics, or catastrophes (caused by natural phenomena) that have had a significant impact on biota in the vicinity of the transmission corridors should also be included.

II. ACCEPTANCE CRITERIA

Acceptance criteria for the review of terrestrial ecology on and in the vicinity of the site and transmission corridors are based on the relevant requirements of the following:

- 10 CFR 51.75 with respect to descriptions of the environment affected by the issuance of a construction permit
- 10 CFR 52, Subpart A, with respect to descriptions of the environment affected by the issuance of an early site permit
- 10 CFR 51.95 with respect to the preparation of supplemental environmental impact statements (EISs) in support of the issuance of an operating license

- Bald and Golden Eagle Protection Act with respect to the prohibition of taking, possessing, selling, transporting, importing, or exporting the bald or golden eagle, dead or alive, without a permit
- Endangered Species Act of 1973 with respect to identifying threatened and endangered species, critical habitats, formal or informal consultation with the U.S. Fish and Wildlife Service and/or National Marine Fisheries Service
- Fish and Wildlife Coordination Act of 1958 with respect to consideration of fish and wildlife resources in the planning of development projects that affect water resources
- Migratory Bird Treaty Act with respect to declaring that it is unlawful to take, import, export, possess, buy, sell, purchase, or barter any migratory bird. Feathers or other parts of nests and eggs, and products made from migratory birds are also covered by the Act. “Take” is defined as pursuing, hunting, shooting, poisoning, wounding, killing, capturing, trapping, or collecting.

Regulatory positions and specific criteria necessary to meet the regulations as identified above are as follows:

- Regulatory Guide 4.7, Rev. 2, *General Site Suitability for Nuclear Power Stations* (NRC 1998), contains guidance concerning the ecological systems and biota at potential sites and their environs should be sufficiently well-known to allow reasonably certain predictions that there would be no unacceptable or unnecessary deleterious impacts on populations of important species or on ecological systems with which they are associated from the construction or operation of a nuclear power station at the site. The reviewer should ensure that the applicant’s description of the site and transmission corridors identifies important species or ecological systems that could potentially be impacted by station and transmission corridor construction or operation.
- Regulatory Guide 4.11, Rev. 1, *Terrestrial Environmental Studies for Nuclear Power Stations* (NRC 1977), contains technical information for the design and execution of terrestrial environmental studies, the results of which may be appropriate for inclusion in the applicant’s ER. The reviewer should ensure that the appropriate results are included in the ER.

Technical Rationale

The technical rationale for evaluating the applicant’s description of the area’s terrestrial ecology is discussed in the following paragraph:

A detailed and thorough description of the terrestrial ecology in the vicinity of the power station site and associated transmission corridors is essential for the evaluation of potential impacts to the terrestrial environment that may result from plant construction or operation. Use of these acceptance criteria should help ensure inclusion of the terrestrial ecological attributes most needed to predict impacts.

III. REVIEW PROCEDURES

The reviewer should ensure that the ecological information is adequate to serve as a basis for assessment of the impacts of design and siting of the plant, and plant construction and operation. In evaluating the adequacy of the description of terrestrial resources of the site and offsite areas, the reviewer should consult the applicable acceptance criteria of this ESRP. Within these criteria, the reviewer will find a framework of those descriptive features of terrestrial resources judged adequate for most situations of nuclear power station siting. The reviewer should also become familiar with the provisions of the legislation listed in this ESRP.

With these guidelines in mind, the reviewer should take the following steps:

- (1) Identify the species and habitats that will be considered “important” ecological resources of the site, vicinity, transmission corridors, and offsite areas for evaluation of potential impacts on them, using Table 2.4.1-1 as a reference.
- (2) Consult with local offices of the appropriate Federal, State, regional, local, and affected Native American tribal agencies to determine the possible presence of such species.
- (3) Identify the threatened and endangered species that, based on known distributions, could be present within these areas, but that have not been recorded by documented observations.
- (4) In the case of commercially or recreationally valuable species, list the types of wildlife and plants that could be adversely impacted by the proposed action, and in addition to the applicant’s ER, consult with State or local agencies or organizations that maintain records of harvest levels of these species.
- (5) Review the available site-specific data for adequacy, accuracy, and completeness.

IV. EVALUATION FINDINGS

The depth and extent of the input to the EIS should be governed by the kinds of terrestrial ecological resources that could be affected by plant construction or operation and by the nature and magnitude of the expected impacts to these resources. The reviewer should prepare input to the EIS descriptions of the site and offsite areas potentially affected by the proposed project. The input should be brief and should include the following information:

- the principal terrestrial ecological features of the site and vicinity, transmission and access corridors, and offsite areas, with emphasis on the communities that will be potentially affected by proposed project construction, operation, or maintenance. This information should be based on an analysis of at least one full year of data, to reflect seasonal variations in terrestrial populations. Thus, the extent of discussion of various plant and animal communities should be adequate to support the impact assessments for ESRP Chapters 4.0 and 5.0.

Table 2.4.1-1. Important Species and Habitats

Species	Habitat
<p>Rare species</p> <ul style="list-style-type: none">• Listed as threatened or endangered at 50 CFR 17.11 (Fish and wildlife) or 50 CFR 17.12 (Plants). This information may also be found via the Internet at the U.S. Fish and Wildlife Homepage in GEn&SIS.• Proposed for listing as threatened or endangered, or is a candidate for listing in the most current list of such species as published in the <i>Federal Register</i>. This information may also be found via the Internet at the U.S. Fish and Wildlife Homepage in GEn&SIS.• Listed as a threatened, endangered, or other species of concern by the State or States in which the proposed facilities are located	<p>Wildlife sanctuaries, refuges, or preserves, if they may be adversely affected by plant or transmission line construction or operation</p> <p>Habitats identified by State or Federal agencies as unique, rare, or of priority for protection, if these areas may be adversely affected by plant or transmission line operation and maintenance</p> <p>Wetlands (Executive Order 11990), floodplains (Executive Order 11988), or other resources specifically protected by Federal regulations or Executive Orders, or by State regulations</p> <p>Land areas identified as “critical habitat” for species listed as threatened or endangered by the U.S. Fish and Wildlife Service</p>
<p>Commercially or recreationally valuable species</p> <p>Species that are essential to the maintenance and survival of species that are rare and commercially or recreationally valuable (as defined previously)</p> <p>Species that are critical to the structure and function of the local terrestrial ecosystem</p> <p>Species that may serve as biological indicators to monitor the effects of the facilities on the terrestrial environment</p>	

- wildlife sanctuaries, natural areas, and related areas that could be affected
- a discussion of “important” species that may be affected by plant or transmission corridor construction or operation. Estimates of their abundance should be provided when appropriate. Special habitat needs, such as cover, forage, and prey species, should be emphasized if the proposed project would potentially disrupt these needs.
- a summary of the consultations with appropriate Federal, State, regional, local, and affected Native American tribal agencies, including the U. S. Fish and Wildlife Service (through the regional director) and the director of the State Fish and Wildlife agency.

V. IMPLEMENTATION

The method described herein will be used by the staff in evaluating conformance with the Commission's regulations, except in those cases in which the applicant proposes an acceptable alternative for complying with specified portions of the regulations.

VI. REFERENCES

10 CFR 51, Subpart A, "National Environmental Policy Act—Regulations Implementing Section 102(2)."

10 CFR 51.45, "Environmental report."

10 CFR 51.75, "Draft environmental impact statements—production and utilization facilities: draft environmental impact statement—construction permit."

10 CFR 51.95, "Final environmental impact statements—production and utilization facilities: supplement to final environmental impact statement."

10 CFR 52, Subpart A, "Early Site Permits."

10 CFR 52.79, "Contents of application; technical information."

50 CFR 17.11, "Fish and wildlife."

50 CFR 17.12, "Plants."

Bald and Golden Eagle Protection Act of 1940, as amended, 16 USC 668 et seq.

Endangered Species Act, as amended, 16 USC 1531 et seq.

Executive Order 11988, "Floodplain Management."

Executive Order 11990, "Protection of Wetlands."

Fish and Wildlife Coordination Act Amendment, 16 USC 661 et seq.

Migratory Bird Treaty Act, as amended, 16 USC 703 et seq.

U.S. Nuclear Regulatory Commission (NRC). 1977. *Terrestrial Environmental Studies for Nuclear Power Stations*. Regulatory Guide 4.11, Rev. 1, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1998. *General Site Suitability for Nuclear Power Stations*. Regulatory Guide 4.7, Rev. 2, Washington, D.C.



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2.4.2 AQUATIC ECOLOGY

REVIEW RESPONSIBILITIES

Primary—Appendix B

Secondary—Appendix B

I. AREAS OF REVIEW

This environmental standard review plan (ESRP) directs the staff's description of the aquatic environment and biota at and in the vicinity of the site and other areas likely to be impacted by the construction, maintenance, or operation of the proposed project. This review should provide input to reviews dealing with evaluation of construction or operational impacts on aquatic ecosystems and to other reviews that deal with the aquatic environment.

The scope of the review directed by this plan should include the spatial and temporal distribution, abundance, and other structural and functional attributes of biotic assemblages on which the proposed action could have an impact. The review should also identify any “important” (see Table 2.4.2-1) or irreplaceable aquatic natural resources and the location of sanctuaries and preserves that might be impacted by the proposed actions.

Review Interfaces

The reviewer for this ESRP should obtain input from or provide input to reviewers for the following ESRPs, as indicated:

- ESRP 2.3.1. Obtain information about the hydrology of the site to complete the description of the site and vicinity's aquatic ecology.

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2.4.2-1

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Published environmental standard review plans will be revised periodically, as appropriate, to accommodate comments and to reflect new information and experience.

Comments and suggestions for improvement will be considered and should be sent to the U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, Washington, D.C. 20555-0001.

- ESRP 2.3.3. Obtain information about water-quality areas to complete the description of the site and vicinity's aquatic ecology.
- ESRP 4.3.2. Provide information on the principal aquatic ecological features of the site and vicinity in sufficient detail to allow for an evaluation of the impacts to the aquatic ecosystems resulting from construction.
- ESRP 5.3.1. Provide information on the principal aquatic ecological features of the site and vicinity in sufficient detail to allow for an evaluation of the impacts of the cooling system intake structures.
- ESRP 5.3.1.1. Provide information regarding the site's aquatic ecology so that a description and assessment of the hydrodynamics and physical impacts of the intake structures can be completed.
- ESRP 5.3.1.2. Provide information regarding the site's aquatic ecology so that a description of impacts from operation of the intake system can be completed.
- ESRP 5.3.2. Provide information on the principal aquatic ecological features of the site and vicinity in sufficient detail to allow for an evaluation of the impacts of the cooling system discharge structures.
- ESRP 5.3.2.1. Provide information regarding the site's aquatic ecology so that a description and assessment of the plant's hydrothermal discharge and associated physical impacts can be completed.
- ESRP 5.3.2.2. Provide information regarding the site's aquatic ecology so that a description of impacts from operation of the discharge system can be completed.
- ESRP 5.6.2. Provide information regarding the site's aquatic ecology so that an evaluation of the impacts to aquatic ecosystems from transmission facility operation and maintenance can be completed.
- ESRP 6.5.2. Provide information regarding the site's aquatic ecology so that an evaluation of monitoring programs as they relate to the aquatic ecology of the site can be completed.

Data and Information Needs

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 impacts. The following data or information should be obtained:

- characterization of the aquatic environment of the water body and onsite streams, including the following information categories:

- biological (from the environmental report [ER] and the general literature)
- hydrological (from ESRP 2.3.1)
- physiochemical (from ESRP 2.3.3).
- maps showing “important” aquatic habitats (“important” habitat defined in Table 2.4.2-1 [see p. 2.4.2-7]) of the site and vicinity
- the temporal and spatial (including depth) distribution and abundance of “important” aquatic species, especially in the discharge area and receiving water body. Such critical life-support requirements as spawning areas, nursery grounds, food habits, feeding areas, wintering areas, and migration routes (to the extent that power plant construction or operation is expected to affect these parameters). Map where applicable (from the ER, the general literature, and consultation with Federal, State, regional, local, and affected Native American tribal agencies)
- the location and value of the commercial and sport fisheries and the seasonal distribution of harvest by species (from the ER, the general literature, and consultation with Federal, State, regional, local, and affected Native American tribal agencies)
- endangered and threatened aquatic species that are known to be present or could potentially occur onsite and an identification of their other locations and critical habitats within the region. Also identify specific habitat requirements (e.g., thermal tolerance ranges), community interrelationships, and relative abundance (from the ER, the general literature, and consultation with Federal, State, regional, local, and affected Native American tribal agencies).
- key aquatic indicator organisms expected to gauge changes in the distribution and abundance of species populations that are particularly vulnerable to impacts from plant construction or operation (from ER)
- the presence of “nuisance” species such as *Corbicula* sp. or *Mytilus* sp. onsite or in the vicinity of the plant and that are capable of blocking or bio-fouling the cooling water intake system or that can cause other significant problems (from ER)
- the relative significance of important aquatic habitats in a regional context (from the ER, the general literature, and consultation with Federal, State, regional, local, and affected Native American tribal agencies)
- a description of onsite natural, man-induced, and pre-existing environmental stresses, and the current ecological conditions that are indicative of such stresses (from the ER).

The following data or information about transmission corridors and offsite areas should be obtained only when the proposed transmission corridors and offsite areas intersect or are adjacent to aquatic resources:

- a map and description of the location and extent of threatened or endangered or other “important” aquatic species that are known or expected to be present in the vicinity of the transmission corridors together with any specific habitat requirements or community interrelationships (from the ER and consultation with Federal, State, regional, local, and affected Native American tribal agencies)
- any physical, chemical, and biological factors known to influence distribution and abundance of threatened and endangered aquatic life in the vicinity of the transmission corridors (from the general literature)
- documentation that the applicant has consulted with the appropriate Federal, State, regional, local, and affected Native American tribal agencies (e.g., as required by the Fish and Wildlife Coordination Act) (from the ER)

II. ACCEPTANCE CRITERIA

Acceptance criteria for the review of aquatic ecology on and in the vicinity of the site and transmission corridors are based on the relevant requirements of the following:

- 10 CFR 51.75 with respect to descriptions of the environment affected by the issuance of a construction permit
- 10 CFR 51.95 with respect to the preparation of supplemental environmental impact statements (EISs) in support of the issuance of an operating license
- 10 CFR 52, Subpart A, with respect to descriptions of the environment affected by the issuance of an early site permit
- Coastal Zone Management Act of 1972 with respect to natural resources, and land or water use of the coastal zone
- Endangered Species Act of 1973 with respect to identifying threatened and endangered species, critical habitats, and initiating formal or informal consultation with the U.S. Fish and Wildlife Service and/or National Marine Fisheries Service
- Federal Water Pollution Control Act (FWPCA), commonly referred to as the Clean Water Act, Amendments of 1972 with respect to restoration and maintenance of the chemical, physical, and biological integrity of water resources
- Fish and Wildlife Coordination Act of 1958 with respect to consideration of fish and wildlife resources in the planning of development projects that affect water resources
- Marine Mammal Protection Act of 1972 with respect to the protection of marine mammals

- Marine Protection, Research, and Sanctuaries Act of 1972 with respect to dumping of dredged material into the ocean
- Rivers and Harbors Appropriations Act of 1899 with respect to the deposition of debris in navigable waters, or tributaries to such waters.

Regulatory positions and specific criteria necessary to meet the regulations identified above are as follows:

- Regulatory Guide 4.2, Rev. 2, *Preparation of Environmental Reports for Nuclear Power Stations* (NRC 1976), details the means by which the applicant collects baseline data used to compare subsequent data to evaluate plant construction and operation impacts. The reviewer should ensure that the applicant's measurement of conditions before site preparation includes all environmental parameters necessary to evaluate impacts during station operation, as well as during site preparation and construction.
- Regulatory Guide 4.7, Rev. 2, *General Site Suitability for Nuclear Power Stations* (1998), contains guidance concerning the ecological systems and biota at potential sites and requires that their environs be sufficiently well-known to allow reasonably certain predictions that there would be no unacceptable or unnecessary deleterious impacts on populations of important species or on ecological systems with which they are associated from the construction or operation of a nuclear power station at the site. The reviewer should ensure that the applicant's description of the site and transmission corridors identify important species or ecological systems that could potentially be impacted by station and transmission corridor construction or operation.

Technical Rationale

The technical rationale for evaluating the applicant's description of the area's aquatic ecology is discussed in the following paragraph:

A detailed and thorough description of the aquatic ecology in the vicinity of the power station site and associated transmission corridors is essential for the evaluation of potential impacts to the aquatic environment that may result from plant construction or operation. Use of the above acceptance criteria will help ensure inclusion of the aquatic ecological attributes most needed to predict impacts.

III. REVIEW PROCEDURES

The reviewer should ensure that the regional and site-specific aquatic ecological information is adequate to serve as a basis for assessment of the effects of design and siting of the plant, construction, and operation. In assessing the adequacy of the description of aquatic resources of the site and offsite areas, the reviewer should consult the applicable acceptance criteria of this ESRP section. Within these

criteria, the reviewer may find a framework of those descriptive features of aquatic resources judged adequate for most situations of nuclear power station siting. The reviewer should also become familiar with the provisions of the legislation listed in the “Acceptance Criteria” section.

With these guidelines in mind, the reviewer should take the following steps:

- (1) Identify the species and habitats that will be considered “important” ecological resources of the site, vicinity, transmission corridors, and offsite areas for evaluation of potential impacts on them, using Table 2.4.2-1 as a reference.
- (2) Consult with local offices of the appropriate Federal agencies and the appropriate State agencies to verify the possible occurrence of such species.
- (3) Identify the threatened or endangered species that, based on known distributions, could be present within these areas, but that have not been recorded by documented observations.
- (4) In the case of commercially or recreationally valuable species, list the types of wildlife and plants that could be adversely impacted by the proposed action, and in addition to the applicant’s ER, consult with State or local agencies or organizations that maintain records of harvest levels of these species.
- (5) Review the available site-specific data for adequacy, accuracy, and completeness.

IV. EVALUATION FINDINGS

The depth and extent of the input to the EIS should be governed by the kinds of aquatic ecological resources that could be affected by plant construction or operation and by the nature and magnitude of the expected impacts to these resources. The reviewer should prepare as input to the EIS descriptions of the onsite and offsite areas potentially affected by the proposed project. The input should be brief and should contain the following information:

- the principal aquatic ecological features of the site and vicinity and those sensitive offsite areas affected by transmission and access corridors and related facilities, with emphasis on the communities of the ecosystem that will be potentially affected by project construction, operation, or maintenance. This information should be based on an analysis of at least one full year of data to reflect seasonal variations in aquatic populations. Thus, the extent of discussion of various biotic components should be in proportion to the estimated severity of impacts and should be adequate to support the assessment of ESRP Chapters 4.0 and 5.0.
- descriptions of environmental or man-induced stresses to aquatic biota at the existing site and vicinity

Table 2.4.2-1. Important Species and Habitats

Species	Habitat
<p>Rare species</p> <ul style="list-style-type: none">• Listed as threatened or endangered at 50 CFR 17.11 (Fish and wildlife) or 50 CFR 17.12 (Plants). This information may also be found via the Internet at the U.S. Fish and Wildlife Homepage in GEn&SIS.• Proposed for listing as threatened or endangered, or is a candidate for listing in the most current list of such species as published in the <i>Federal Register</i>. This information may also be found via the Internet at the U.S. Fish and Wildlife Homepage in GEn&SIS.• Listed as a threatened, endangered, or other species of concern by the State or States in which the proposed facilities are located	<p>Wildlife sanctuaries, refuges, or preserves, if they may be adversely affected by plant or transmission line construction or operation</p> <p>Habitats identified by State or Federal agencies as unique, rare, or of priority for protection, if these areas may be adversely affected by plant or transmission line operation and maintenance</p> <p>Wetlands (Executive Order 11990), floodplains (Executive Order 11988), or other resources specifically protected by Federal regulations or Executive Orders, or by State regulations</p> <p>Land areas identified as “critical habitat” for species listed as threatened or endangered by the U.S. Fish and Wildlife Service</p>
<p>Commercially or recreationally valuable species</p> <p>Species that are essential to the maintenance and survival of species that are rare and commercially or recreationally valuable (as defined previously)</p> <p>Species that are critical to the structure and function of the local terrestrial ecosystem</p> <p>Species that may serve as biological indicators to monitor the effects of the facilities on the terrestrial environment</p>	

- a discussion of “important” aquatic species that may be affected by plant or transmission corridor construction or operation. Estimates of their abundance should be provided where appropriate. Special habitat and forage needs should be emphasized, if the proposed project would potentially disrupt these.
- a summary of consultations with appropriate Federal, State, regional, local, and affected Native American tribal agencies, including the U.S. Fish and Wildlife Service (through the regional director), and the director of the State fish and wildlife agency.

V. IMPLEMENTATION

The method described herein will be used by the staff in evaluating conformance with the Commission's regulations, except in those cases in which the applicant proposes an acceptable alternative for complying with specified portions of the regulations.

VI. REFERENCES

10 CFR 51.45, "Environmental report."

10 CFR 51.75, "Draft environmental impact statement—construction permit."

10 CFR 51.95, "Supplement to final environmental impact statement."

10 CFR 52, Subpart A, "Early Site Permits."

50 CFR 17.11, "Fish and wildlife."

50 CFR 17.12, "Plants."

Coastal Zone Management Act, as amended, 16 USC 1451 et seq.

Endangered Species Act, as amended, 16 USC 1531 et seq.

Executive Order 11988, "Floodplain Management."

Executive Order 11990, "Protection of Wetlands."

Federal Water Pollution Control Act (FWPCA), as amended, 33 USC 1251 et seq. (also known as Clean Water Act).

Fish and Wildlife Coordination Act Amendment, 16 USC 661 et seq.

Marine Mammal Protection Act of 1972, Pub. L. 92-522, Oct. 21, 1972, 86 Stat. 1027, as amended, 16 USC 1361 et seq.

Marine Protection, Research, and Sanctuaries Act, as amended, 33 USC 1401 et seq.

Rivers and Harbor Appropriations Act, as amended, 33 USC 401 et seq.

U.S. Nuclear Regulatory Commission (NRC). 1976. *Preparation of Environmental Reports for Nuclear Power Stations*. Regulatory Guide 4.2, Rev. 2, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1998. *General Site Suitability for Nuclear Power Stations*. Regulatory Guide 4.7, Rev. 2, Washington, D.C.



U.S. NUCLEAR REGULATORY COMMISSION
ENVIRONMENTAL
STANDARD
REVIEW PLAN
OFFICE OF NUCLEAR REACTOR REGULATION

5.3.1.2 AQUATIC ECOSYSTEMS

REVIEW RESPONSIBILITIES

Primary—Appendix B

Secondary—Appendix B

I. AREAS OF REVIEW

This environmental standard review plan (ESRP) directs the staff's analysis and assessment of potential plant intake system impacts on aquatic ecosystems.

The scope of the review directed by this plan should include an analysis of the effects of entrapment, impingement, and entrainment in sufficient detail to allow the reviewer to predict potential impacts on “important species” and to evaluate the significance of such impacts. The review should be extended to consider the effects of altered circulation patterns and reentrainment of heated effluents if these effects are determined to be significant.

Review Interfaces

The reviewer for this ESRP should obtain input from or provide input to reviewers for the following ESRPs, as indicated:

- **ESRP 2.4.2.** Obtain a description of the aquatic ecology in the vicinity of the site, especially those resources potentially affected by the cooling-water intake system.
- **ESRP 3.1.** Obtain information about the power plant's external appearance and layout in enough detail to support the analyses made in ESRP 5.3.1.2.

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USNRC ENVIRONMENTAL STANDARD REVIEW PLAN

Environmental standard review plans are prepared for the guidance of the Office of Nuclear Reactor Regulation staff responsible for environmental reviews for nuclear power plants. These documents are made available to the public as part of the Commission's policy to inform the nuclear industry and the general public of regulatory procedures and policies. Environmental standard review plans are not substitutes for regulatory guides or the Commission's regulations and compliance with them is not required. The environmental standard review plans are keyed to Preparation of Environmental Reports for Nuclear Power Stations.

Published environmental standard review plans will be revised periodically, as appropriate, to accommodate comments and to reflect new information and experience.

Comments and suggestions for improvement will be considered and should be sent to the U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, Washington, D.C. 20555-0001.

- ESRP 3.4.1. Obtain a description of the cooling system and its operational modes in enough detail to support the analyses made in ESRP 5.3.1.2.
- ESRP 5.2.1. Obtain information regarding hydrological alterations from operation and the adequacy of the plant water supply so that an evaluation of impacts to the aquatic ecosystem from the cooling system intake can be completed.
- ESRP 5.2.2. Provide information regarding impacts on the aquatic ecosystem from the cooling system intake so that an evaluation of impacts of operation on plant water use can be completed.
- ESRP 5.3.1.1. Obtain information regarding physical impacts caused by the flow field induced by the intake system so that an evaluation of impacts on the aquatic ecosystem from the cooling system intake can be completed.
- ESRP 5.10. Provide a list of potentially adverse impacts of the cooling system intake on aquatic biota and a list of applicant commitments to limit these adverse impacts.
- ESRP 6.5.2. Provide a discussion of any preoperational baseline monitoring programs necessary to assess impacts of intake system operation.
- ESRP 9.4.2. Provide a list of adverse impacts of intake system operation that could be mitigated or avoided through alternative system design, location, or operation and assist in determining appropriate alternatives.
- ESRP 10.1. Provide a summary of the unavoidable adverse impacts on aquatic biota that are predicted to occur as a result of intake system operation.
- ESRP 10.2. Provide a summary of irreversible and irretrievable commitments of aquatic resources that are predicted to occur as a result of intake system operation.

Data and Information Needs

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 impacts. The following information should be obtained:

- susceptibility of “important” aquatic species (as defined in Table 2.4.2-1) to entrainment, entrapment, and impingement (from the environmental report [ER] and the general literature)
- the economic value of the species for local or regional commercial and recreational fisheries. For species that are commercially or recreationally valuable, estimates of natural survival rates up to those life stages at which the species are recruited to the harvestable or parent stocks (from the ER and consultation with Federal, State, regional, local, and affected Native American tribal agencies).

- for those “important” species potentially affected by plant operation, estimates of the regional standing stocks (from the ER and consultation with Federal, State, regional, local, and affected Native American tribal agencies)
- for once through systems, transit time from the intake structure to the point of discharge to a receiving water body (from the ER).

Besides the specific site and vicinity information listed here, additional data will be needed to review the impacts on the aquatic ecology from operation of the cooling intake system. This background information can be found in ESRPs 2.3.1, 2.3.3, and 2.4.2 and concerns “important species” as well as the hydrological and ecological conditions on and in the vicinity of the site.

Additional information about the plant design and operating procedures should be taken from other ESRPs, including 3.4.2, 5.3.1.1, and 5.3.2.1. These sections describe components of the cooling system and the hydrodynamics and physical impacts of the intake and discharge.

II. ACCEPTANCE CRITERIA

Acceptance criteria for the review of construction impacts on aquatic resources in the vicinity of the site and transmission corridors are based on the relevant requirements of the following:

- 10 CFR 51.45 with respect to ERs and the analysis of potential impacts contained therein
- 10 CFR 51.75 with respect to descriptions of the environment affected by the issuance of a construction permit
- 10 CFR 51.95 with respect to the preparation of supplemental EISs in support of the issuance of an operating license
- 10 CFR 52, Subpart A, with respect to descriptions of the environment affected by the issuance of an early site permit
- 40 CFR 122 with respect to NPDES permit conditions specified in the Federal Water Pollution Control Act (FWPCA), commonly referred to as the Clean Water Act
- Coastal Zone Management Act of 1972 with respect to natural resources and land or water use of the coastal zone
- Endangered Species Act of 1973, as amended, with respect to identifying threatened and endangered species, critical habitats, and initiating formal or informal consultation with the U.S. Fish and Wildlife Service and/or National Marine Fisheries Service

- Clean Water Act with respect to restoration and maintenance of the chemical, physical, and biological integrity of water resources
- Fish and Wildlife Coordination Act of 1958 with respect to consideration of fish and wildlife resources in the planning of development projects that affect water resources
- Marine Mammal Protection Act of 1972 with respect to the protection of marine mammals
- Marine Protection, Research, and Sanctuaries Act of 1972 with respect to the dumping of dredged material into the ocean

Regulatory positions and specific criteria necessary to meet the regulations identified above are as follows:

- Regulatory Guide 4.2, Rev. 2, *Preparation of Environmental Reports for Nuclear Power Stations* (NRC 1976), contains guidance to the applicant concerning the analysis of potential impacts of operation of the cooling water intake system. The reviewer should ensure that the applicant's analysis is sufficient to evaluate impacts during station operation.
- Regulatory Guide 4.7, Rev. 2, *General Site Suitability for Nuclear Power Stations* (NRC 1998) contains guidance concerning the ecological systems and biota at potential sites and requires that their environs be sufficiently well known to allow reasonably certain predictions of impacts and that there are no unacceptable or unnecessary deleterious impacts on populations of important species or on ecological systems from the construction or operation of a nuclear power station. This guide also provides regulatory positions concerning entrainment, impingement, or other forms of entrapment and effects of cooling systems on aquatic species migration routes.
- Compliance with environmental quality standards and requirements of the Clean Water Act is not a substitute for and does not negate the requirement for NRC to weigh the environmental impacts of the proposed action, including any degradation of water quality, and to consider alternatives to the proposed action that are available for reducing the adverse impacts. If an environmental assessment of aquatic impacts is available from the permitting authority, the NRC will consider the assessment in its determination of the magnitude of the environmental impacts in striking an overall benefit-cost balance. When no such assessment of aquatic impacts is available from the permitting authority, the NRC (possibly in conjunction with the permitting authority and other agencies having relevant expertise) will conduct its own assessment and use it in its determination of the overall benefit-cost balance.
- Memorandum of Understanding Between the Corps of Engineers, U.S. Army, and the NRC for the Regulation of Nuclear Power Plants (40 FR 37110) with respect to the NRC exercising the primary responsibility in conducting environmental reviews and in preparing EISs for nuclear power stations. However, the Corps of Engineers will participate with the NRC in the preparation of EISs by helping to draft material for sections covering (1) coastal erosion and other shoreline modifications,

(2) siltation and sedimentation processes, (3) dredging activities and disposal of dredged materials, and (4) location of structures affecting navigable waters.

- Second Memorandum of Understanding and Policy Statement Regarding Implementation of Certain NRC and EPA Responsibilities, serves as the legal basis for NRC decisionmaking concerning licensing matters covered by NEPA and Section 511 of the Federal Water Pollution Control Act (FWPCA), commonly referred to as the Clean Water Act.

Technical Rationale

The technical rationale for evaluating the applicant's plant system impacts on aquatic ecosystem intakes is discussed in the following paragraph:

The EIS should include an analysis that considers the environmental effects of the proposed cooling water intake system and the alternatives available for reducing or avoiding adverse environmental effects, as well as any environmental benefits that may result from the proposed action. Following the acceptance criteria listed above will help ensure that the environmental impacts of the proposed cooling water intake system are considered with respect to matters covered by such standards and requirements.

III. REVIEW PROCEDURES

The impacts from cooling water intake are regulated through the National Pollutant Discharge Elimination System (NPDES) permit system. The Clean Water Act requires that the location, design, construction, and capacity of the cooling water intake structure reflect the best technology available for minimizing environmental impacts. Responsibility for making this determination rests with the EPA or with its designees.

In the most practical terms, the reviewer's final evaluation is determined through professional judgment based on the pertinent data and analyses. The reviewer may refer to earlier NRC environmental reviews in which evaluation of intake system operational impacts has been important.

The reviewer should take the following steps:

- (1) Determine whether the applicant has provided a current NPDES permit with a 316(b) determination, if appropriate, or equivalent State permits and supporting documentation. If these documents are not available, not current, or do not reflect conditions during the license renewal term, continue the analysis at Step (2). Otherwise, prepare a statement for the SEIS describing the potential for entrainment of fish and shellfish in early life stages that
 - summarizes the permitting documents that have been reviewed
 - states that a current NPDES permit and 316(b) determination are available and current

- concludes that there are no cooling water intake system impacts of entrainment on fish and shellfish in early life stages.
- (2) Identify the “important” aquatic organisms and their life stages susceptible to entrapment, impingement, or entrainment, coordinating efforts with the reviewer of ESRP 2.4.2 to ensure that these susceptible “important” species are also described in that ESRP.
- If fish and shellfish species are present and are susceptible to entrainment such that effects will be detectable or may destabilize or noticeably alter fish or shellfish population levels, then continue the analysis at Step (3). Otherwise, prepare a statement for the supplemental EIS (SEIS) describing the potential for entrainment of fish and shellfish in early life stages that
- summarizes the permitting information, species data, and methods for quantifying fish and shellfish entrainment that have been reviewed
 - states that there are no populations of fish or shellfish species present in the vicinity of the site that will be entrained in the cooling water intake system to the point where changes in their population levels are detectable
 - concludes that, because fish and shellfish populations will remain stable even if some are entrained, the cooling water intake system impacts of entrainment on fish and shellfish in early life stages are **SMALL** within the context of the analysis in NUREG-1437.
- (3) Estimate the levels of susceptibility in either qualitative or quantitative terms, or both. Methods for quantifying entrapment and impingement susceptibilities are not well developed; therefore, it may be necessary to draw on the experience of comparable, currently operating power stations to predict whether the potential is **HIGH**, **MEDIUM**, or **LOW** for the proposed plant. Methods for quantifying entrainment susceptibilities are available; however, they are generally applicable to specific habitat species station characteristics.
- Ensure that assumptions made in available model developments are valid for the case under review.
 - Consider habitat type in determining levels of susceptibility.
- (4) After identifying the “important” species and determining their susceptibility, estimate the survival rates for those species impinged or entrained by relying on experience at other stations. Certain species have been shown to be especially fragile (e.g., threadfin shad, menhaden, bay anchovy), whereas some shellfish are much hardier (e.g., blue crab and penaeid shrimp).
- Consider the design and proposed operation of any proposed screen wash and fish return system.
 - Consider the potential value of such a system, if a return system is not proposed.

- Assume 100% mortality for all entrained biota, considering the following:
 - For once through systems, however, you may perform an analysis using a refined estimate of mortality and factoring in species tolerances to thermal, chemical, mechanical, and pressure stresses; transit time through the system; and plant operational characteristics.
 - For the special case of a multipurpose cooling pond for which makeup water is provided from another water body, the impacts should be considered at both the plant intake and the source water intake.
- (5) Consider the potential for altered hydrodynamic characteristics induced by inlet system operation (e.g., altered circulation patterns) to affect attraction and entrapment of aquatic biota, and consult with the reviewer for ESRP 5.3.1.1 to determine the extent and seasonal variation of any such alterations.
- (6) Consult with the reviewer for ESRP 5.3.2.1 to determine if there is any potential for the recirculation of heated effluent from the plant discharge system. If recirculation is predicted, analyze the potential effects of increased impacts of entrapment, entrainment, and impingement.
- (7) In this final step, estimate the magnitude of the potential impingement and entrainment impacts on the species populations and the aquatic ecosystem.
 - Use the results of Step 4 as the starting point (i.e., the potential station cropping rates for phytoplankton, zooplankton, and meroplankton, including fish eggs and larvae, and juvenile stages of “important” species).
 - Consider these cropping rates in relation to natural mortality rates, reproductive rates, and standing stock estimates for the species populations.
 - Consider other existing stresses (cumulative mortality) to the fragile species (e.g., impacts of other electrical generating stations sited nearby).

In general, the entrainment cropping of phytoplankton and zooplankton will not impact these communities due to the short reproductive cycles for these species. More detailed consideration should be given to those species with annual reproductive cycles, such as most fish and shellfish.

The reviewer may assume, for a first approximation, that plant cropping translates directly to a reduction in the harvestable or parent stocks. Where possible, this impact should be expressed in quantitative units such as (1) catch per unit effort, (2) harvestable stock by weight, (3) recruitment in numbers, (4) dollar values, and (5) numbers or percentages of specific size, age group, or life stage. The reviewer may use more refined analyses (e.g., population modeling, compensation factors) when results suggest that additional precision is needed.

IV. EVALUATION FINDINGS

The depth and extent of input to the EIS will be governed by the attributes of the aquatic ecological resources that could be affected by operation of the station's heat dissipation systems and by the magnitude of the expected impacts on these resources. This section of the EIS should present (1) a list of adverse impacts of cooling system intake operation to aquatic ecosystems, (2) a list of the impacts for which there are measures or controls to limit adverse impacts and the associated measures and controls, (3) the applicant's commitments to limit these impacts, and (4) the staff's evaluation of the adequacy of the applicant's measures and controls to limit adverse impacts. This information should be summarized for the reviewer of ESRP 5.10.

The staff's analysis may be provided by referencing the aquatic biota descriptions of ESRP 2.4.2 and describing in brief detail the impacts on those biota that are "important" and susceptible to entrainment, entrapment, or impingement. Types, life stages, and relative abundance of impacted "important" biota should be described, along with specific aspects of proposed intake system operation responsible for such impacts on these biota. This section should provide estimates of survival from these intake system impacts and estimates of the relative or absolute losses to the impacted populations.

Staff conclusions should contain an evaluation of the significance of losses to the populations of "important" species, including a determination of whether these losses will constitute an adverse impact that should be mitigated or avoided. This section may include a summary of staff consultations with the appropriate NPDES administrative agencies having responsibilities under the FWPCA. Any studies or environmental investigations performed by these agencies that address intake system impacts should be described or referenced.

If any threatened or endangered species will be potentially affected by the operation of the cooling water intake system, a Section 7 consultation process should be initiated with the appropriate Federal agency (U.S. Fish and Wildlife Service or National Marine Fisheries Service) must be arranged. The EIS should contain a summary of the results of such consultations if they occur.

If the reviewer verifies that sufficient information has been provided in accordance with the guidance provided by this ESRP section, then the evaluation will support one of the following concluding statements, to be included in the EIS:

- The staff reviewed the available information relative to potential impacts of the cooling water intake system on the site's aquatic ecology. Based on this review, the staff concluded that the impact is small and mitigation was considered but was deemed not warranted.
- The staff reviewed the available information relative to potential impacts of the cooling water intake system on the site's aquatic ecology. Based on this review, the staff concluded that the impacts are moderate (or large). Potential mitigation measures have been identified and evaluated.

V. IMPLEMENTATION

The method described herein will be used by the staff in evaluating conformance with the Commission's regulations, except in those cases in which the applicant proposes an acceptable alternative for complying with specified portions of the regulations.

VI. REFERENCES

10 CFR 51.45, "Environmental report."

10 CFR 51.75, "Draft environmental impact statement—construction permit."

10 CFR 51.95, "Supplement to final environmental impact statement."

10 CFR 52, Subpart A, "Early Site Permits."

40 CFR 122, "EPA Administered Permit Programs: The NPDES Pollution Elimination Systems."

Coastal Zone Management Act, as amended, 16 USC 1451 et seq.

Endangered Species Act, as amended, 16 USC 1531 et seq.

Federal Water Pollution Control Act (FWPCA), as amended, 33 USC 1251 et seq. (also known as Clean Water Act).

Fish and Wildlife Coordination Act Amendment, 16 USC 661 et seq.

Marine Mammal Protection Act of 1972, as amended, 16 USC 1361 et seq.

Marine Protection, Research, and Sanctuaries Act, as amended, 33 USC 1401 et seq.

Memorandum of Understanding between the Corps of Engineers, U.S. Army, and the U.S. Nuclear Regulatory Commission for the Regulation of Nuclear Power Plants, 40 *Federal Register* 37110 (August 25, 1975).

Second Memorandum of Understanding and Policy Statement Regarding Implementation of Certain NRC and EPA Responsibilities, 40 *Federal Register* 60115 (December 31, 1975).

U.S. Nuclear Regulatory Commission (NRC). 1976. *Preparation of Environmental Reports for Nuclear Power Stations*. Regulatory Guide 4.2, Rev. 2, Washington, D. C.

U.S. Nuclear Regulatory Commission (NRC). 1996. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*. NUREG-1437, Vol. 1, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1998. *General Site Suitability for Nuclear Power Stations*. Regulatory Guide 4.7, Rev. 2, Washington, D. C.



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5.3.2.2 AQUATIC ECOSYSTEMS

REVIEW RESPONSIBILITIES

Primary—Appendix B

Secondary—Appendix B

I. AREAS OF REVIEW

This environmental standard review plan (ESRP) directs the staff's description, quantification, and assessment of potential thermal, physical, and chemical stresses to aquatic organisms that may occur as a result of plant cooling system discharges to receiving water bodies. The principal objective of this ESRP is to predict and assess impacts to "important" aquatic populations in the vicinity of the station and evaluate the significance of such impacts. "Important" resources are defined in ESRP 2.4.2, Review Procedures.

The scope of the review directed by this plan should include the analysis of alterations to the receiving water body resulting from plant thermal, physical, and chemical discharges in sufficient detail to predict and determine the nature and extent of potential impacts on aquatic ecosystems.

Review Interfaces

The reviewer for this ESRP should obtain input from or provide input to reviewers for the following ESRPs, as indicated:

- **ESRP 2.3.1.** Obtain information about the hydrology of the site and environs in sufficient detail to allow analysis of impacts on the aquatic ecosystem from cooling system discharge.

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USNRC ENVIRONMENTAL STANDARD REVIEW PLAN

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Published environmental standard review plans will be revised periodically, as appropriate, to accommodate comments and to reflect new information and experience.

Comments and suggestions for improvement will be considered and should be sent to the U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, Washington, D.C. 20555-0001.

- ESRP 2.3.3. Obtain information concerning water quality at or in the vicinity of the site in sufficient detail to determine impacts on the aquatic environment, especially as they relate to the cooling system and discharge.
- ESRP 2.4.2. Obtain information about the aquatic environment to determine the aspects of the aquatic environment that could potentially be impacted by operation of the cooling discharge system.
- ESRP 3.6.1. Obtain information concerning chemicals or biocides used in relation to the cooling system that could potentially impact the aquatic ecology at the site and its environs.
- ESRP 3.6.2. Obtain information concerning sanitary system effluents that could potentially impact the aquatic ecology at the site and its environs.
- ESRP 5.2.1. Obtain information regarding hydrological alterations from operation and the adequacy of the plant water supply so that an evaluation of impacts on the aquatic ecosystem from the cooling system discharge can be completed.
- ESRP 5.2.2. Provide information regarding impacts on the aquatic ecosystem from the cooling system discharge so that an evaluation of impacts of operation on plant water use can be completed.
- ESRP 5.3.2.1. Obtain information about physical impacts and thermal plumes in enough detail to determine potential impacts on the aquatic ecosystem.
- ESRP 5.5.1. Provide information regarding impacts on the aquatic ecosystem from the cooling system discharge so that an evaluation of impacts from discharge of nonradioactive effluents can be completed.
- ESRP 5.10. Provide a list of applicant commitments and staff evaluations of measures and controls to limit adverse discharge system aquatic impacts.
- ESRP 6.5.2. Provide a discussion of any preoperational baseline monitoring programs necessary to assess impacts of discharge system operation.
- ESRP 9.4.1. Provide a list of adverse impacts of heat-dissipation systems that could be mitigated through alternative system design, location, or operation, and assist in determining appropriate alternatives.
- ESRP 9.4.2. Provide a list of adverse impacts of circulating-water-system operation that could be mitigated or avoided through alternative system design, location, or operation, and assist in determining appropriate alternatives.
- ESRP 10.1. Provide a summary of the unavoidable adverse impacts on aquatic biota that are predicted to occur as a result of discharge system operation.

- ESRP 10.2. Provide a summary of irreversible and irretrievable commitments of aquatic resources that are predicted to occur as a result of discharge system operation.

Data and Information Needs

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 impacts. The following types of data or information should be obtained:

- obtain a copy of the plant's current NPDES permit. If this is not available, obtain the following:
 - thermal
 - data on temperature duration mortality relationship of susceptible "important" aquatic species (from the environmental report [ER] and the general literature)
 - additional information about thermal characteristics as they relate to the discharge system taken from other ESRPs, including ESRPs 2.4.2 and 5.3.2.1, which describe the aquatic ecology of the site and its environs and the physical impacts of the discharge system.
- chemical
 - tolerances of the "important" aquatic species identified in ESRP 2.4.2 to acute and chronic exposure to chemicals in the plant discharge (from the ER and the general literature)
 - tolerances of "important" aquatic species identified in ESRP 2.4.2 to acute and chronic exposure to dissolved gases (from the ER and the general literature)
 - additional information on the biological effects of chemical alterations to the receiving water body obtained from other ESRPs, including ESRPs 2.3.3 and 3.6.1, which describe the water quality of the site and chemical and biocidal nonradiological wastes.
- physical, including information regarding biological effects of physical alterations to the receiving water body obtained from other ESRPs, including ESRPs 2.3.1 and 5.3.2.1, which discuss the hydrology of the site and the physical impacts of the discharge system
- a description of the condenser cooling system because its configuration can determine which permits must be acquired and the severity of impacts on particular aquatic organisms or systems
- a description of applicable State and Federal (40 CFR 423) effluent guidelines and the thermal standards or limitations applicable to the water body to which the discharge is made (including maximum permissible temperature, maximum permissible temperature increase, mixing zones, and maximum rates of increase and decrease) and whether and to what extent these standards or

limitations have been approved by the Administrator of the EPA in accordance with the Federal Water Pollution Control Act (FWPCA), as amended.

II. ACCEPTANCE CRITERIA

Acceptance criteria for the review of impacts to aquatic ecosystems from the discharge system are based on the relevant requirements of the following:

- 10 CFR 51.45 with respect to ERs and the analysis of potential impacts contained therein
- 10 CFR 51.75 with respect to analysis of impacts to the terrestrial environment affected by the issuance of a construction permit
- 10 CFR 52, Subpart A, with respect to analysis of impacts to the terrestrial environment affected by the issuance of an early site permit
- 10 CFR 51.95 with respect to the preparation of supplemental environmental impact statements (EISs) in support of the issuance of an operating license
- 40 CFR 122 with respect to EPA administered programs, especially the National Pollutant Discharge Elimination System (NPDES)
- 40 CFR 423 with respect to effluent guidelines and thermal standards
- Coastal Zone Management Act of 1972 with respect to natural resources, and land or water use of the coastal zone
- Endangered Species Act of 1973, as amended, with respect to identifying threatened or endangered species and critical habitats and formal or informal consultation with the U.S. Fish and Wildlife Service and/or National Marine Fisheries Service
- Federal Water Pollution Control Act (FWPCA), commonly referred to as the Clean Water Act (CWA), Amendments of 1972, Sections 402 and 316[a], with respect to restoration and maintenance of the chemical, physical, and biological integrity of water resources
- Fish and Wildlife Coordination Act of 1958 with respect to consideration of fish and wildlife resources and the planning of development projects that affect water resources
- Marine Mammal Protection Act of 1972 with respect to the protection of marine animals
- Marine Protection, Research, and Sanctuaries Act of 1972 with respect to the dumping of dredged material into the ocean

- Rivers and Harbors Appropriations Act of 1899 with respect to the deposition of debris in navigable waters, or tributaries to such waters.

Regulatory guidance and specific criteria to meet the requirements identified above are presented in the following guidance documents:

- Compliance with environmental quality standards and requirements of the Clean Water Act is not a substitute for and does not negate the requirement for NRC to weigh the environmental impacts of the proposed action, including any degradation of water quality, and to consider alternatives to the proposed action that are available for reducing the adverse impacts. If an environmental assessment of aquatic impacts is available from the permitting authority, the NRC will consider the assessment in its determination of the magnitude of the environmental impacts in striking an overall benefit-cost balance. When no such assessment of aquatic impacts is available from the permitting authority, the NRC (possibly in conjunction with the permitting authority and other agencies having relevant expertise) will conduct its own assessment and use it in its determination of the overall benefit-cost balance.
- Memorandum of Understanding between the Corps of Engineers, U. S. Army, and the USNRC for the Regulation of Nuclear Power Plants, with respect to the NRC exercising the primary responsibility in conducting environmental reviews and in preparing EISs for nuclear power stations. However, the Corps of Engineers will participate with the NRC in the preparation of EISs by helping to draft material for sections covering (1) coastal erosion and other shoreline modifications, (2) siltation and sedimentation processes, (3) dredging activities and disposal of dredged materials, and (4) location of structures affecting navigable waters.

Technical Rationale

The technical rationale for evaluating the applicant's potential plant discharge system impacts to the aquatic ecosystem is discussed in the following paragraph:

The EIS needs to contain an analysis that considers the environmental effects of the cooling-water discharge system and the alternatives available for reducing or avoiding adverse environmental effects, as well as the environmental benefits of the proposed action. Adhering to the acceptance criteria listed above will help ensure that the environmental impacts of the cooling-water discharge system will be considered with respect to matters covered by such standards and requirements.

III. REVIEW PROCEDURES

Regulation of impacts from cooling system discharges is accomplished via the NPDES permit system administered by the EPA and the permitting States under Sections 316(a) and 402 of the CWA. The CWA requires that discharge system operation must ensure the protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife in and on the receiving water body. Responsibility for making this determination (or for reassigning the responsibility) rests with the EPA.

Discharge system impacts on aquatic biota may result from the effects of thermal, chemical, and physical alterations to the receiving water body. Major alterations are usually confined to a limited discharge area (the mixing zone), whereas lesser alterations may extend over a larger portion of the receiving-water body. Adverse effects on biota that are transported through, migrate through, or are attracted to the mixing zone may be acute or chronic, and impacts may be reflected as changes in the populations of “important” species and in the structure and function of the ecosystem.

The reviewer should take the following steps to evaluate the impacts of the plant’s discharge system:

- (1) Determine whether the applicant has provided a current NPDES permit with a 316(a) determination (if required) or equivalent State permits and supporting documentation. If these documents are not available, are not current, or do not reflect conditions during the license-renewal term, continue the analysis at Step (2). Otherwise, prepare a statement for the SEIS describing the potential for discharge impacts to aquatic biota at the site that
 - summarizes the permitting documents reviewed
 - states that the required current NPDES permit and 316(a) determination are available and current
 - concludes that there are no discharge impacts to aquatic organisms that may occur as a result of plant-cooling-system discharges to receiving water bodies.
- (2) If “important” aquatic species are present and are susceptible to heat shock resulting from plant-cooling-system discharges to the receiving water bodies such that the effects will be detectable or may destabilize or noticeably alter population levels, then continue the analysis at Step (3). Otherwise, prepare a statement for the SEIS describing the potential for thermal impacts to aquatic biota at the site that
 - summarizes the permitting information, species data, and methods for quantifying thermal stresses due to heat shock to aquatic biota that have been reviewed
 - states that there are no populations of “important” aquatic biota present in the vicinity of the site that will be adversely affected by plant-cooling-system thermal discharges to the point where changes in their population levels are detectable
 - concludes that, because aquatic biota populations will remain stable even if some are affected by heat shock, the cooling-system discharge impacts on aquatic biota are SMALL within the context of the analysis in NUREG-1437 and that mitigation is not warranted.
- (3) Determine and assess the levels of potential biological impacts.
 - Consider the biological effects of thermal, chemical, and physical alterations to the receiving water body on the identified “important” aquatic species, including combined effects (e.g., thermal plus chemical effects) and the potential for gas-bubble disease.

- Give particular attention to the relationship of these stresses to life history requirements (e.g., growth, reproduction, migration).
- Evaluate the discharge system impacts of the plant as described below.

Procedures for reviewing specific impacts of thermal, chemical, and physical alterations are listed below. Analyze the impacts for the parameter when considered alone and the impacts for the parameter when combined with other parameters. The review should be based on general habitat types such as

- rivers and streams
- lakes and reservoirs
- estuaries
- seacoast.

Thermal Effects

The reviewer should consider species in the vicinity of the station and their susceptibility to thermal effects.

(1) Consider the following:

- maximum sustained temperatures for each season that are consistent with maintaining desirable levels of productivity
- maximum levels of metabolic acclimation to warm temperatures that will permit return to ambient winter temperatures if artificial sources of heat cease
- temperature limitations for survival of brief exposures to temperature extremes, both upper and lower
- if spawning or nursery areas are affected, restricted temperature ranges for various stages of reproduction, including (for fish) gonad growth and gamete maturation, spawning migration, release of gamete, development of the embryo metamorphosis, emergence, and other activities of early life stages, such as commencement of independent feeding by juveniles, and temperature required
- thermal limits for diverse compositions of species of aquatic communities, particularly where nuisance growths of certain organisms create reduction in diversity or where important food sources or chains are altered
- thermal requirements of downstream aquatic life where upstream warming of a cold-water source will adversely affect downstream temperature requirements
- areal extent of the plume

- percent of unaffected area
 - physical concentrating factors.
- (2) Identify the most thermally intolerant “important” species expected to be affected.
- (3) Quantify the magnitude of potential thermal impacts to the aquatic ecosystem.
- (4) Evaluation of thermal impacts, addressing the following recommendations:
- Growth of aquatic species should be maintained at levels necessary for sustaining actively growing and reproducing populations if the maximum weekly average temperature in the zone inhabited by the species at that time does not exceed one-third the range between the optimum temperature and the ultimate upper incipient lethal temperature of the species, and the temperatures above the weekly average do not exceed the criterion for short term exposures.
 - After the specific limiting temperatures and exposure times have been determined by studies tailored to local conditions, the reproductive activity of selected species should be protected in those areas in which (1) temperature regimes required for gonad growth and maturation are preserved, (2) no temperature differentials are created that block spawning migrations, although some delay or advancement of timing based upon local conditions may be tolerated, (3) temperatures are not raised to a level at which necessary spawning or incubation temperatures of winter spawning species cannot occur, (4) sharp temperature changes are not induced in spawning areas, either in mixing zones or in mixed water bodies (the thermal and geographic limits to such changes will be dependent upon local requirements of species, including spawning microhabitat, e.g., bottom gravels, littoral zone, and surface strata), (5) timing of reproductive events is not altered to the extent that synchrony is broken where reproduction or rearing of certain life stages is shown to be dependent upon cyclic food sources or other factors at remote locations, and (6) normal patterns of gradual temperature changes throughout the year are maintained.
 - Nuisance growths of organisms may develop where there are increases in temperature or alterations of the temporal or spatial distribution of heat in either the receiving water bodies (e.g., rivers, lakes) or in onsite cooling ponds. Some nuisance conditions may be created by operation of cooling ponds that may not affect receiving water body biota, but that may affect the aesthetic quality of the site and vicinity. The reviewer should consider such factors (e.g., odors from algal or macrophyte growth and decomposition) in making this evaluation. There should be careful evaluation of all factors contributing to nuisance growths at any site before establishment of thermal limits based upon this response, and temperature limits should be set in conjunction with restrictions on certain other factors (e.g., eutrophication).

Chemical Effects

The reviewer should consider species in the vicinity of the station and their susceptibility to chemicals released.

(1) Consider the following parameters:

- acute toxicity
- chronic toxicity
- accumulation
- biomagnification
- sublethal and behavioral effects.

(2) Determine if applicant needs to perform bioassays for important chemicals such as copper, chlorine, or related components, and scale inhibitors based on site-specific conditions.

(3) Compare the concentrations of chemicals at the discharge points with concentrations of the same chemicals in ambient waters.

- Consider dilution and mixing of chemical discharges.
- Obtain estimates of concentrations at various distances from the release point.
- Assess the effects of variable environmental and plant operation conditions on injury or mortality of suspectable organisms.
- Determine the potential for bioconcentration, biomagnification, and interacting effects for certain chemicals.

(4) Determine the biological losses from chemical stress based upon

- plume configuration
- time and concentration
- worst and average conditions.

(5) Determine if losses of either resident or migratory species will occur given proposed specifications for chemical releases.

(6) Evaluations of chemical impacts should address the following:

- the possible environmental effect of certain chemicals, like chlorine (hypochlorite), chlorination byproducts, other biocides, and scale and corrosion inhibitors
- alternatives to the biocide treatment of condenser tubing.

Physical Effects

The reviewer should consider species in the vicinity of the station and their susceptibility to physical effects.

(1) Consider the following parameters:

- reduction in density, species composition, and community structure of the benthos
- loss or alteration of habitat
- alteration of migratory pathways.

(2) Consider the potential effects of the following on habitat loss and species composition

- altered current patterns
- current velocity
- littoral drift
- scouring
- siltation
- increased turbidity
- gas supersaturation (gas-bubble disease)
- low dissolved oxygen
- predation
- parasitism
- disease among organisms exposed to sublethal stresses.

(3) Note effects associated with loss or alteration of habitat and the resultant potential reduction in species composition and community structure.

(4) Evaluation of physical impacts should address the following:

- potential loss or alteration of unique habitat
- potential effects of altered migratory pathways
- potential effects of other biotic changes.

IV. EVALUATION FINDINGS

Input to the EIS should (1) a list of adverse impacts of cooling system discharge operation to aquatic ecosystems, (2) a list of impacts for which there are measures or controls to limit adverse impacts and the associated measures and controls, (3) the applicant's commitments to limit these impacts, and (4) the staff's evaluation of the adequacy of the applicant's measures and controls to limit adverse impacts. This information will be summarized by the reviewer of ESRP 5.10.

The staff's analysis may be provided by referencing the aquatic biota descriptions of ESRP 2.4.2 and describing in brief detail the effects on biota that are "important" and susceptible to thermal, chemical, or physical impact. Types, life stages, and relative abundance of impacted "important" biota should be

described, along with specific aspects of the proposed discharge-system operation responsible for impacts on these biota. This section should contain estimates of survival from these discharge system impacts and estimates of the relative or absolute losses of the impacted populations. Documentation of informal or formal consultations under Section 7 of the ESA that took place with the appropriate regional offices of the U.S. Fish and Wildlife Service and/or National Marine Fisheries Service, or with appropriate State agencies or affected Native American tribes to determine the extent of potential impacts on aquatic species on and in the vicinity of the site should be included in the EIS.

Staff conclusions should evaluate the significance of losses to the populations of “important” species, including a determination of whether these losses will constitute an adverse impact that should be mitigated or avoided. Any studies or environmental investigations that address discharge system impacts should be described or referenced. The reviewer should ensure that measures and controls to limit or avoid impacts are consistent with the NPDES permit, if available.

If the reviewer verifies that sufficient information has been provided in accordance with the guidelines of this ESRP section, then the evaluation supports the following types of concluding statements to be included in the staff's EIS:

The staff reviewed the available information relative to impacts to the aquatic environment on or in the vicinity of the site. The staff concludes that the list and description of impacts is adequate to comply with 10 CFR 51.45.

V. IMPLEMENTATION

The method described herein will be used by the staff in evaluating conformance with the Commission's regulations, except in those cases in which the applicant proposes an acceptable alternative for complying with specified portions of the regulations.

VI. REFERENCES

10 CFR 51.45, “Environmental report.”

10 CFR 51.75, “Draft environmental impact statement—construction permit.”

10 CFR 51.95, “Supplement to the final environmental impact statement.”

10 CFR 52, Subpart A, “Early Site Permits.”

40 CFR 122, “EPA Administered Permit Programs: The NPDES Pollution Elimination Systems.”

40 CFR 423, “Steam Electric Power Generating Point Source Category.”

Coastal Zone Management Act, as amended, 16 USC 1451 et seq.

Endangered Species Act, as amended, 16 USC 1531 et seq.

Federal Water Pollution Control Act (FWPCA), as amended, 33 USC 1251 et seq. (also known as Clean Water Act).

Fish and Wildlife Coordination Act Amendment, 16 USC 661 et seq.

Marine Mammal Protection Act of 1972, Pub. L.92-527, Oct. 21, 1972, 86 Stat. 1027, as amended, 16 USC 1361 et seq.

Marine Protection, Research, and Sanctuaries Act, as amended, 33 USC 1401 et seq.

Memorandum of Understanding between the Corps of Engineers, U.S. Army, and the U.S. Nuclear Regulatory Commission for the Regulation of Nuclear Power Plants. 40 *Federal Register* 37110 (August 25, 1975).

Rivers and Harbor Appropriation Act, as amended, 33 USC 401, et seq.



U.S. NUCLEAR REGULATORY COMMISSION
ENVIRONMENTAL
STANDARD
REVIEW PLAN
OFFICE OF NUCLEAR REACTOR REGULATION

9.4.1 HEAT DISSIPATION SYSTEMS

REVIEW RESPONSIBILITIES

Primary—Appendix B

Secondary—Appendix B

I. AREAS OF REVIEW

This environmental standard review plan (ESRP) directs the staff's analysis of alternatives to the applicant's proposed heat dissipation system. This includes evaluating these alternatives, in comparison with the proposed system, to identify those systems that are (1) environmentally preferable to the proposed system and (2) environmentally equivalent to the proposed system. Environmentally preferable alternatives should be compared with the proposed system on a benefit-cost basis to determine if any such system should be considered as a preferred alternative to the proposed system.^(a)

The scope of the review directed by this plan should be limited to alternative heat dissipation systems considered feasible for construction and operation at the proposed plant site and that (1) are not prohibited by Federal, State, regional, or local regulations, or Native American tribal agreements, (2) are consistent with any findings of the Federal Water Pollution Control Act (FWPCA), commonly referred to as the Clean Water Act (CWA), and (3) can be judged as practical from a technical standpoint with respect to the proposed dates of plant construction and operation. This review should also include the investigation of alternatives proposed by other reviewers to mitigate impacts associated with construction and operation of the proposed heat dissipation system.

(a) The review of environmentally preferable heat dissipation systems should include both environmental and economic considerations. The activities of and information from two or more reviewers may be needed in conducting this portion of the review.

October 1999

9.4.1-1

NUREG-1555

USNRC ENVIRONMENTAL STANDARD REVIEW PLAN

Environmental standard review plans are prepared for the guidance of the Office of Nuclear Reactor Regulation staff responsible for environmental reviews for nuclear power plants. These documents are made available to the public as part of the Commission's policy to inform the nuclear industry and the general public of regulatory procedures and policies. Environmental standard review plans are not substitutes for regulatory guides or the Commission's regulations and compliance with them is not required. The environmental standard review plans are keyed to Preparation of Environmental Reports for Nuclear Power Stations.

Published environmental standard review plans will be revised periodically, as appropriate, to accommodate comments and to reflect new information and experience.

Comments and suggestions for improvement will be considered and should be sent to the U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, Washington, D.C. 20555-0001.

This plan provides the basis for staff conclusions with respect to the environmental preference or equivalence of alternative heat dissipation systems, and for environmentally preferable systems and conclusions regarding any such systems having an equivalent or better benefit-cost balance than the proposed system.

Review Interfaces

The reviewer for this ESRP should obtain input from or provide input to the reviewers for the following ESRPs, as indicated:

- ESRPs 2.2.1, 2.3.1, 4.1.1, 4.3.1, 5.1.1, and 5.3.3.2. Obtain input from the reviewers for these ESRPs to develop the comparative land-use and ecological impact data with regard to heat dissipation systems.
- ESRPs 2.3, 4.2.2, 4.3.2, and 5.2.2. Obtain input from reviewers to develop the comparative water-quality and water-use data.
- ESRPs 2.7 and 5.3.3.1. Obtain input from the reviewers to develop comparisons, which may be based on verified applicant supplied data or on independent staff estimations of atmospheric effects.
- ESRPs 2.3.1, 4.2.1, and 5.2.1. Obtain input from the reviewers for assistance in comparing each alternative heat dissipation system with the effects of the proposed system.
- ESRPs 2.5, 3.1, 5.8.1, and 5.8.2. Obtain input from the reviewers when comparing the aesthetic impacts and potential recreational benefits of each alternative system with those of the proposed system.
- ESRP 3.3.1. Obtain plant water consumption data to be used in the evaluation of impacts using component alternatives.
- ESRPs 4.1.3 and 5.1.3. If proposed construction or operation of the heat dissipation system may result in adverse impacts to historic properties, obtain information regarding alternative systems or locations that may be taken into consideration as a means to avoid the impacts.
- ESRPs 4.4.1 through 4.4.3. If socioeconomic impacts from construction of the heat dissipation system appear to be adverse, consider alternative systems or locations to avoid the impacts.
- ESRPs 4.6 and 5.10. Provide a list of those measures and controls to limit adverse heat dissipation system impacts that were developed as a result of this environmental review.
- ESRP 9.4.2. Obtain input from the reviewers when an alternative heat dissipation system would involve the use of intake or discharge systems that would be substantially different from the proposed system.

- ESRPs 10.1 through 10.4.3. Provide data and information to the appropriate reviewers to permit the inclusion of any such alternatives in the final evaluation of the proposed action when suggested consideration of an alternative heat dissipation system is determined to be environmentally preferable.
- Interface with the Environmental Project Manager (EPM). Obtain input from the EPM when an alternative heat dissipation system appears to be environmentally preferable and meets regulatory requirements.

Data and Information Needs

The kinds 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 practicality of adapting the potential alternative to the proposed site. The following data or information should be obtained:

- (1) proposed heat dissipation system and for each potential alternative as follows:
 - land-use requirements (from ESRP 3.1 and the environmental report [ER])
 - water-use requirements (from ESRP 3.3.1 and the ER)
 - operating and maintenance experience for similar units (from the ER and the general literature)
 - capital, maintenance, and operating costs (from the ER and the general literature)
 - effect on generating efficiency (from the ER and the general literature)
 - predicted thermal and physical effects, e.g., thermal plume, scouring (from ESRPs 5.3.1.1 and 5.3.2.1 and the ER)
 - predicted atmospheric effects, e.g., fogging, icing, drift (from ESRP 5.3.3.1 and the ER)
 - predicted operating noise levels (from ESRP 5.8.1 and the general literature)
 - predicted aesthetic effect, e.g., visual plumes (from the ER)
 - predicted recreational benefits (from the ER)
- (2) site and vicinity land use, current and projected (from ESRP 2.2.1)
- (3) site and vicinity hydrological data (from ESRP 2.3.1)
- (4) site and vicinity water use, current and projected (from ESRP 2.3.2)
- (5) site and vicinity water-quality criteria (from ESRP 2.3.3)
- (6) site and vicinity ecological data (from ESRP 2.4)
- (7) site and vicinity meteorological characteristics (from ESRP 2.7).

II. ACCEPTANCE CRITERIA

The analysis of alternative plant heat dissipation systems is a necessary step in the environmental impact statement (EIS) process. The acceptance criteria for this analysis are based on the relevant requirements of the following:

- 10 CFR 51.71(a) referring to 10 CFR 51.45(a)(3) with respect to the need to discuss alternatives in the environmental analysis
- 10 CFR 51, Appendix A, discussing alternatives to the proposed action
- Fish and Wildlife Coordination Act of 1958
- Marine Sanctuaries Act of 1972 (amended 1995)
- Marine Mammal Protection Act (amended 1994)
- Coastal Wetlands, Planning Protection and Restoration of 1990
- Coastal Zone Management Act of 1972 (amended 1992)
- CWA of 1987
- 40 CFR 122 with respect to NPDES permit conditions specified in the CWA
- Endangered Species Act of 1973 (amended 1988).

Regulatory positions and specific criteria necessary to meet the regulations as identified above are as follows:

- Regulatory Guide 4.2, Rev. 2, *Preparation of Environmental Reports for Nuclear Power Stations* (NRC 1976), with respect to alternative systems designs.
- Memorandum of Understanding Between NRC and the Army Corps of Engineers for the Regulation of Nuclear Power Plants (40 FR 37110, August 25, 1975) with respect to locating structures affecting navigable waters.
- Federal, State, regional, local, and affected Native American tribal agencies, on water use, air and water quality, effluent discharge, and land use.

Technical Rationale

The technical rationale for evaluating alternatives to the applicant's heat dissipation systems is discussed in the following paragraph:

The consideration of alternatives is the essence of the NEPA process. The review conducted under this ESRP section contributes to the consideration of alternatives by addressing alternative means of heat dissipation to determine if there is an obviously superior method in terms of environmental impacts and economic costs when compared to the proposed system.

III. REVIEW PROCEDURES

The principal objectives of this analysis are (1) to provide assistance to the reviewers for ESRP Chapters 4.0 and 5.0 concerned with construction or operational heat dissipation system impacts in identifying and verifying means to mitigate adverse impacts associated with the proposed heat dissipation system and (2) to identify and analyze reasonable alternatives to the applicant's proposed system to the extent needed to rank them, from an environmental standpoint, as preferable, equivalent, or inferior to the applicant's proposed system.

The depth of the analysis should be governed by the nature and magnitude of proposed heat dissipation system impacts predicted by the reviews of ESRP Chapters 4.0 and 5.0. If adverse impacts are predicted, the reviewers should coordinate in identifying and analyzing means to mitigate these impacts. The proposed system with any verified mitigation schemes (i.e., measures and controls to limit adverse impacts) should be the baseline system against which alternative heat dissipation systems are compared. The nature and adversity of the remaining unmitigated impacts for this baseline system should establish the level of analysis required in the review of alternative systems. This should permit staff evaluation and conclusions with respect to the environmental preference or equivalence of these alternatives. When no adverse impacts have been predicted for the proposed system, the review should be limited to an analysis of alternative heat dissipation systems in the depth necessary to judge their environmental equivalence to the applicant's proposed system.

When environmentally preferable alternatives have been identified, the review should be expanded to consider the economic costs of any such alternative. This analysis should be done in consultation with appropriate ESRP 10.4 reviewers. Assistance from these reviewers should be requested to establish the economic-cost data to be used to develop a benefit-cost comparison with the baseline (proposed) heat dissipation system.

The reviewer should consider the following classes of heat dissipation systems (additional systems, e.g., a combined tower/pond system, may be considered when site-specific conditions suggest that such a system would be environmentally preferable to the proposed system):

- once through systems
- closed cycle systems:
 - mechanical draft wet cooling towers (including circular towers)
 - natural draft cooling towers (including fan assisted towers)
 - wet dry cooling towers
 - dry cooling towers
 - cooling ponds
 - spray ponds.

The reviewer should consider these alternatives for construction and operation at the applicant's proposed site. The analysis should include intake- and discharge-system environmental impacts (and economic costs) when these systems would need to be substantially different than those associated with the proposed heat dissipation system.

The reviewer should conduct an initial environmental screening of each alternative heat dissipation system to eliminate those systems that are obviously unsuitable for use at the proposed site. Factors to be considered in this initial screening are land use (e.g., site size and terrain), water use (e.g., availability of cooling water), and legislative restrictions. Economic factors should not be considered in this initial screening. Working through the EPM, the reviewer may consult with appropriate Federal and State agencies when needed to conduct this screening. The reviewer should also consult (through the EPM)

with the appropriate National Pollutant Discharge Elimination System (NPDES) administrative agencies to screen those alternatives that will not meet CWA requirements. The reviewer may establish other justifiable environmental bases for rejection of a given alternative. When the reviewer rejects an alternative, that alternative needs no further consideration other than the preparation of the reasons and justification for the rejection.

The following procedure for developing the analysis of alternative heat dissipation systems considers both environmental and economic-cost factors. In following this procedure, the reviewer should initially consider only the environmental factors and should repeat the procedure for economic factors only for those alternatives shown to be environmentally preferable by the evaluation procedures of this ESRP. The analysis of those alternative heat dissipation systems not eliminated by the initial screening process should be based on the environmental and economic factors shown in Table 9.4.1-1. The reviewer should prepare a similar table for the heat dissipation systems under consideration, comparing each of the environmental and economic cost and benefit factors with those of the proposed heat dissipation system. Information for this table may be presented either in terms of absolute environmental and economic costs and benefits or as incremental costs and benefits referenced to the proposed system. Additional factors may be included when needed on a site- or system-specific basis. Preparation of this table should involve the following:

- (1) Land Use—Determine (1) the onsite land-use requirements of each system, (2) the practicality of heat dissipation system construction and operation within the specifics of site area, terrain, and the impacts of social and economic land-use costs, (3) the extent to which any system is sited on or results in modifications to the floodplain,^(a) and (4) the impacts to terrestrial biota associated with system construction and operation. The reviewer should consult with the reviewers for ESRPs 2.2.1, 2.3.1, 4.1.1, 4.3.1, 5.1.1, and 5.3.3 to develop the comparative land-use and ecological impact data.

Table 9.4.1-1. Screening of Alternative Heat Dissipation Systems

Factors Affecting System Selection	Alternative 1	Alternative 2	Alternative 3
Land-use Onsite land requirements Terrain considerations			
Water use			
Legislative restrictions			
Is this a suitable alternative heat dissipation system? (Yes/No)			

(a) See ESRP 2.3.1 for a definition of the floodplain.

- (2) **Water Use**—Determine (1) the water-use requirements of each system, including intake requirements, water consumption, and intake/discharge water quality and quantity, (2) the practicality of this water use within the specifics of water availability and the impacts of present and known future water uses, and (3) the impacts of aquatic biota associated with system construction and operation. The reviewer should compare these data with characteristics of the proposed heat dissipation system. The economic cost of water consumed should be considered when these data are available. The reviewer should consult with the reviewers for ESRPs 2.3, 4.2.2, 4.3.2, 5.2.2, and 5.3 to develop the comparative water quality, water use, and ecological impact data.
- (3) **Atmospheric Effects**—Determine the predicted atmospheric effects of each alternative heat dissipation system (e.g., the extent and magnitude of cooling tower drift) and compare these effects with those of the proposed system. The reviewer should consult with the reviewers for ESRPs 2.7 and 5.3.3 to develop this comparison, which may be based on verified applicant supplied data or on independent staff estimations of atmospheric effects.
- (4) **Thermal and Physical Effects**—Estimate the predicted thermal and physical effects (e.g., thermal plumes, erosion, scouring) of each alternative heat dissipation system, and compare these effects with those of the proposed system. The reviewer should consult with the reviewers for ESRPs 2.3.1, 4.2.1, and 5.2.1 for assistance in making this comparison.
- (5) **Noise Levels**—Estimate operational noise levels for each of the alternatives and compare them with the predicted operating noise levels of the proposed system and with any Federal, State, regional, local, or affected Native American tribal restrictions. The reviewer should consider construction noise levels when these could be significant.
- (6) **Aesthetics and Recreational Benefits**—Compare the aesthetic impacts and potential recreational benefits of each alternative system with those of the proposed system. The reviewer should consult with the reviewers for ESRPs 2.5, 3.1, and 5.8 for assistance in making this comparison.
- (7) **Operating and Maintenance Experience**—Compare operating and maintenance experience of each alternative with the proposed system to develop a projected reliability factor for each system.
- (8) **Generating Efficiency**—Estimate the plant electrical generation efficiency for each alternative heat dissipation system and compare it with the generating efficiency using the proposed system.
- (9) **Costs**—Estimate the capital, operating, and maintenance costs for the proposed system and for each alternative considered. The reviewer should use these figures for economic-cost comparisons. The reviewer should determine if there are any site-specific factors that might affect the costs of any alternative and factor these additional costs into the comparison.
- (10) **Other Considerations**—When an alternative heat dissipation system will involve the use of intake or discharge systems that would be substantially different from the proposed system, repeat these

procedures for both intake and discharge systems. This should supplement the appropriate environmental and economic-cost factors, as needed, to account for any differing intake and discharge system effects. The reviewer should consult with the reviewer for ESRP 9.4.2.

The reviewer should ensure that each heat dissipation system alternative has been described in sufficient detail to enable an effective analysis and comparison of environmental impacts leading to a staff conclusion that the alternative system is environmentally preferable, equivalent, or inferior to the proposed system. For those alternatives determined to be environmentally preferable, the reviewer should ensure that economic-cost data are available in sufficient detail to enable the reviewer to conduct benefit-cost balance and comparisons with the proposed system leading to a final staff conclusion for heat dissipation-system consideration. The reviewer should also ensure that all comparisons are made on the basis of the proposed system as supplemented with those measures and controls to limit adverse impacts proposed by the applicant and concurred with by the staff. For those alternatives eliminated from consideration on the basis of land-use, water-use, or legislative restrictions, the reviewer should ensure that adequate documented justification for this action has been prepared.

- (1) General Considerations—If a mitigation measure or alternative heat dissipation system is to be considered, determine that the measure or system being evaluated has a lesser overall environmental impact than the proposed system (i.e., is environmentally preferable). When this is true, the economic costs of mitigation or of the alternative could result in an equivalent or improved project benefit-cost balance. When these criteria are met, the reviewer should verify those mitigation measures proposed by the reviewers for ESRP Chapters 4.0 and 5.0 or should consider an alternative heat dissipation system. The reviewer should be guided by the following general considerations:
 - Keep in mind that an environmental review of alternative heat dissipation systems, if conducted in the depth applied to the review of the proposed system, would be expected to find additional impacts and/or increased severity of the impacts already predicted for the alternative. The reviewer should allow for this when evaluating the comparative environmental impacts of each proposed alternative with those of the proposed system.
 - Ensure that the level of detail provided for each economic, environmental, and social cost estimate is commensurate with the level of importance of the related environmental impact.
 - Adjust the economic costs of each alternative system on the basis of equivalent generating capacity.
 - The evaluation of alternative heat dissipation systems should include consultation and coordination with those agencies responsible for NPDES administration. The reviewer should coordinate the evaluation of measures and controls to limit adverse impacts, or of alternatives to avoid adverse impacts (with the EPM as liaison), with NPDES administrators. When consulting with the EPA or with agencies of States having memoranda of understanding with NRC, the reviewer should ensure that the staff analyses and evaluations (1) are consistent with the details of these memoranda and (2) will serve the needs of these agencies.

(2) Measures and Controls to Limit Adverse Impacts—When considering measures provided by the reviewers for ESRP Chapters 4.0 and 5.0 to mitigate adverse environmental impacts predicted for the proposed heat dissipation system, the reviewer's verification of the desirability of the measure should lead to the following conclusions:

- The measure provides the desired mitigation and does not introduce other adverse environmental impacts not predicted for the proposed system.
- The measure will result in an overall benefit-cost balance equivalent to or better than that of the proposed project.
- The measure is not precluded by Federal, State, regional, local, and affected Native American tribal regulations or ordinances.
- The measure is consistent with NPDES restrictions.

(3) Alternative Heat dissipation Systems—The initial step in the evaluation of those alternative heat dissipation systems identified by the analysis procedure of this ESRP should be to categorize these systems as environmentally preferable, equivalent, or inferior to the proposed heat dissipation system as modified by measures and controls to limit adverse impacts. The following criteria should be applied to this evaluation:

- When the reviewer determines that the proposed system (with mitigation measures, if necessary) will have no unavoidable adverse impacts and the system will comply with the requirements of the CWA, the reviewer should conclude that there are no environmentally preferable heat dissipation-system alternatives. When this conclusion is reached, the reviewer should evaluate the alternatives to identify those that may be considered environmentally equivalent. For this condition, environmental “equivalence” means that an alternative has no unavoidable adverse impacts and meets CWA requirements. The reviewer should not indicate a preference between environmentally equivalent alternatives nor should benefit-cost balancing be made when this condition prevails. Alternatives having unavoidable adverse environmental impacts or that do not meet CWA requirements should be judged environmentally inferior to proposed heat dissipation systems meeting these conditions.
- When the reviewer determines that the proposed heat dissipation system will meet CWA requirements, but is predicted to have unavoidable adverse environmental impacts, the reviewer should evaluate the identified alternative systems for potential environmental preference to the proposed system. The scope and extent of this evaluation should depend on the nature and magnitude of the proposed system's environmental impacts. An environmental review for the alternatives may be needed following the analysis and evaluation procedures of the appropriate ESRP Chapters 4.0 and 5.0. The following criteria apply to this evaluation:

- *Environmental preference will be established* when an alternative can be shown to have no unavoidable adverse impacts and will meet CWA requirements.
- *Environmental preference may be established* when an alternative that meets CWA requirements can be shown to have unavoidable adverse impacts that are less severe in both nature and magnitude than those of the proposed system. Determination of environmental preference under these conditions should involve consultation with the EPM and the appropriate ESRP Chapter 4.0 and 5.0 reviewers. This consultation should result in a joint determination of the status of any such alternative.
- *Environmental equivalence will be established* when an alternative that meets CWA requirements can be shown to have unavoidable adverse impacts of the same or equivalent nature and magnitude as those of the proposed system.
- *Environmental inferiority will be established* when an alternative can be shown to have unavoidable adverse impacts that are more severe in both nature and magnitude than those of the proposed system, or that will not meet CWA requirements.

When the reviewer determines that there are environmentally preferable alternatives to the proposed heat dissipation system, the reviewer should conduct those portions of the analysis instructions of this ESRP that deal with the economic costs of the alternative systems.

- When environmentally preferable alternative heat dissipation systems have been identified, the reviewer should ensure that economic cost data have been developed for the alternatives and that these data are adequate for a benefit-cost balancing and comparison with the proposed system. This portion of the evaluation procedure should be conducted with the assistance of appropriate ESRP 10.4 reviewers. The reviewer should complete the economic and reliability portions of Table 9.4.1-1. On the basis of the completed table, the reviewer should balance and compare benefits and costs of the environmentally preferable alternative(s) with those of the proposed system. When an environmentally preferable alternative can be shown to have the same benefits in terms of electrical output as the proposed system with comparable reliability and at the same or lesser economic costs, the reviewer may conclude that the alternative should be considered an alternative to the proposed system. For those cases in which the benefits of the alternative are less than those of the proposed system (e.g., lower electrical output or decreased reliability) or if economic costs are greater than those of the proposed system, a conclusion that the alternative should receive additional consideration should involve consultation with the EPM and with the appropriate ESRP Chapter 4.0 and 5.0 reviewers. If this consultation establishes that the benefit-cost balances of such alternatives are no more than equivalent to the proposed system, the alternatives should not receive further consideration. When alternatives have significantly decreased benefits or increased economic costs, they should be rejected for any further consideration as alternatives to the proposed systems.

IV. EVALUATION FINDINGS

This review should accomplish the following objectives: (1) description of alternative heat dissipation systems considered and results of the staff's analysis of these alternatives, (2) presentation of the basis for the staff's analysis, and (3) presentation of the staff's conclusions relative to alternative heat dissipation systems.

The input to the EIS should describe (1) those alternatives considered by the staff, (2) those alternatives rejected by the staff as being inappropriate for the proposed site, (3) the staff's analysis and comparison of potentially appropriate alternatives seeking environmentally preferable alternatives to the proposed heat dissipation system, and (4) the staff's conclusions related to consideration of alternative heat dissipation systems. Staff contacts with the EPA or with agencies responsible for NPDES determinations should be referenced.

The reviewer should discuss briefly those alternatives rejected because of specific deficiencies and state why each alternative was rejected. The reviewer should also identify those alternatives judged environmentally equivalent or inferior to the proposed system. The use of a table similar to Table 9.4.1-1 to present the staff's comparison of these potentially acceptable alternative heat dissipation systems is recommended. When the reviewer has concluded that an alternative is environmentally preferable and should be considered as the preferred heat dissipation system, sufficient additional detail should be presented to justify the alternative both environmentally and on a benefit-cost basis.

V. IMPLEMENTATION

The method described herein will be used by the staff in evaluating conformance with the Commission's regulations, except in those cases in which the applicant proposes an acceptable alternative for complying with specified portions of the regulations.

VI. REFERENCES

10 CFR 51, Appendix A, "Format for Presentation of Material in Environmental Impact Statements."

10 CFR 51.45, "Environmental report."

10 CFR 51.71, "Draft environmental impact statement—contents."

40 CFR 122, "EPA Administered Permit Programs: The NPDES Pollution Elimination System."

Coastal Wetlands, Planning Protection and Restoration Act of 1990.

Coastal Zone Management Act, as amended, 16 USC 1451 et seq.

Endangered Species Act, as amended, 16 USC 1531 et seq.

Federal Water Pollution Control Act (FWPCA), as amended, 33 USC 1251 et seq. (also known as Clean Water Act).

Fish and Wildlife Coordination Act Amendment, 16 USC 661 et seq.

Marine Mammal Protection Act, as amended, 16 USC 1361 et seq.

Marine Protection, Research, and Sanctuaries Act, as amended, 33 USC 1401 et seq.

Memorandum of Understanding for the Regulation of Nuclear Power Plants. 40 *Federal Register* 37110 (August 25, 1975).

U.S. Nuclear Regulatory Commission (NRC). 1976. *Preparation of Environmental Reports for Nuclear Power Stations*. Regulatory Guide 4.2, Rev. 2, Washington, D. C.