



U.S. NUCLEAR REGULATORY COMMISSION

ENVIRONMENTAL STANDARD REVIEW PLAN

5.3.1.2 AQUATIC ECOSYSTEMS

REVIEW RESPONSIBILITIES

Primary—Organization responsible for the review of ecological information

Secondary—None

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 their habitats** 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

This section describes the types of interfaces needed with other staff. Interfaces require coordination primarily with the lead for hydrology, and to a lesser extent with the leads for alternatives and cumulative impacts. 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.

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USNRC ENVIRONMENTAL STANDARD REVIEW PLAN

This Environmental Standard Review Plan has been prepared to establish guidance for the U.S. Nuclear Regulatory Commission staff responsible for environmental reviews for nuclear power plants. The Environmental Standard Review Plan is not a substitute for the NRC's regulations, and compliance with it is not required.

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. Individual sections of NUREG-1555 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 New Reactors, Washington, D.C. 20555-0001.

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- 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.
- 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 for use in the evaluation of impacts to the aquatic ecosystem from the cooling system intake.
- ESRP 5.2.2. Provide information regarding impacts on the aquatic ecosystem from the cooling system intake for use in the evaluation of impacts of operation on plant water use.
- ESRP 5.3.1.1. Obtain information regarding physical impacts caused by the flow field induced by the intake system for use in the evaluation of impacts on the aquatic ecosystem from the cooling system intake.
- ESRP 5.10. Provide a list of potential adverse impacts of the cooling system intake on aquatic biota and a list of applicant commitments to limit these adverse impacts.
- ESRP 5.11. Provide information on the magnitude of potential entrapment, impingement, and entrainment impacts to "important" species and habitats on and in the vicinity of the proposed site for the cumulative impacts analysis for operation activities.
- ESRP 6.5.2. Provide a discussion of "important" species and/or habitats that likely would be affected by intake system operation.
- ESRP 9.3. Provide information on the magnitude of potential impacts to "important" species and habitats on and in the vicinity of the proposed site.
- 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 **and mitigation measures**.
- 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 **and at which the species reaches reproductive maturity** (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 **as well as the species’ tolerance ranges and lethal thresholds for habitat requirements (e.g., salinity, temperature, currents, dissolved oxygen water depth, substrate, etc.)** (from the ER and consultation with Federal, State, regional, local, and affected Native American tribal agencies)
- 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. These ESRPs describe the hydrological and ecological conditions on and in the vicinity of the site as well as define “important” species.

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 ESRPs 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 operation 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, **early site permit, or combined license**

- 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 and 125 with respect to NPDES permit conditions specified in the Federal Water Pollution Control Act, commonly referred to as the Clean Water Act
- Coastal Zone Management Act, as amended, with respect to natural resources and land or water use of the coastal zone
- Endangered Species Act, as amended, with respect to identifying Federal threatened and endangered, and/or Federally designated 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, as amended, commonly referred to as the Clean Water Act, with respect to restoration and maintenance of the chemical, physical, and biological integrity of water resources
- Fish and Wildlife Coordination Act, as amended, with respect to consideration of fish and wildlife resources in the planning of development projects that affect water resources
- Magnuson-Stevens Fishery Conservation and Management Act, as amended, with respect to identifying impacts on essential fish habitat (EFH) in the vicinity of the site and initiating consultation with the National Marine Fisheries Service
- Marine Mammal Protection Act, as amended, with respect to the protection of marine mammals
- Marine Protection, Research, and Sanctuaries Act, as amended, 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 would be no unacceptable or unnecessary deleterious impacts on populations or habitats of important species or on ecological systems from the operation of a nuclear power station. This guide

also provides regulatory positions concerning entrainment, impingement, entrapment, and effects of cooling systems on aquatic species, **their habitats, and their** 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.
- Memorandum of Understanding Between the U.S. Army Corps of Engineers and the NRC for the Regulation of Nuclear Power Plants (40 FR 37110) provides guidance with respect to the NRC exercising the primary responsibility in conducting environmental reviews and in preparing EISs for nuclear power stations. The Corps of Engineers should be consulted regarding (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 the National Environmental Policy Act (NEPA) and Section 511 of the Federal Water Pollution Control Act , commonly referred to as the Clean Water Act.
- LIC-203, Revision 1, Procedural Guidance for Preparing Environmental Assessments and Considering Environmental Impacts (NRC 2004), with respect to NRC compliance with the Endangered Species 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 operation of the proposed cooling water intake system and the alternatives **and mitigation measures** 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.

However, 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 mitigation measures and 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.

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 depending on whether or not the new facility is being located at a site close to an existing nuclear facility.

If the facility is located at a site close to an existing nuclear facility:

Determine whether the applicant has a current NPDES permit with a Clean Water Act Section 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 associated with the proposed facility, continue the analysis below for a site that is not located close to an existing nuclear facility. Otherwise, prepare an assessment of entrapment, entrainment or impingement of aquatic biota for the new plant based on the records of historical data of the existing facility emphasizing the "important" aquatic organisms. The statement for the EIS would:

- summarizes the permitting documents that have been reviewed
- compares the estimated future entrapment, entrainment and impingement losses from the new facility to the entrapment, entrainment and impingement losses from the existing facility
- discusses the differences in the **siting**, orientation and structure between the existing and new facilities

- evaluate the potential cooling water intake system impacts for entrapment, entrainment, or impingement on aquatic species.

If the facility is not located at a site close to an existing nuclear facility:

- (1) 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 “important” aquatic species are present and are susceptible to entrapment, entrainment, or impingement, and effects would neither be detectable nor noticeably alter or destabilize population levels, then continue the analysis at Step (2). Otherwise, prepare a statement for the EIS describing the potential for entrapment, entrainment, or impingement of aquatic species that

- summarizes the permitting information, species data, and methods for quantifying entrainment, entrapment, and impingement data that have been reviewed
- states there are no populations of aquatic species present in the vicinity of the site that would be entrained, entrapped, or impinged by the cooling water intake system to the point where changes in their population levels are detectable
- states that design and operation meet Clean Water Act Section 316(b) Phase I guidelines.

- (2) 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 the magnitude of the potential impact 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.

- (3) After identifying the “important” species and determining their susceptibility, estimate the survival rates for those species entrapped, impinged or entrained by relying on experience at other stations. Certain species have been shown to be especially fragile (e.g., threadfin shad, menhaden, and 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.
- (4) 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 hydrological alterations.
 - (5) 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.
 - (6) Finally, estimate the magnitude of the potential entrapment, impingement and entrainment impacts on the species populations and the aquatic ecosystem.
 - Use the results of Step 2 as the starting point (i.e., the potential station cropping rates for phytoplankton, zooplankton, and meroplankton, including vegetative spores, 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 would not affect these communities due to the short reproductive cycles for these species. More detailed consideration should be given those species with annual reproductive cycles, such as most fish and shellfish.

The reviewer may assume, for a first approximation, that entrainment 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 or 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 intake system and by the magnitude of the expected impacts on these resources. This section of the EIS should present (1) a list of 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 adverse 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 affected populations **and the aquatic ecosystem.**

Staff conclusions should contain an evaluation of the significance of losses to the populations of "important" species, including a determination of whether these losses would 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 Federal Water Pollution Control Act. Any studies or environmental investigations performed by these **and other** agencies that address intake system impacts should be described or referenced.

If any Federal threatened or endangered species would be potentially affected by the operation of the cooling water intake system, an informal and, if necessary, formal Section 7 consultation under the Endangered Species Act should be initiated with the appropriate Federal agency (U.S. Fish and Wildlife Service and/or National Marine Fisheries Service). The EIS should contain a summary of the results of such consultations if they occur.

If any Federally designated essential fish habitat would be potentially affected by the operation of the cooling water intake system, consultation under the Magnuson-Stevens Fishery Conservation and Management Act should be initiated with the National Marine Fisheries Service. The EIS should contain a summary of the results of such consultation if it occurs.

If the reviewer verifies that sufficient information has been provided in accordance with the requirements of this ESRP section, then the reviewer should prepare a summary of the impacts associated with potential plant intake system on aquatic ecosystems. The summary should include an impact characterization for each category of impacts using the NRC's SMALL, MODERATE, or LARGE terminology (see the Introduction) **and a discussion of potential mitigation measures, if applicable.**

V. IMPLEMENTATION

The method described in this ESRP should be used by the staff in evaluating conformance with NRC requirements, except in those cases in which the applicant proposes an acceptable alternative for complying with specified portions of the requirements.

VI. REFERENCES

10 CFR 51.45, “Environmental report.”

10 CFR 51.75, “Draft environmental impact statement—construction permit, early site permit, or combined license.”

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

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

40 CFR 125, “Criteria and Standards for the National Pollutant Discharge Elimination System.”

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

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

Magnuson-Stevens Fishery Conservation and Management Act, as amended, 16 USC. 1801 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 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).

National Environmental Policy Act (NEPA), 42 USC 4321 et seq.

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.

U.S. Nuclear Regulatory Commission (NRC). 2004. *Procedural Guidance for Preparing Environmental Assessments and Considering Environmental Issues*. LIC-203, Revision 1, Washington, D.C.

PAPERWORK REDUCTION ACT STATEMENT

The information collections contained in the Environmental Standard Review Plan are covered by the requirements of 10 CFR Part 51, and were approved by the Office of Management and Budget, approval number 3150-0021.

PUBLIC PROTECTION NOTIFICATION

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