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U.S. NUCLEAR REGULATORY COMMISSION

ENVIRONMENTAL STANDARD REVIEW PLAN

STANDARD REVIEW PLANS FOR ENVIRONMENTAL REVIEWS FOR NUCLEAR POWER PLANTS

July 2007

U.S. NUCLEAR REGULATORY COMMISSION

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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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4.7 CUMULATIVE IMPACTS RELATED TO CONSTRUCTION ACTIVITIES

REVIEW RESPONSIBILITIES

Primary— Organization responsible for the review of cumulative impacts

Secondary— None

I. AREAS OF REVIEW

This environmental standard review plan (ESRP) directs the staff's summarization of potential cumulative environmental impacts associated with construction activities for the proposed project. The term *cumulative impact* is defined as:

> the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

The preceding definition appears in the regulations of the Council on Environmental Quality (CEQ) implementing the National Environmental Policy Act (NEPA) (40 CFR 1508.7). NRC regulations state that 40 CFR 1508.7 will be used by NRC in implementing NEPA [10 CFR 51.14(b)].

Review Interfaces

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

- ESRPs 4.1 through 4.5. Obtain cumulative impact information, including any new and significant information, from the reviewers of ESRPs 4.1 through 4.5. The information should include a characterization of cumulative impacts using NRC's SMALL, MODERATE, LARGE terminology (see the Introduction).

- ESRPs 10.1 through 10.4. Provide cumulative impact information and impact characterizations to the reviewers of ESRPs 10.1 through 10.4.

- Interface with Environmental Project Manager (EPM). Consult with the EPM on any cumulative impacts characterized as MODERATE or LARGE. Potential mitigation measures and their merits should be identified as the EPM directs.

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 cumulative impacts. The following data or information should be obtained:

- Identification of the geographic area to be considered in evaluating cumulative impacts.

- Identification of past, present, and reasonably forseeable Federal, non-Federal, and private actions that could have meaningful cumulative impacts with the proposed action.

- Information on cumulative impacts of relevant actions within the identified geographic area (from the reviewers of ESRPs 4.1 through 4.5).

II. ACCEPTANCE CRITERIA

Acceptance criteria for the summary of cumulative impacts associated with proposed construction activities are the following:

- 10 CFR 51.10(a) with respect to NRC policy to voluntarily take account, subject to certain conditions, of the regulations of CEQ implementing NEPA. The CEQ regulations specify that an EIS discuss cumulative impacts [40 CFR 1508.25(c)(3)].

Regulatory positions and specific criteria 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) with respect to the inclusion in an application of an assessment of (1) cumulative and projected long-term effects from the point of view that each generation is trustee of the environment for each succeeding generation, and (2) any cumulative buildup of radionuclides in the environment.

Technical Rationale

The technical rationale for evaluating cumulative impacts associated with the applicant's proposed construction activities is discussed in the following paragraph:

Evaluation of the proposed action includes identification and evaluation of potential cumulative impacts associated with plant construction. This review results in a summary of the potentially

cumulative impacts and the staff's characterization of the impacts using the NRC's SMALL, MODERATE, LARGE terminology described in the Introduction.

III. REVIEW PROCEDURES

The reviewer's analysis should include identification and tabulation of potentially adverse cumulative impacts associated with construction of the proposed plant. The reviewer should take the following steps:

(1) Identify past, present, and reasonably foreseeable Federal, non-Federal, and private actions that could have meaningful cumulative impacts with the proposed action. Review of the aggregate effects of past actions is needed to the extent that the review provides information regarding the proposed action (CEQ 2005).

(2) Identify the geographic area to be considered in evaluating cumulative impacts. CEQ guidance is to use natural ecological or sociocultural boundaries (CEQ 1997). Possible geographic areas that could be used to determine the appropriate geographic area for a cumulative impact analysis are in Table 2-2 of CEQ (1997).

(3) Identify and tabulate the cumulative impacts associated with construction of the proposed plant. Input should be obtained from the reviewers for ESRPs 4.1 through 4.5. CEQ guidance is that agencies should focus on cumulative impact information that is relevant to reasonably foreseeable significant adverse impacts, is essential to a reasoned choice among alternatives, and can be obtained without exorbitant cost (CEQ 2005). Cumulative effects may result from the accumulation of similar effects or the synergistic interaction of different effects (CEQ 1997).

IV. EVALUATION FINDINGS

The reviewer should prepare a summary of the cumulative impacts associated with construction of the proposed project. The summary should include an impact characterization for each category of impacts using the NRC's SMALL, MODERATE, LARGE terminology.

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 51.10, "Purpose and scope of subpart; application of regulations of Council on Environmental Quality."

40 CFR 1508, “Terminology and Index.”

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

Council on Environmental Quality (CEQ). 1997. *Considering Cumulative Effects under the National Environmental Policy Act*.

Council on Environmental Quality (CEQ). 2005. “Guidance on the Consideration of Past Actions in Cumulative Effects Analysis.”

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

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5.3.1.1 HYDRODYNAMIC DESCRIPTIONS AND PHYSICAL IMPACTS OF INTAKES

REVIEW RESPONSIBILITIES

Primary—Organization responsible for the review of hydraulic information

Secondary—None

I. AREAS OF REVIEW

This environmental standard review plan (ESRP) directs the staff's description of intake hydrodynamics and analysis and assessment of predicted physical impacts caused by the flow field induced by the water intakes.

The scope of the review directed by this plan should include consideration of the spatial and temporal distribution of the surface-water body flow field and the physical effects of the flow field induced by intake system operation. The review should be in sufficient detail to describe intake hydrodynamics to the extent necessary for subsequent assessment of predicted intake system impacts to aquatic biota. In addition, the reviewer should assess potential intake system physical impacts (e.g., bottom scouring, induced turbidity, silt buildup, and alteration of thermal stratification patterns) and evaluate how these impacts should be treated in the licensing process. When necessary, the reviewer should identify and evaluate alternative designs, practices, or procedures that would mitigate or avoid predicted adverse impacts.

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 and provide input to the reviewers for the following ESRPs, as indicated:

- ESRP 2.3.1. Obtain descriptions of the hydrology of the region surrounding the proposed plant site (specifically, the hydrology of the surface water bodies that would be affected by the intake system).

- ESRP 2.4.2. Obtain descriptions of the baseline aquatic ecology for the surface water bodies in the area surrounding the proposed plant site that would be affected by the cooling system intake system.

- ESRP 3.1. Obtain descriptions of the layout of the proposed plant (specifically, the layout of the main water bodies, including locations of all intakes and discharges).

- ESRP 3.3.1. Obtain descriptions of the expected water use of the proposed plant.

- ESRPs 3.4.1 and 3.4.2. Obtain descriptions of the cooling system of the proposed plant.

- ESRP 5.2.2. Provide input related to potential water-use restrictions caused by operation of the intake system.

- ESRP 5.3.1.2. Obtain input regarding the potential for impacts of the induced hydrodynamic flow field to aquatic biota including biota with behaviors or life stages that can potentially be impacted by flow fields (which will be used to determine the appropriate extent of the hydrodynamic description required for the environmental impact statement [EIS]).

- ESRP 5.3.2.1. Obtain descriptions of the physical impacts to surface-water bodies caused by the discharge system of the proposed plant (if the same water bodies are used for intake to the cooling system).

- ESRPs 5.3.1.2 and 5.3.2.1. Provide a description of the intake system hydrodynamic flow field.

- ESRP 5.4.1 and 5.4.2. Provide a description of changes in hydrodynamics that might change radiation pathways and dose to the public for a range of water conditions.

- ESRP 5.8.1. Provide a summary of the physical impacts related to the presence and operation of the intake system.

- ESRP 5.10. Provide a list of measures and controls to limit adverse impacts that have been identified and evaluated for consideration in the licensing process.

- ESRPs 6.3 and 6.6. Provide input regarding the need for and possible limitations on any monitoring activities as a result of the presence or operation of the cooling intake system.

- ESRP 9.4. Provide a list of adverse physical impacts that could be mitigated or avoided through alternative intake system designs or operational procedures, and assist in determining appropriate alternatives.

- ESRP 10.1. Provide a summary of the unavoidable adverse physical impacts 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 data or information should be obtained:

- bathymetry and substrate characteristics in the vicinity of the intake structure(s) (from ESRP 2.3.1)
- maps depicting station layout with respect to the water body, including locations of all intakes and discharges (from ESRPs 3.1 and 3.4.2)
- intake flow rates and velocities as a function of plant operating conditions (from ESRP 3.4.2)
- detailed drawings of the intake structure(s), including the relationship of the structure to the water surface (normal and minimum levels) (from ESRP 3.4.2)
- ambient current patterns in the vicinity of the proposed intake structure(s) (from ESRP 2.3.1)
- descriptions of other intake system design and performance characteristics affecting hydrodynamics (e.g., horizontal and vertical approach velocities, through-screen velocities, geometry of intake canals, submerged riprap) (from the environmental report [ER])
- descriptions of spatial and temporal alterations of the ambient flow field and of any other physical hydrologic effects induced by intake-system operation (from the ER).

II. ACCEPTANCE CRITERIA

Acceptance criteria for the hydrodynamic physical impacts at the proposed plant sites 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
- 33 CFR 322 with respect to definition of activities requiring permits
- Clean Water Act with respect to Section 316(b) and Section 401
- 40 CFR 122 and 125 with respect to National Pollutant Discharge Elimination System (NPDES) permit conditions
- Rivers and Harbors Appropriation Act of 1899
- Federal, State, regional, local, and affected Native American tribal water laws and water rights.

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

- 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 establish its own impact determination.

- Regulatory Guide 4.2, Rev. 2, *Preparation of Environmental Reports for Nuclear Power Stations* (NRC 1976), provides guidance on the format and content of ERs including hydrology, water-use, and water-quality issues.

- 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 hydrodynamic descriptions and physical impacts 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 reviewer's description of intake hydrodynamics should be linked to the environmental descriptions provided by ESRPs 2.3.1 2.3.2, 2.3.3, 3.3, and 3.4 to ensure that water body characteristics affecting intake hydrodynamics are described in sufficient detail to allow prediction of the flow field induced by the operation of the intake system. The reviewer's analysis of physical impacts of intake system operation should be linked to the environmental descriptions and impact analyses of ESRPs 2.4.2, 5.3.1.2, 5.3.2.1, 5.4.1, and 5.4.2 to ensure that those environmental factors most likely to be affected are described in sufficient detail to permit assessment of the predicted changes or impacts. The extent of the description of intake hydrodynamics and analysis of physical impacts should be governed by the magnitude of potential intake system impacts to aquatic biota.

Intake-Hydrodynamic Description

The reviewer should take the following steps to develop a description of the intake hydrodynamics:

(1) Conduct a simple independent hydrodynamic analysis (e.g., calculate of the induced potential flow field by standard procedures and prepare an intake system hydrodynamic description.

- The reviewer needs to determine the range of low water surface elevation at the intake. Guaranties of future water commitments from upstream dam operators are necessary to bound the operational conditions for the intake before velocities at the intake can be computed.

- Discuss this with reviewers for ESRPs 2.4.2 and 5.3.1.2 to determine its adequacy for use in predicting intake system impacts to aquatic biota.

- When determined that the induced flow fields would result in only minor impacts on aquatic biota (or that no biota would be affected), this portion of the analysis is complete.

(2) When it is determined that the simple hydrodynamic analysis is insufficient (e.g., the analysis results in predictions of significant adverse impact; there are large populations of "important" aquatic biota in the vicinity of the intake), prepare a detailed independent analysis of intake hydrodynamics consisting of

- a review of any applicant supplied flow field predictions or

- a reviewer prepared prediction of the induced flow field based on modeling procedures.

  - Consult with the reviewers for ESRPs 2.4.2 and 5.3.1.2 to determine the extent of the surface-water body to be analyzed.

  - Consult with the reviewers for ESRP 5.3.2.1 and ESRP 5.4.2 to ensure that the area of the water body to be analyzed is sufficient to permit analysis of potential recirculation of discharged cooling water, if applicable.

  - Provide a quantitative description of the induced flow field taking into account the ambient currents.

  - Provide velocity vectors or other descriptors showing the areal extent of the region affected by the induced flow field.

Physical Impacts of Intakes

The reviewer should take the following steps to analyze the physical impacts of the intake system:

(1) Identify and analyze physical changes resulting from intake system operation, including

- shoreline erosion
- bottom scouring
- induced turbidity
- silt buildup
- alterations of stratification patterns.

Staff experience has indicated that the impacts listed above are generally minor. However, impacts to other resources (e.g., aquatic ecology) may be more significant. Impact findings in this ESRP are limited to those not covered in other ESRPs.

(2) Unless adverse impacts have been identified, no further evaluation is required.

The reviewer should ensure that the description of the intake flow field is adequate to serve as a basis for the impact assessment of ESRPs 5.3.1.2, 5.4.1, and 5.4.2. and for providing flow patterns necessary for the assessment of potential heated water recirculation conducted in ESRP 5.3.2.1.

The reviewer should ensure that analyses involving mathematical or physical modeling of intake flow fields are appropriate for the specific situation being modeled, have been verified or shown to be conservative, and are documented and referenced. The reviewer should consider the procedures of Regulatory Guides 4.4, *Reporting Procedure for Mathematical Models Selected for Predict Heated Effluent Dispersion in Natural Water Bodies* (NRC 1974), and 1.125, Rev. 1, *Physical Models for Design and Operation of Hydraulic Structures and Systems for Nuclear Power Plants* (NRC 1978), in making this evaluation. However, reviewers should be aware that these documents are dated and may not represent current standard engineering practice in some areas. For analyses involving less detailed procedures than mathematical or physical models, the reviewer should ensure that the procedures used by the applicant were appropriate for the specific situation and were adequately conservative.

For specific physical impacts identified by the "Review Procedures" section, the reviewer should evaluate each impact with regard to water standards and guides or good operating procedures for intake systems. Unless potentially severe impacts have been identified, no further evaluation is required.

IV. EVALUATION FINDINGS

Input to the EIS should contain the following: (1) a physical description of the induced hydrodynamic flow field resulting from operation of the intake system, (2) a description and assessment of physical impacts resulting from intake system operation, (3) the basis for the staff's review and analysis, (4) staff evaluations and conclusions, and (5) the range of environmental conditions considered (meteorological, hydrological, etc). The extent of the hydrodynamic description input to the EIS should be governed by the potential for impacts on aquatic biota (ESRP 5.3.1.2), radiological dose impacts (ESRP 5.4.2), and water quality impacts (ESRP 5.2.3). The extent of the physical impacts to be included should be determined by the results of the "Review Procedures" section in identifying potentially significant changes.

The following information should be included in the EIS:

- hydrodynamic description of the intake induced flow fields, including effects of ambient flow patterns. Tables or figures may be used.
- a description and assessment of the analysis technique used
- the intake flow conditions that may result in adverse impacts on aquatic biota
- a description and assessment of potential physical impacts.

Once the reviewer obtains sufficient information from the applicant in accordance with this ESRP section, then the reviewer should prepare a summary of the hydrodynamic and physical impacts associated with operation of the cooling water intake. The summary should include an impact characterization for each of the impacts using the NRC's SMALL, MODERATE, or LARGE terminology (see the Introduction) and discussion of potential mitigation measures considered, 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."

33 CFR 322, "Permits for Structures and Work in or Affecting Navigable Waters of the United States."

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."

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

Rivers and Harbors Appropriation Act of 1899, 33 USC 401.

U.S. Nuclear Regulatory Commission (NRC). 1974. *Reporting Procedure for Mathematical Models Selected for Predict Heated Effluent Dispersion in Natural Water Bodies*. Regulatory Guide 4.4, Washington, D. C.

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). 1978. *Physical Models for Design and Operation of Hydraulic Structures and Systems for Nuclear Power Plants*. Regulatory Guide 1.125, Rev 1, 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

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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.

- 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

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U.S. NUCLEAR REGULATORY COMMISSION

ENVIRONMENTAL STANDARD REVIEW PLAN

5.3.4 IMPACTS TO MEMBERS OF THE PUBLIC

REVIEW RESPONSIBILITIES

Primary— Organization responsible for the review of nonradiological impacts.

Secondary— None

I. AREAS OF REVIEW

This environmental standard review plan (ESRP) directs the staff's evaluation of the human health impacts associated with the plant's cooling system. This includes impacts from etiological agents such as microorganisms, parasites, and thermo-stable viruses, formerly referred to collectively as thermophilic microorganisms, and from noise resulting from the operation of the cooling system.

The scope of this ESRP includes: (1) background information on etiological agents that could negatively affect human health, (2) methods for evaluating the potential for an increase in the numbers of these etiological agents as a result of thermal discharges, and (3) the potential for noise resulting from the plant's cooling system. Noises that are generated by the plant's paging system or from transmission wires and associated substations are addressed in ESRP 5.6.3 and are not discussed further in this ESRP.

Review Interfaces

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

- ESRP 1.4. Obtain information on any new and significant information related to ESRP 5.3.4.

- ESRPs 3.4.1 and 3.4.2. Obtain a description of the cooling system and its operational modes, a description of the location of thermal discharges for the plant, and estimated noise levels.

- ESRP 5.3.2.1. Obtain an indication of the temperature increases expected for the aquatic environments that are subject to the plant's thermal discharges.

- ESRP 5.10. Provide any mitigation measures that should be employed to (1) minimize potential impacts caused by increased numbers of deleterious etiological agents as a result of thermal discharges, and (2) minimize potentially unacceptable noise levels resulting from operation of the cooling system.

Data and Informational 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:

- etiological agents (formerly referred to as thermophilic microorganisms)

  - a description of the location of the thermal discharges for the plant's cooling system (i.e., a cooling pond, lake, canal, small river, large river, or ocean) (from the environmental report (ER) or ESRP 3.4.1)

  - the temperature increase expected for the aquatic environment that is subject to the plant's thermal discharges (from the ER or ESRP 5.3.2.1)

  - the results of any analyses that have been made for the presence of etiological agents. These include the enteric pathogens *Vibrio* spp., *Salmonella* spp., *Shigella* spp., and *Plesiomonas shigelloides*, as well as *Pseudomonas spp.*, thermophilic fungi, noroviruses, and toxin-producing algae such as *Karenia brevis*. In addition, analyses for the presence of unusually high concentrations of the normally present *Legionella* spp. (Legionnaires' disease bacteria) and the free-living amoebae of the genera *Naegleria, Acanthamoeba*, and *Cryptosporidium*, should be cited (from the ER or the applicant). Also, historical and recent algal blooms in the vicinity of the site should be discussed.

  - a list of the outbreaks of waterborne diseases in the United States during the previous 10 years in the vicinity of the site. This list is published regularly by, and can be obtained from, the Centers for Disease Control and Prevention (CDC). Additional information on waterborne organisms of current interest can be found on the CDC website (under Emerging Infectious Diseases, www.cdc.gov), on the National Institutes of Health's website (under the National Institute of Allergy and Infectious Diseases, www.nih.gov or www3.naiad.nih.gov), and on the U.S. Environmental Protection Agency (EPA) website (under the Water subtopics, www.epa.gov).

  - an evaluation of any available data concerning the occurrence and concentrations in the vicinity of the plant of any of the etiological agents listed above and a determination of whether any of them are present under conditions and in locations that might be harmful to members of the

public who come in contact with them. If such an evaluation exists, it may be obtained from the applicant or from the State Public Health Department in the State in which the plant is being constructed.

- if applicable, a description of any monitoring program to be employed.

- noise

  - the type of cooling system, specifically, whether the plant has cooling towers or other components that are capable of producing offsite noise levels (from the ER or ESRP 3.4.2).

  - the distance to the nearest offsite residence and to the site boundary (from the ER or the reviewer of ESRP 2.5.1).

II. ACCEPTANCE CRITERIA

Acceptance criteria for the analysis and evaluation of the nonradiological health impacts of the cooling system on humans are based on 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

Regulatory positions and specific criteria are as follows:

- The *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (NUREG-1437) (NRC 1996) contains an analysis of the effects of cooling system discharges on thermophilic microorganisms that have the potential to adversely affect human health. This analysis can provide guidance to the staff in determining the significance of the potential effects of these discharges and the extent of the analysis required.

Technical Rationale

The technical rationale for evaluating the applicant's description of nonradiological health impacts of the cooling system on humans is discussed in the following paragraphs for etiological agents and noise:

Etiological agents (formerly known as Thermophilic Microorganisms)—Etiological agents associated with cooling towers and thermal discharges can impair human health. These agents may include microorganisms, thermophilic fungi, parasites, and viruses that were formerly referred to as

thermophilic organisms because their presence or numbers can be affected by the addition of heat. While the growth rate of some etiological agents can be increased by the addition of heat, others can resist moderately high temperatures long enough to be released into a cooler body of water for growth. Thus, cooling towers and thermal discharges can act to harbor *or* accelerate some etiologic agents that ultimately affect human health once released into the environment.

These etiological agents include, but are not limited to, the enteric pathogens *Salmonella* spp., *Vibrio* spp. and *Shigella* spp. as well as *Pseudomonas* spp., toxin-producing algae, and thermophilic fungi. They also include the bacteria *Legionella* spp., which causes Legionnaires' disease, and free-living amoebae of the genera *Naegleria*, *Acanthamoeba,* and *Cryptosporidium*. Exposure to these microorganisms, or in some cases the endotoxins or exotoxins produced by the organisms, can cause illness or death. In addition, the presence of thermostable viruses should be considered.

40 CFR 141.70 regulates maximum contaminant levels of various microorganisms, including *Legionella* spp. in public drinking water systems. However, there are no regulations established for microorganisms, viruses or other pathogens associated with cooling towers or thermal discharges. No Occupational Safety and Health Administration (OSHA) or other regulatory standards for exposure to microorganisms exist at the present time.

In 1986, EPA published bacterial water-quality criteria for untreated fresh and marine water sources (EPA 1986) and made these criteria water-quality standards for the states and territories that did not adopt the criteria before 2004. For freshwater (e.g., lakes and rivers), EPA has recommended criteria that the monthly geometric mean water-quality indicator concentration be ≤33 CFU/100 mL (Colony Forming Units, CFU) for enterococci or ≤126 CFU/100 mL for *Escherichia coli*. For marine water, EPA has recommended criteria that the monthly geometric mean water-quality indicator concentration be ≤35 CFU/100 mL for enterococci. However, state and local authorities have discretionary authority to determine which interventions should be used (e.g., posting signs to alert visitors of water contamination or closing the beach for swimming) when these limits have been exceeded. This information may provide guidance to the staff for evaluating any monitoring to be performed.

Noise— Some Federal regulations for levels of noise for public exposures remain in effect today (i.e., Noise Control Act of 1972 as amended by the Quiet Communities Act of 1978); however, the primary responsibility of regulating noise was transferred to the State or local government level in 1982. The existing Federal regulations (10 CFR Parts 201–211) are limited to standards for transportation equipment, interstate rail and motor carriers, low-noise emission products, and construction equipment, so the review of cooling system impacts will require familiarity with the State and local requirements. When noise levels are below the levels that result in hearing loss, impacts have been judged primarily in terms of adverse public reactions to noise. The Department of Housing and Urban Development (24 CFR 51.101(a)(8)) uses day-night average sound levels recommended by EPA as guidelines or goals for outdoors in residential areas. Noise levels are acceptable and allowable if the day-night average sound level outside a residence is less than or equal to 65 decibels.

III. REVIEW PROCEDURES

The review procedures for impacts from etiologic agents are discussed separately from the procedures for impacts from noise.

Etiologic Agents (formerly Thermophilic Microorganisms)

Consideration of the impact of etiologic agents on the public health is important, especially for those plants using cooling ponds, lakes, canals, or small rivers because the operation of these plants may significantly increase the presence and numbers of harmful waterborne diseases. Additional information regarding these organisms can be found in the Appendix to this ESRP. The following review procedures should be used:

(1) Review of available data, site description, and cooling system description, to determine whether a potential exists of a detrimental impact from the thermal discharges on the concentration levels of deleterious etiological agents. If this potential exists, then further analysis of any available data would be appropriate, especially if public recreation occurs within the vicinity of the discharge or if the plant is located in the southern regions of the United States. The minimum review should include:

- Consultation with the State Public Health Department.
- Review of any records associated with waterborne disease outbreaks in the region.

(2) If it appears to be likely that thermal discharges from the plant would increase the number of deleterious etiologic agents to levels that could cause a public health problem, the applicant should be requested to consider mitigative measures to minimize the potential impacts.

- Mitigative measures may include:
  - setting up and executing a monitoring program for etiologic agents or other harmful biological agents to insure acceptable levels.
  - limiting public activities that allow contact with discharge waters in the vicinity of the site.
  - the use of respirators and protective clothing by plant workers to protect against mists from cooling towers or dusts inhaled during cleaning processes or limiting maintenance activities on the cooling system to times when the structures or components are dewatered.
- The reviewer should analyze any mitigative measures and forward them to the reviewer for ESRP 5.10.

(3) Irrespective of the plant cooling system design or the type of station discharge water body, if there has been an outbreak of waterborne disease during the previous 10 years in the vicinity of the site, at the minimum, mitigative measures may include:

- Consultation with the State Public Health Department.
- In the absence of monitoring data, consideration should be made of limiting public activities that allow contact with discharge waters in the vicinity of the site.
- The use of respirators and protective clothing by plant workers to protect against mists from cooling towers or dusts inhaled during cleaning processes or limiting maintenance activities on the cooling system to times when the structures or components are dewatered.

Noise

The primary responsibility of regulating noise was transferred to the State or local government level in 1982 and, as a result, the review of cooling system impacts will require familiarity with the applicable State and local requirements. When noise levels are below the levels that result in hearing loss, impacts have been judged primarily in terms of adverse public reactions to the noise. The principal sources of noise from plant operations include natural-draft and mechanical-draft cooling towers. Other occasional noise sources may include auxiliary equipment, such as pumps to supply cooling water from a remote reservoir. Generally, power-plant sites do not result in offsite noise levels greater than 10 dB(A) above background (NRC 1996). Noise level increases larger than 10 dB(A) would be expected to lead to interference with outdoor speech communication, particularly in rural areas or low-population areas where the day-night background noise level is in the range of 45 to 55 dB(A). Surveys around major sources of noise, such as major highways or airports, have found that when the day-night level increases beyond 60 to 65 dB(A), noise complaints increase significantly. Noise levels below 60 to 65 dB(A) are considered to be of small significance (NRC 1996). More recently, the impact of noise was considered in the *Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities, Supplement 1 Regarding the Decommissioning of Nuclear Power Reactors* (NRC 2002). In that document, the criterion for assessing the level of significance was not expressed in terms of sound levels. Rather, the level of significance was based on the effect of noise on human activities and threatened or endangered species. The criterion in NUREG-0586 Supplement 1 (NRC 2002) is stated as follows:

> The noise impacts ... are considered detectable if sound levels are sufficiently high to disrupt normal human activities on a regular basis. The noise impacts ... are considered destabilizing if sound levels are sufficiently high that the affected area is essentially unsuitable for normal human activities, or if the behavior or breeding of a threatened or endangered species is affected.

(1) The reviewer should become familiar with the applicable State noise limits for residential areas and other types of land use.

(2) The reviewer should determine whether the plant has or will have cooling towers or other components of the cooling system capable of contributing to offsite noise levels.

- If no cooling towers or other noise-producing components of the cooling system are anticipated, the analysis is complete.

- If cooling towers or other noise-producing components of the cooling system are present, the reviewer should compare the anticipated day night average level of noise determined at the site boundary (based on the dB(A-scale)) from the cooling system with applicable State noise limits.

- If no State noise limits are available and if the day-night noise level is below 60 to 65 dB(A), no further analysis is needed.

- If the noise levels exceed the State noise limits or in the absence of such limits if the day-night noise level exceeds 65 dB(A), the reviewer should request the applicant to propose measures for mitigating the impact from the noise. The reviewer should analyze these mitigation measures and forward them to the reviewer for ESRP 5.10.

IV. EVALUATION FINDINGS

Etiologic Agents (formerly Thermophilic Microorganisms)

When the reviewer determines that the proposed plant does not fall within the parameters discussed above (i.e., uses a cooling pond, lake, or canal or uses once-through cooling systems with discharges to other than small rivers or had a documented outbreak of a waterborne disease within the last 10 years that could be affected by operation of a cooling system), the reviewer should:

- Provide a statement for the EIS similar to the following: The proposed plant utilizes a cooling system as described in ESRP 3.4.1. Because this system does not use a cooling pond, lake, or canal or discharge to a river with a flow rate below 9×10^{10} m^3/yr (3.15×10^{12} ft^3/yr), there is little potential for a detrimental increase in etiological agents that would have a deleterious effect on public health (NUREG-1437). There have been no reported cases of a waterborne disease in the vicinity of the site within the last 10 years that could be related to the operation of a cooling system.

- Risk analysis may be warranted to mitigate against the buildup of deliterious microbes (and/or biofilms) that could result in generation of etiologic agents or pose a health risk to on-site workers, such as maintenance workers (see ESRP 3.6.3).

If the reviewer determines that the proposed plant does fall within the parameters given above, i.e., uses a cooling pond, lake, or canal or uses once-through cooling with a discharge to a small river (i.e., flow rate below 9×10^{10} m^3/yr [3.15×10^{12} ft^3/yr]), then the reviewer should:

- Provide the results of the analyses and evaluation given above for the EIS, including the results of the consultation with the State Public Health Department, related to any regional outbreaks of waterborne diseases.

- Discuss any mitigative measures that should be used to minimize negative human health impacts resulting from a potential increase in the levels of etiologic agents.

Noise

When the reviewer determines that the proposed plant does not have cooling towers or other components of the cooling system capable of contributing to offsite noise levels, the reviewer should provide a statement for the EIS similar to the following:

> The proposed plant utilizes a cooling system as described in ESRPs 3.4.1 and 3.4.2 that does not depend on a cooling tower or other components that contribute to offsite noise levels. Thus, the noise levels related to operation of the cooling system are not pertinent to this plant.

When the reviewer determines that the proposed plant does have cooling towers or other components of the cooling system capable of producing offsite noise levels and has determined that the day-night noise level emanating from the cooling system during operation is below 65 dB(A) at the site boundary, the reviewer should provide a statement for the EIS that is similar to the following:

> The day-night noise levels that are anticipated from the plant's cooling system are less than 65 dB(A) at the site boundary, which is considered to be of small significance to the public. Thus, no mitigation alternatives are necessary.

When the reviewer determines that the cooling towers or other components of the cooling system from the applicant's plant will produce day-night noise levels above 65 dB(A) at the site boundary, the reviewer should describe the magnitude of the noise levels and the mitigative factors that will be employed.

V. IMPLEMENTATION

The method described in this ESRP will 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 regulations.

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.”

24 CFR Part 51. Code of Federal Regulations, Title 24, *Housing and Urban Development*, Part 51, “Environmental Criteria and Standards.”

40 CFR Part 141. Code of Federal Regulations, Title 40, *Protection of the Environment*, Part 141, “National Primary Drinking Water Regulations.”

40 CFR Parts 201–211. Code of Federal Regulations, Title 40, Protection of the Environment, Parts 201–211, “Subchapter G—Noise Abatement Programs.”

Centers for Disease Control (CDC). 1996. *Surveillance for Waterborne-Disease Outbreaks—United States, 1993-1994.* M.H. Kramer, B.L. Herwaldt, G.F. Craun, R.L. Calderon, D.D. Juranek. Source: MMWR 45(SS-1):1-33. April 12, 1996.

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U.S. Food and Drug Administration (FDA). 1996. *Foodborne Pathogenic Microorganisms and Natural Toxins 1992* (Bad Bug Book). Center for Food Safety & Applied Nutrition, 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). 2002. *Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities Supplement 1 Regarding the Decommissioning of Nuclear Power Reactors*. NUREG-0586, Supplement 1, Volumes 1 and 2, Washington, D.C.

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APPENDIX

Etiologic Agents - Background

Etiologic agents associated with cooling towers and thermal discharges can impair human health. These agents may include microorganisms, parasites, viruses, and chemical toxins that were formerly referred to as thermophilic organisms because their presence or numbers can be affected by the addition of heat. While the growth rate of some etiological agents can be increased by the addition of heat, others can resist moderately high temperatures long enough to be released into a cooler body of water for growth. Thus, cooling towers and thermal discharges can act to harbor or accelerate some etiologic agents that ultimately affect human health once released into the environment.

The etiologic agents include, but are not limited to, the enteric pathogens *Salmonella* spp., *Vibrio* spp. and *Shigella* spp., and *Plesiomonas* shigelloides, as well as *Pseudomonas* spp., thermophilic fungi, noroviruses, and toxin-producing algae such as Karenia brevis. They also include the bacteria *Legionella* spp., which causes Legionnaires' disease, and free-living amoebae of the genera *Naegleria, Acanthamoeba, and Crytosporidium*. Exposure to these microorganisms, or in some cases the endotoxins or exotoxins produced by the organisms, can cause illness or death. In addition, the presence of thermostable viruses, such as the Echovirus and Norovirus, or Microcystin toxin (from blue-green algae) should be considered. Additional information on waterborne organisms of current interest can be found on the CDC website (under Emerging Infectious Diseases, www.cdc.gov), on the National Institutes of Health's website (under the National Institute of Allergy and Infectious Diseases, www. nih.gov or www3.naiad.nih.gov), or on the U.S. EPA website (under the Water subtopics, www.epa.gov).

The test methods for verifying the presence of these agents are known, but the degree to which their presence can be controlled in aquatic environments is variable. The inhalation or ingestion of small quantities of these organisms or associated endotoxins/exotoxins may impair the health of individuals that are immunosuppressed (NRC 1996).

Notable examples of etiologic agents that are hard to control that may be present in surface water, include the bacteria *Legionella* spp., which causes Legionnaires' disease, and free-living amoebae of the genera *Naegleria*, *Acanthamoeba*, and *Crytosporidium*. Some of the known cases of Legionellosis were traced to the aerosolization of waterborne *Legionella* spp. by cooling towers and evaporative condensers. *Legionella* is normally found in natural surface waters, and thus it is not surprising that they are found in even greater numbers in water from cooling towers and evaporative condensers. This type of equipment can amplify *Legionella* spp. concentrations and disperse the pathogen through aerosolization (NRC 1996).

Naegleria fowleri causes primary amoebic meningoencephalitis (PAM) and *Acanthamoebic keratitis* and *Acanthamoebic uveitis* cause granulomatious amoebic encephalitis (GAE). GAE is a particular risk for persons who are immunodeficient, although infections have occurred in otherwise healthy individuals (FDA 1996). The primary infection site is thought to be the lungs. The organisms that are in the brain are generally associated with blood vessels, suggesting vascular dissemination (FDA 1996). Only 100 to

200 reports of PAM have occurred worldwide (NRC 1996). Sources of infection for PAM generally include heated swimming pools, thermal springs, and a variety of naturally or artificially heated surface waters. During 1993 to 1994, only one case of PAM was reported by the Centers for Disease Control (CDC 1996). The one case was caused by *Naegleria fowleri* and was associated with swimming in both a waste-water holding pond and in the Rio Grande River.

A study of cooling waters from 11 nuclear-power plants and associated control source waters indicated that only two sites were positive for the pathogenic *Naegleria fowleri* (Tyndall 1981). In addition to testing for pathogenic amoebae in cooling waters, the 11 nuclear-power plants in the 1981 study were also studied for the presence of *Legionella* spp. In general, the artificially heated waters showed only a slight increase (i.e., ≤10-fold) in concentrations of *Legionella* spp. relative to source water. In a few cases, source waters had higher levels than did heated waters. Infectious *Legionella* spp. were found in 7 of 11 test waters and 5 of 11 source waters (NRC 1996). An additional study of *Legionella* spp. presence in the environs of coal-fired electric power plants showed that *Legionella* was only infrequently found in locations that were not adjacent to cleaning operations. It was concluded that exposure to *Legionella* spp. from power-plant operations was a potential problem for part of the workforce, but that it would not be a public-health issue because concentrated aerosols of the bacteria would not traverse plant boundaries (NRC 1996).

Because the route of infection with *Naegleria* spp. is through inhalation, workers exposed to aerosols that could harbor this pathogen should have respiratory protection. Although the observed risk from *Naegleria fowleri* is low, heavily used bodies of fresh water merit special attention and possibly routine monitoring for pathogenic *Naegleria* spp. Because *Naegleria* spp. concentrations in fresh water can be increased by thermal additions, nuclear power plants that utilize cooling lakes, canals, ponds, or small rivers may enhance the naturally occurring amoebae.

In general, the staff recognize the potential propagation of etiological agents, water-borne diseases, and associated public health impact stemming from heated effluents. Factors that affect the distribution of these agents, in general or those specific to cooling towers, are not well understood and further investigations are needed. With the advent of new bioanalytical techniques, such as genomics and proteomics technology, there are opportunities to employ assays to monitor for the presence of harmful pathogens in and around cooling tower effluents. In addition, because the route of infection of some of these agents (e.g., *Legionella* and *Naegleria fowleri*) is through inhalation it may be prudent to include proven industrial-hygiene principles (e.g. personal protection equipment) for workers who are at a high risk of exposure to such agents (e.g. maintenance workers), unless a monitoring program is used to assure that such agents are not present. Workers who become infected can pose a public health risk.

Overall, public-health questions require special consideration, especially for plants using cooling ponds, lakes, canals, or small rivers having low flow rates (less than 9×10^{10} m^3/yr [3.15×10^{12} ft^3/yr]) and in cases where the public shares access and use of these low-flow bodies of water, because the effluents from these plants may significantly promote the presence and numbers of etiological agents (Tyndall 1989, NRC 1996).

U.S. NUCLEAR REGULATORY COMMISSION

ENVIRONMENTAL STANDARD REVIEW PLAN

5.11 CUMULATIVE IMPACTS RELATED TO STATION OPERATION

REVIEW RESPONSIBILITIES

Primary— Organization responsible for review of cumulative impacts

Secondary— None

I. AREAS OF REVIEW

This environmental standard review plan (ESRP) directs the staff's summarization of potential cumulative environmental impacts associated with operational activities for the proposed project. The term *cumulative impact* is defined as:

> the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

The preceding definition appears in the regulations of the Council on Environmental Quality (CEQ) implementing the National Environmental Policy Act (NEPA) (40 CFR 1508.7). NRC regulations state that 40 CFR 1508.7 will be used by NRC in implementing NEPA [10 CFR 51.14(b)].

Review Interfaces

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

- ESRPs 4.1 through 4.5. Obtain cumulative impact information, including new and significant information, from the reviewers of ESRPs 5.1 through 5.9. The information should include a

characterization of cumulative impacts using NRC's SMALL, MODERATE, LARGE terminology (see the Introduction).

- ESRPs 10.1 through 10.4. Provide cumulative impact information and impact characterizations to the reviewers of ESRPs 10.1 through 10.4.

- Interface with Environmental Project Manager (EPM). Consult with the EPM on any cumulative impacts characterized as MODERATE or LARGE. Potential mitigation measures and their merits should be identified as the EPM directs.

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 cumulative impacts. The following data or information should be obtained:

- Identification of past, present, and future Federal, non-Federal, and private actions that could have meaningful cumulative impacts with the proposed action.

- Identification of the geographic area to be considered in evaluating cumulative impacts.

- Information on cumulative impacts of relevant actions within the identified geographic area (from the reviewers of ESRPs 5.1 through 5.9).

II. ACCEPTANCE CRITERIA

Acceptance criteria for the summary of cumulative impacts associated with proposed operational activities are the following:

- 10 CFR 51.10(a) with respect to NRC policy to voluntarily take account, subject to certain conditions, of the regulations of CEQ implementing NEPA. The CEQ regulations specify that an EIS discuss cumulative impacts [40 CFR 1508.25(c)(3)].

Regulatory positions and specific criteria 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) with respect to the inclusion in an application of an assessment of (1) cumulative and projected long-term effects from the point of view that each generation is trustee of the environment for each succeeding generation, and (2) any cumulative buildup of radionuclides in the environment.

Technical Rationale

The technical rationale for evaluating cumulative impacts associated with the applicant's proposed operational activities is discussed in the following paragraph:

Evaluation of the proposed action includes identification and evaluation of potential cumulative impacts associated with plant operation. This review results in a summary of the potentially cumulative impacts and the staff's characterization of the impacts using the NRC's SMALL, MODERATE, LARGE terminology.

III. REVIEW PROCEDURES

The reviewer's analysis should include identification and tabulation of potentially adverse cumulative impacts associated with operation of the proposed plant. The reviewer should take the following steps:

(1) Identify past, present, and known future Federal, non-Federal, and private actions that could have meaningful cumulative impacts with the proposed action. Review of the aggregate effects of past actions is needed to the extent that the review provides information regarding the proposed action (CEQ 2005).

(2) Identify the geographic area to be considered in evaluating cumulative impacts. CEQ guidance is to use natural ecological or sociocultural boundaries (CEQ 1997). Possible geographic areas that could be used to determine the appropriate geographic area for a cumulative impact analysis are in Table 2-2 of CEQ (1997).

(3) Identify and tabulate the cumulative impacts associated with operation of the proposed plant. Input should be obtained from the reviewers for ESRPs 4.1 through 4.5. CEQ guidance is that agencies should focus on cumulative impact information that is relevant to reasonably foreseeable significant adverse impacts, is essential to a reasoned choice among alternatives, and can be obtained without exorbitant cost (CEQ 2005). Cumulative effects may result from the accumulation of similar effects or the synergistic interaction of different effects (CEQ 1997).

IV. EVALUATION FINDINGS

The reviewer should prepare a summary of the cumulative impacts associated with operation of the proposed project. The summary should include an impact characterization for each category of impacts using the NRC's SMALL, MODERATE, LARGE terminology.

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 51.10, "Purpose and scope of subpart; application of regulations of Council on Environmental Quality."

40 CFR 1508, “Terminology and Index.”

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

Council on Environmental Quality (CEQ). 1997. *Considering Cumulative Effects under the National Environmental Policy Act*.

Council on Environmental Quality (CEQ). 2005. Memorandum from James L. Connaughton, Chairman CEQ, to Heads of Federal Agencies regarding “Guidance on the Consideration of Past Actions in Cumulative Effects Analysis.”

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.

U.S. NUCLEAR REGULATORY COMMISSION

ENVIRONMENTAL STANDARD REVIEW PLAN

9.4.1 HEAT DISSIPATION SYSTEMS

REVIEW RESPONSIBILITIES

Primary—Organization responsible for the review of hydrology information

Secondary—None

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 environmentally preferable 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 alternative heat dissipation systems should include both environmental and economic considerations. The activities of and information from two or more reviewers may be needed to conduct this portion of the review.

This plan provides the methodology for reaching staff conclusions with respect to the environmental preference of alternative heat dissipation systems, and for environmentally preferable systems and conclusions regarding any such systems having a 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 51.71with 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, as amended
- Marine Mammal Protection Act, as amended
- Coastal Zone Management Act of 1972, as amended
- Federal Water Pollution Control Act
- 40 CFR 122 and 125 with respect to National Pollutant Discharge Elimination System (NPDES) permit conditions
- Magnuson-Stevens Fishery Conservation and Management Act
- Rivers and Harbors Appropriation Act of 1899
- Endangered Species Act of 1973, as amended.

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.
- LIC-203, Revision 1, *Procedural Guidance for Preparing Environmental Assessments and Considering Environmental Impacts* (NRC 2004), with respect to NRC compliance with the Coastal Zone Management Act, the Endangered Species Act, and the Fish and Wildlife Coordination Act.
- The "Memorandum of Understanding between the Corps of Engineers, U.S. Army, and the NRC for the Regulation of Nuclear Power Plants," 40 FR 60115, 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.
- Federal, State, regional, local, and affected Native American tribal regulations, 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 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 of these alternatives. When no adverse impacts have been predicted for the proposed system 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 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 or regulatory 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 may also consult (through the EPM) with the appropriate 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] (4) any relevant wetlands or critical habitat issues, and

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

(5) 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.

(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.

General Considerations

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 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 (1) on the basis of land-use, water-use, or legislative or regulatory requirements, or (2) because it is judged inferior to the proposed system, the reviewer should ensure that adequate documented justification for this action has been prepared.

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 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 may include consultation and coordination with those agencies responsible for NPDES administration. The reviewer may 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.

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 better than that of the proposed project.

- The measure is not precluded by Federal, State, regional, local, or affected Native American tribal regulations, requirements, or ordinances.

- The measure is consistent with NPDES requirements.

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 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 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 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 reviewers for ESRPs 10.4.1 through 10.4.3. 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 a higher benefit to cost ratio than the proposed system, 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 or if economic costs are greater than those of the proposed system, a tentative conclusion that the alternative is superior lead to 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 not superior to that of 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 or judged environmentally inferior to the proposed system, (3) the staff's analysis and comparison of potentially 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 inferior to the proposed system, and therefore removed from further consideration. 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 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, 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."

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

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

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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.

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

Rivers and Harbors Appropriation Act of 1899, 33 USC 401.

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). 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.

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 or regulatory requirements			
Is this a suitable alternative heat dissipation system? (Yes/No)			

U.S. NUCLEAR REGULATORY COMMISSION

ENVIRONMENTAL STANDARD REVIEW PLAN

9.4.2 CIRCULATING WATER SYSTEMS

REVIEW RESPONSIBILITIES

Primary—Organization responsible for the review of hydrology information

Secondary—None

I. AREAS OF REVIEW

This environmental standard review plan (ESRP) directs the staff's analysis of alternatives to the applicant's proposed circulating water systems. This includes evaluation of alternatives, in comparison with the proposed system, to identify those systems that are environmentally preferable 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 circulating water systems considered feasible for construction and operation at the proposed plant site and that (1) are not prohibited by Federal, State, regional, local, and affected Native American tribal agreements, (2) are consistent with 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 circulating water system. The review should include (1) alternative intake designs and locations, (2) alternative discharge designs and locations, (3) alternative water supplies, and

(a) The review of environmentally preferable alternative circulating water systems should include both environmental and economic considerations. The activities of and information from two or more reviewers may be needed to conduct this portion of the review.

(4) alternative water treatment. The reviewer should consider the kind and magnitude of environmental impacts and the efficiencies and economics of the alternatives.

This plan provides the methodology for reaching staff conclusions with respect to the environmental preference of alternative circulating water systems and, for environmentally preferable systems, conclusions regarding any such systems having a 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 2.3.2, 4.1.1, 4.3.1, 5.1.1, 5.3, and 5.3.3.2. Obtain input from these reviewers to develop the comparative land-use and ecological impact data.

- ESRPs 2.3, 4.2.2, 4.3.2, and 5.2.2. Obtain input from these reviewers to develop the comparative water-quality, water-use, and aquatic ecological impact data.

- ESRP 3.3.2. Obtain descriptions of water treatment systems that may be used in comparisons or evaluation of alternative water-treatment systems.

- ESRPs 4.1.3 and 5.1.3. If proposed construction or operations of the circulating water system results 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 proposed construction of the circulating water system appear to be adverse, obtain information regarding alternative systems or locations that may be taken into consideration as a means to avoid the impacts.

- ESRPs 5.3.1.2, 5.3.3.1, 5.3.3.2, and 5.8.2. Obtain input from these reviewers to develop comparisons of intake and discharge effects.

- ESRPs 4.6 and 5.10. Provide these reviewers, as appropriate, with a list of those measures and controls to limit adverse impacts that were developed as a result of this review of circulating water system alternatives.

- ESRPs 10.4.1 and 10.4.2. Provide relevant data and information to the appropriate ESRP Chapter 10.0 reviewers to permit the inclusion of any such alternatives in the final evaluation of the proposed action if an obviously superior alternative circulating water system or system component is identified.

- Interface with Environmental Project Manager (EPM). Obtain input from the EPM when an alternative circulating water system appears to be environmentally preferable and meets regulatory requirements.

Data and Information Needs

The degree of detail should be modified according to the anticipated magnitude of potential impacts of the proposed systems and to the practicability of adapting the reviewed alternative to the proposed site. Data or information should be obtained for the following systems:

(1) Intake Systems

- sketches or preliminary designs and operational characteristics of alternative intake systems, showing the intake design and its relationship to water surface, bottom geometry, shoreline, and discharge structure (from the environmental report [ER])
- alternative pumping facilities, if proposed (from the ER)
- alternative locations of the proposed intake system and pumping facility on the same waterbody (from the ER)
- alternative procedures and schedules for intake defouling, including any use of defouling chemicals (from the ER)
- descriptions and operational characteristics of any alternative trash racks, traveling screens, trash baskets, or fish return systems (from the ER)
- predicted physical impacts from hydrologic alternatives and impacts to aquatic ecosystems, including entrapment, impingement, and entrainment, for each alternative intake system (from the ER)
- capital, maintenance, and operating costs for each alternative intake system and costs associated with system adaptation to the proposed site (from the ER).

(2) Discharge Systems

- sketches or preliminary designs and operational characteristics of alternative discharge systems showing the discharge design, its location with respect to the receiving water body, and its relationship to water surface, bottom geometry, intake structure, and shoreline (from the ER)
- description of alternative discharge lines (or canals) from the heat dissipation system to the receiving water body (from the ER)

- description of alternative locations of the proposed discharge system on the same water body (from the ER)

- estimated physical impacts from hydrologic alterations and impacts to aquatic biota for each alternative discharge system (from the ER)

- capital, maintenance, and operating costs for each alternative discharge system and costs associated with system adaptation to the proposed site (from the ER).

(3) Water Supply

- description of potential alternative sources of water and their availability, including location of water supply source with respect to the plant site (from ESRP 2.3.1, the ER, and consultation with Federal, State, regional, local, and affected Native American tribal agencies)

- water availability data, including groundwater sustained yield, average surface-water flows and yields, and estimates of potential water shortages associated with each alternative water supply (from ESRP 2.3.1)

- present and known future restrictions on use of water from alternative water sources (from the ESRPs 2.3.1 and 2.3.2)

- economic and environmental cost data for water delivered from each alternative source (from the ER).

(4) Water Treatment

- description and purpose of alternative water treatment systems for

  - circulating water system (from the ER)
  - plant (service) water system (from the ER)

- chemicals and additives (or mechanical treatment) to be used in each alternative water treatment system (from the ER)

- operating cycles for each alternative water treatment system (from the ER)

- capital, maintenance, and operating costs for each alternative water treatment system (from the ER and the general literature).

(5) Other Data

- site and vicinity hydrological data (from ESRP 2.3.1)

- site and vicinity water use, current and projected (from ESRP 2.3.2)
- site and vicinity water-quality criteria (from ESRP 2.3.3)
- site and vicinity ecological data (from ESRP 2.4)
- proposed circulating water system design and operation (from ESRPs 3.3.2 and 3.4)
- plant water use (from ESRP 3.3.1)
- impacts of proposed circulating water system construction and operation (from ESRPs 4.2, 4.3.2, 5.2, 5.3.1, and 5.3.2)
- capital, maintenance, and operating costs for the proposed intake system, discharge system, and water treatment system, and water costs for the proposed water supply (from the ER).

II. ACCEPTANCE CRITERIA

Acceptance criteria for the review of alternatives to the proposed circulating water system are based on the relevant requirements of the following:

- 10 CFR 51.71 with respect to the need to discuss alternatives in the environmental analysis
- 10 CFR 51, Appendix A, with respect to discussing alternatives to the proposed action
- 40 CFR 122 and 125 with respect to National Pollutant Discharge Elimination System (NPDES) permit conditions
- Federal Water Pollution Control Act
- Coastal Zone Management Act of 1972, as amended
- Endangered Species Act of 1973, as amended
- Fish and Wildlife Coordination Act of 1958
- Marine Mammal Protection Act, as amended
- Marine Sanctuaries Act of 1972, as amended
- Magnuson-Stevens Fishery Conservation and Management Act
- Rivers and Harbors Appropriation Act of 1899.

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), with respect to alternative systems designs

- LIC-203, Revision 1, *Procedural Guidance for Preparing Environmental Assessments and Considering Environmental Impacts* (NRC 2004), with respect to NRC compliance with the Coastal Zone Management Act, the Endangered Species Act, and the Fish and Wildlife Coordination Act.

- The "Memorandum of Understanding between the Corps of Engineers, U.S. Army, and the NRC for the Regulation of Nuclear Power Plants," 40 FR 60115, 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.

- Federal, State, regional, local, and affected Native American tribal regulations on water use, air and water quality, effluent discharge, and land use.

Technical Rationale

The technical rationale for evaluating alternatives to the applicant's proposed circulating water 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 cooling water circulation to determine whether 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 procedure are (1) to provide assistance to those ESRP Chapter 4.0 and 5.0 reviewers concerned with construction or operational circulating water system impacts in identifying and verifying means to mitigate adverse impacts associated with the proposed circulating water systems, and (2) to identify and analyze reasonable alternatives to the applicant's proposed systems to the extent needed to rank them from an environmental standpoint as preferable or inferior to the applicant's proposed system. Tables 9.4.2-1 through 9.4.2-5 can be used or adapted to aid the review as appropriate.

The depth of the analysis should be governed by the nature and magnitude of proposed circulating water system impacts predicted by the ESRP Chapter 4.0 and 5.0 reviewers. When adverse impacts are

predicted, the reviewer should coordinate with these reviewers 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 circulating water systems will be 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 to permit staff evaluation and conclusions with respect to the environmental preference of these alternatives. If no adverse impacts have been predicted for the proposed system 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 environmentally preferable alternatives have been identified, the review should be expanded to consider the economic costs of any such alternative. The reviewer should estimate the capital, operating, and maintenance costs for each circulating water system component considered and for each component of the proposed system. The reviewer should use these data to estimate total annual costs for each system and should use these annual costs for economic-cost comparisons. The reviewer should determine if there are any site-specific factors that might affect the costs of any alternative and should factor these increased or reduced costs into the comparison. As necessary, these cost estimates should consider allowances for additional maintenance costs when it can be shown (e.g., by operating experience) that system reliability will be lower than expected for the proposed system. This analysis should be done in consultation with appropriate reviewers for ESRPs 10.4.1 through 10.4.3. Assistance from these reviewers should be requested to establish the economic-cost data used to develop a benefit-cost comparison with the baseline (proposed) circulating water system.

In this analysis, the reviewer should consider alternatives to the following components of the plant circulating water system:

(1) intake systems
(2) discharge systems
(3) water supply
(4) water treatment.

The analysis should consider only those alternatives that are applicable at the proposed site and compatible with the proposed heat dissipation system.[(a)]

The following procedure for developing the analysis of alternative circulating water 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.

(a) Alternative heat dissipation systems are the subject of ESRP 9.4.1. When the reviewer of that section considers potential alternative heat dissipation systems that involve circulating water system components other than those proposed, the reviewer of this plan should provide assistance in determining appropriate circulating water system components for such heat dissipation systems.

Initial Environmental Screening

The reviewer should consider the following factors in the initial environmental screening of each alternative circulating water system to eliminate those systems (or components) that are obviously unsuitable for use at the proposed site. Economic factors should not be considered in this initial screening.

- plant water requirements
- site terrain and relationship to water bodies
- water body geometry
- other water use
- ecological considerations
- legislative or regulatory requirements.

The following steps should be considered by the reviewer as part of the initial environmental screening procedures for each system:

- Work through the EPM to consult with appropriate Federal, State, regional, local, and affected Native American tribal agencies when needed to conduct this screening.

- Consult the appropriate NPDES administrative agencies to screen for those alternatives that will not meet CWA requirements.

- Establish any other justifiable environmental bases for rejection of a given alternative. When the reviewer rejects an alternative, that alternative needs no further consideration other than preparation of the reasons and justification for the rejection.

(1) Intake Systems—To analyze alternative intake systems, the reviewer should perform the following steps:

(a) Consult with the appropriate ESRP Chapter 4.0 and 5.0 reviewers to identify any mitigation measures or potentially superior alternative intake systems identified by these reviewers.

(b) Consider the following classes of alternatives:

- alternative intake systems (e.g., offshore vs. shoreline)
- proposed system design modifications (e.g., reduced intake velocity, fish return system)
- alternative locations of proposed system (e.g., up/downstream, alternative water bodies)
- alternative procedures (e.g., screenwash operation, thermal defouling).

(c) Consider the following environmental impacts and economic costs or factors for each mitigation measure and class of alternative:

- construction impacts

- impacts to aquatic ecology, including
  - entrapment
  - impingement
  - entrainment
  - other (site-specific) aquatic impacts.

- water-use impacts, including physical impacts resulting from hydrologic alterations (e.g., breakwater construction) and impacts resulting from siting on the floodplain[(a)]

- compliance with Federal, State, regional, local, or affected Native American tribal regulations, requirements, or ordinances

- capital cost, annual operating and maintenance costs, and total annual costs.

(d) Compare the proposed system with those remaining classes of alternatives not eliminated in an initial screening:

- Use a format similar to that shown in Table 9.4.2-1.

- Inputs for this table may be either absolute costs and benefits or incremental costs and benefits referenced to the proposed intake system.

- Additional factors may be included on a site- or system-specific basis.

(2) Discharge Systems—To analyze alternative discharge systems, the reviewer should perform the following steps:

(a) Consult with the appropriate ESRP Chapter 4.0 and 5.0 reviewers to identify any mitigation measures or alternative discharge systems suggested by these reviewers.

(b) Consider the following classes of alternatives:

- alternative discharge systems (e.g., submerged offshore vs. shoreline) and discharge type (e.g., slot, multiport)

- proposed system design modifications (e.g., modified discharge velocity, screens to prevent fish entry)

- alternative locations of proposed discharge system (e.g., up/downstream, alternative water body).

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

(c) Consider the following environmental impacts and economic costs or factors for each of the above classes of alternatives:

- construction impacts
- impacts to aquatic ecology
- water-use impacts, including physical impacts of hydrological alterations and siting on the floodplain
- compliance with Federal, State, regional, local, or affected Native American tribal regulations, requirements, or ordinances
- capital costs, annual operating and maintenance costs, and total annual costs.

(d) Compare the proposed system with those remaining classes of alternatives not eliminated in an initial screening. Use a table format similar to that shown in Table 9.4.2-1.

(3) Water Supply Systems—To analyze alternative water supplies, the reviewer should perform the following steps:

(a) Consult with the appropriate ESRP Chapter 4.0 and 5.0 reviewers to identify any mitigation measures or alternative water supplies suggested by these reviewers.

(b) Consider as potential alternative water sources those water bodies within reasonable proximity to the proposed plant site that are capable of supplying plant water needs.

(c) When such water sources can be identified, compare them with the proposed water source using the following comparison factors:

- water body location and description
- estimated availability of water for plant use
- restrictions (if any) on water use for power plant cooling
- estimated aquatic, terrestrial, social, and environmental impacts associated with construction, operation, and maintenance of water transport systems from the water body to the plant
- capital costs and operation and maintenance costs of the water transport system, including annual costs of water as delivered to the plant and costs associated with any necessary water treatment.

(d) Use a format similar to that shown in Table 9.4.2-3 for this comparison. Data for this table may be prepared either as absolute benefits and costs or as incremental benefits and costs referenced to the proposed water source.

(4) Water Treatment System—To analyze water treatment systems, the reviewer should perform the following steps:

(a) Consider alternatives on the basis of systems that avoid or minimize the use of chemicals, use lesser quantities of or less toxic chemicals, or do not discharge chemical wastes directly to the environment.

(b) Unless an adverse impact attributable to the proposed plant service water treatment system has been identified, restrict this analysis to alternative circulating water treatment systems.

(c) Consult with the reviewer for ESRP 3.3.3 to determine proposed water treatment systems and with the reviewer for ESRP 5.3.2.2 to determine potential impacts of discharged chemicals to aquatic biota.

(d) Consider the following classes of alternatives:

- alternative water treatment systems (e.g., mechanical vs. chemical)
- modifications to the proposed system (e.g., alternative chemicals, alternative discharge points)
- alternative operating procedures (e.g., shock treatment vs. continuous chemical addition, modified cooling tower concentration factors).

(e) Determine the following environmental and economic costs or factors for each of the above classes of alternatives:

- impacts to aquatic ecology (e.g., chemical toxicity)
- land-use impacts (e.g., evaporation ponds)
- water-use impacts (e.g., increased water use to achieve lower discharge chemical concentrations)
- compliance with Federal, State, regional, local, or affected Native American tribal regulations, requirements, or ordinances
- capital costs, annual operating and maintenance costs, and total annual costs.

(f) Compare the proposed system with those remaining classes of alternatives not eliminated in an initial screening. Use a format similar to that shown in Tables 9.4.2-1 through 9.4.2-5.

General Considerations

The reviewer should ensure that each circulating water system alternative has been described in sufficient detail to enable the reviewer to make an effective analysis and comparison of environmental impacts leading to a staff conclusion that the alternative system is environmentally preferable 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 balancing and comparisons with the proposed system, leading to a final staff conclusion for circulating water system consideration. The reviewer should also ensure that all comparisons were 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 (1) on the basis of land-use, water-use, or legislative or regulatory requirements, or (2) because it is judged inferior to the proposed system, the reviewer should ensure that adequate documented justification for this action has been prepared.

If a mitigation measure or alternative circulating water system is to be considered, the reviewer should 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 improved projected 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 identify the need for an alternative circulating water system. The reviewer should be guided by the following general considerations:

- The reviewer should keep in mind that an environmental review of alternative circulating water 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.

- The reviewer should 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.

- The reviewer should adjust the economic costs of each alternative system on the basis of equivalent generating capacity.

- The evaluation of alternative circulating water systems may include consultation and coordination with those agencies responsible for NPDES administration. With the EPM as liaison, the reviewer should coordinate the evaluation of measures and controls to limit or avoid adverse impacts. When consulting through the EPM with the EPA, or with agencies of States that have memoranda of understanding with the NRC, the reviewer should ensure that the staff analyses and evaluations

(1) are consistent with the details of these memoranda, (2) will serve the environmental impact statement needs of these agencies, and (3) are consistent with the requirements of the CWA.

Measures and Controls to Limit Adverse Impacts

When considering measures identified by the reviewers for ESRP Chapters 4.0 and 5.0 to mitigate adverse environmental impacts predicted for the proposed circulating water 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 better than that of the proposed project.

- The measure is not precluded by Federal, State, regional, local, or affected Native American tribal regulations, requirements, or ordinances.

- The measure is consistent with NPDES requirements.

Alternative Circulating Water Systems

The initial step in evaluating those alternative intake systems, discharge systems, water supplies, or water treatment systems identified by the analysis procedure of this ESRP should be to categorize these systems as environmentally preferable or inferior to the proposed circulating water systems 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 alternatives.

- When the reviewer determines that the proposed circulating water 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 Chapters 4.0 and 5.0 reviewers. This consultation should result in a joint determination of the status of any such alternative.

- *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 circulating water 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 circulating water 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 reviewers for ESRPs 10.4.1 through 10.4.3. The reviewer should complete the economic and reliability portions of Table 9.4.2-1. 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 a higher benefit to cost ratio than the proposed system, the reviewer may conclude that it should be considered as an alternative to the proposed system. For those cases in which benefits of the alternative are less than those of the proposed system or where economic costs are greater than those of the proposed system, a tentative conclusion that the alternative is superior should lead to 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 not superior to that of 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 section of the EIS should meet the following objectives: (1) description of alternative circulating water 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 circulating water systems.

The reviewer should prepare input describing the review and analysis of each alternative intake system, discharge system, water supply, and water treatment system. If desired, each input may be prepared as a separate EIS section (e.g., 9.4.2.1, "Alternative Intake Systems"). Each input to the EIS should normally describe (1) those alternatives considered, (2) those alternatives rejected by the staff as being inappropriate for the proposed site or judged environmentally inferior to the proposed system, (3) the staff's

analysis and comparison of potentially environmentally preferable alternatives to the proposed system, and (4) the staff's conclusions for consideration of alternative systems.

The reviewer should discuss briefly those alternatives rejected because of specific deficiencies and should state why the alternative system was rejected. The reviewer should also identify those alternatives judged environmentally inferior to the proposed system, and therefore removed from further consideration. The use of tables similar to Table 9.4.2-1 through 9.4.2-5 to present the staff's comparison of potentially acceptable alternative circulating water systems is recommended. When the reviewer has concluded that an alternative is environmentally preferable and should be considered as a preferred circulating water system, sufficient additional detail should be presented to justify the alternative both environmentally and on a benefit-cost basis.

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

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

Magnuson-Stevens Fishery Conservation and Management Act, 16 USC 1801et 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 Between NRC and the Army Corps of Engineers, 40 *Federal Register* 37110 (August 25, 1975).

Rivers and Harbors Appropriation Act of 1899, 33 USC 401.

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). 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.

Table 9.4.2-1. Comparison of Alternatives to the Proposed Intake System

	Proposed System	Alternative Systems	Design Modifications	Intake Locations	Operating Procedures
Construction Impacts					
Aquatic Impacts					
Water-Use Impacts					
Compliance with Regulations					
Total Annual Costs					

Table 9.4.2-2. Comparison of Alternatives to the Proposed Water Discharge System

	Proposed System	Alternative Systems	Design Modifications	Alternative Locations
Construction Impacts				
Impacts on Aquatic Ecology				
Water-Use Impacts				
Compliance with Regulations				
Total Costs				

Table 9.4.2-3. Comparison of Alternatives to the Proposed Water Supply

	Proposed Water Body	Alternative Water Body 1	Alternative Water Body 2	Alternative Water Body 3
Impacts to Aquatic Ecology				
Land-Use Impacts				
Water-Use Impacts				
Compliance with Regulations				
Total Costs				

Table 9.4.2-4. Comparison of Alternatives to the Proposed Water Treatment System

	Proposed System	Alternative Treatment System	System Modifications	Alternative Operating System
Chemicals Used (types and amounts)				
Impacts on Aquatic Ecology				
Land-Use Impacts				
Water-Use Impacts				
Compliance with Regulations				
Total Costs				

Table 9.4.2-5. Screening of Alternative Circulating Water Systems

Factors Affecting System Selection	Alternative 1	Alternative 2	Alternative 3
System description: Intake Discharge Water Supply Water Treatment			
Plant Water Requirements			
Land Land Relationship to Water Bodies Site Terrain Considerations			
Other Water Use			
Ecological Effects			
Legislative Restrictions			
Is this a suitable alternative circulating water system? (Yes/No)			

U.S. NUCLEAR REGULATORY COMMISSION

ENVIRONMENTAL STANDARD REVIEW PLAN

9.4.3 TRANSMISSION SYSTEMS

RESPONSIBILITIES

Primary— Organization responsible for the review of transmission system information

Secondary—None

I. AREAS OF REVIEW

This environmental standard review plan (ESRP) directs the staff's analysis of alternatives to the applicant's proposed transmission system[a]. This includes evaluation of alternatives, in comparison with the proposed system routing, to identify those system routings that are environmentally preferable 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.[b]

The scope of the review directed by this plan should focus on alternative corridor routes. The review should be limited to route alternatives that (1) are applicable to and compatible with the proposed plant, the service area, and the regional transmission network, (2) are not prohibited by local, State, or Federal regulations, and (3) can be judged as practical from a technical standpoint with respect to the proposed dates of plant operation. This review should also take account of the investigation of alternatives proposed by other reviewers to mitigate impacts associated with construction and operation of the proposed transmission system.

(a) "System", as used in this ESRP, refers to the proposed transmission line(s) and route(s) and the grid to which it can be connected. It includes routes and corridors, substations and the voltages at which the lines operate.

(b) The review of environmentally preferable transmission systems should consider both the environment and economics; two or more reviewers may be needed to conduct this portion of the review.

This plan is the basis for staff conclusions with respect to the environmental preference of alternative transmission system routes 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:

- ESRP 3.7. Obtain background information on the proposed transmission system owner, operator, siting and design.

- ESRPs 4.1.2, 5.1.2, and 5.6.3. Obtain input from these reviewers to obtain information regarding the environmental impacts and impacts to man from construction and operation of the proposed transmission system and corridors.

- ESRP 4.1.3. If the proposed construction of the transmission system and corridors is likely to result in adverse impacts to historic properties, obtain information regarding alternative locations for the system that may be taken into consideration.

- ESRPs 4.6 and 5.10. Provide, as appropriate, a list of those measures and controls to limit adverse transmission-system impacts that were developed as a result of this environmental review.

- ESRPs 5.6.1 and 5.6.2. Obtain a list of adverse impacts to the aquatic or terrestrial ecology from the transmission system that could be avoided or mitigated through alternative design or maintenance procedures.

- ESRPs 4.4.3 and 5.8.3. If disproportionate adverse impacts on minority or low-income populations from transmission systems are identified, consider alternate designs, locations, or activities to avoid the impacts.

- ESRPs 10.1 and 10.4. Provide data and information to permit the inclusion of any suggested alternative to the proposed transmission system in the final evaluation of the proposed action.

- Interface with the Environmental Project Manager (EPM). Obtain input from the EPM when an alternative route or design appears to be environmentally preferable and meets regulatory requirements.

Data and Information Needs

In some cases transmission lines may be constructed and operated by an entity other than the applicant. In such cases, alternative route and impact information may be limited and the reviewer should proceed with the assessment using the information that can be obtained.

The kinds of data and information needed will be affected by site- and region-specific factors, and the degree of detail should be modified according to the magnitude of the impacts predicted for the proposed transmission system and to the practicability of adopting the alternative under consideration. Data or information should be obtained for the following alternatives:

(1) Alternative Corridor Routes

- maps or aerial photographs showing alternative transmission corridors from the station site to interconnecting points on the existing high voltage system and identifying corridor characteristics (e.g., new lines/towers on existing corridors, widening of existing corridors, new corridors). A map detailing this information should be included in the environmental report (ER).

- maps or aerial photographs showing existing and known future generating stations and transmission networks for the service area or affected region. For existing transmission corridors not proposed as alternatives to the proposed system, reasons why they were not considered (e.g., system reliability) should be provided (from the ER and through consultation with agencies such as regional power pools).

- approximate location and description of known populations of threatened or endangered species of plants and animals occurring along alternative corridors (through consultation with Federal, State, regional, local, and affected Native American tribal agencies) and locations of major wetlands and critical habitat (from the ER).

- lengths and widths of rights-of-way for each alternative segment or corridor (from the ER).

- number and approximate location of known historic/archaeological sites within 2 km of the alternative corridors (from the ER and through consultation with Federal, State, regional, local, and affected Native American tribal agencies)

- State and local laws or regulations that affect right-of-way acquisition, transmission line construction and operation, or corridor siting (from the ER and consultation with appropriate Federal, State, regional, local, and affected Native American tribal agencies).

Note: The following items should not be needed when the alternative route is an existing corridor containing towers and lines that will not be widened or require new towers for use as an alternative:

- maps or aerial photographs showing the approximate locations of national, State, or private wildlife refuges or other areas dedicated to ecological preservation, management, or study that are within 1 km of alternative corridors (from the ER and through consultation with Federal, State, regional, local, and affected Native American tribal agencies)

- location and extent of agricultural areas that are on or within 2 km of alternative corridors that are routinely serviced by aircraft (e.g., crop dusting) (through consultation with local representatives of the State and Federal departments of agriculture)

- corridor proximity to airports, roads, railroads, or other transportation facilities (from the ER)

- general land-use characteristics along the alternative corridors, expressed as percentages of total corridor length and in terms of the intensity of use (e.g., residential density) for the following classifications (from the ER and through consultation with State and Federal agencies):

  - agricultural

  - forest, woodland

  - rangeland

  - recreational or ecologically sensitive areas such as parks, wildlife preserves/refuges or management areas, wetlands, wild and scenic rivers

  - urban or residential areas

  - commercial or industrial areas

  - other potentially significant classifications (e.g., Federally owned lands, Native American tribal lands, ethnic enclaves, or areas of high minority population)

  - potential geologic hazards (e.g., active faults) that could affect transmission system reliability.

(2) Selection Process and Cost Data

- discussion of the selection process used to evaluate transmission line routes and the rationale and criteria used to select the proposed route (from the ER)

- acquisition cost data for the proposed and alternative route rights-of-way (from the ER)

- construction and maintenance costs for the proposed system and for principal system alternatives (from the ER)

- estimated transmission line losses for the proposed system and for principal alternatives (from the ER).

II. ACCEPTANCE CRITERIA

Acceptance criteria for the review of alternative transmission systems 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, with respect to discussion of alternatives to the proposed action
- 18 CFR Part 50 with respect to regulations for filing applications for permits to site interstate electric transmission facilities
- Regulatory requirements specific for particular land types (see Table 4.1.2-1)

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), with respect to evaluation of alternative systems designs
- Regulatory Guide 4.7, Rev. 2, *General Site Suitability for Nuclear Power Stations* (NRC 1998), with respect to site suitability guidelines
- U.S. Nuclear Regulatory Commission, "Alternative Electrical Transmission Systems and Their Environmental Impact," NUREG-0316, August 1977 (NRC 1977), with respect to environmental impacts.

Technical Rationale

The technical rationale for evaluating alternatives to the applicant's proposed transmission 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 power transmission to determine if there is an obviously superior transmission corridor in terms of environmental impacts and economic costs when compared to the proposed system.

III. REVIEW PROCEDURES

The principal objectives of this analysis procedure are (1) to provide assistance to those ESRP Chapter 4.0 and 5.0 reviewers concerned with identifying and verifying means to mitigate adverse impacts associated with the proposed transmission 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 or not preferable to the applicant's proposed system. The analysis should consider only those alternatives applicable to and compatible with the proposed plant, the applicant's service area, and the regional transmission network. In this analysis, the reviewer should consider alternatives to transmission corridor routes. The reviewer should also ensure that due consideration has been given to the use of existing transmission line corridors as an alternative to the development of new corridors.

The depth of the analysis should be governed by the nature and magnitude of proposed transmission-system impacts predicted by the ESRP Chapter 4.0 and 5.0 reviewers. When adverse impacts are predicted, the reviewer should coordinate with these reviewers 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 transmission systems will be 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 to 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 transmission systems in the depth necessary to judge their environmental preferability to the applicant's proposed system.

The reviewer should conduct an initial environmental screening of each alternative transmission system to eliminate those systems that are obviously unsuitable for application to the proposed project. Economic factors should not be considered in this initial screening. Working through the EPM, the reviewer may consult with appropriate Federal, State, regional, local, and affected Native American tribal agencies when needed to conduct this screening. When the reviewer rejects an alternative, that alternative needs no further consideration other than the preparation of the reasons and justification for the rejection.

When environmentally preferable alternatives are identified, the review should be expanded to consider the economic costs of any such alternative. This analysis should be done in consultation with appropriate reviewers for ESRPs 10.4.1, 10.4.2, and 10.4.3. Assistance from these reviewers should be sought to establish the economic-cost data used to develop a benefit-cost comparison with the baseline (proposed) transmission system.

The following procedure for developing the analysis of alternative transmission 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 transmission systems not eliminated by the initial screening process should be based on the environmental and economic factors shown in Table 9.4.3-1. The reviewer should prepare a similar table for each transmission system element under consideration, comparing each of the environmental and economic cost and benefit factors with those of the proposed transmission system element. Information for this table may be prepared 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 as follows:

(a) The reviewer's analysis of alternative corridor routes should be based on a comparison of those routes with the proposed routes described in ESRP 3.7. The comparison may be made for complete routes or for route segments, as appropriate, and should consider those factors listed under the heading "Data and Information Needs" in this ESRP.

(b) The reviewer should consider both environmental and economic factors, using a tabular format similar to that shown in Table 9.4.3-1. The reviewer should consult with the reviewer for ESRP 3.7 and the appropriate ESRP Chapter 4.0 and 5.0 reviewers to establish construction and operation impacts for the proposed corridor routes. The reviewer's comparison of these data with those for the alternative corridors should involve the following:

- Impacts—The reviewer should estimate the impacts that can be expected from development of alternative transmission corridors. The appropriate ESRP Chapter 4.0 and 5.0 reviewers should be consulted in making these estimates and in comparing these impacts with those predicted for the proposed corridor routes.

- Economic Factors—The reviewer should estimate acquisition or right-of-way costs, clearing and construction costs, maintenance costs, and the costs to mitigate predicted environmental impacts for the proposed and alternative routes. Where there are appreciable differences in transmission line lengths, the reviewer should estimate the loss in delivered electrical capacity due to transmission line losses.

(c) The reviewer should consider alternative locations of auxiliary transmission system facilities only when the reviewers for ESRPs 4.1.2 or 5.1.2 advise relocating of such facilities.

Using the guidance below, the reviewer should evaluate the applicant's process for identifying and selecting alternative transmission system routes to ensure that reasonable alternatives to the proposed routes have been considered. The reviewer should ensure that each transmission system alternative has been described in sufficient detail to enable the reviewer to make 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 recommendation for

Table 9.4.3-1. Comparison of Alternative Corridor Routes

Factor	Proposed Route or Segment	Alternative A Route/Segment	Alternative B Route/Segment
Descriptions New Corridors Total Length Right-of-Way Width Total Area Corridor Characteristics • As Appropriate from "Data Information Needs" in this ESRP • Others as Appropriate Existing (Cleared Corridors) Total Length Right-of-Way Width Total Area			
Impacts Land Use (e.g., agriculture, recreational areas) Terrestrial Ecology (e.g., habitat loss, endangered species) Aquatic Ecology (e.g., siltation, stream crossings) Socioeconomics (e.g., aesthetics, historic sites)			
Economic Factors Estimated Acquisition Cost Estimated Construction Costs Estimated Maintenance Costs Estimated Transmission Losses			

transmission 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

(a) If a mitigation measure or alternative transmission system is being considered, the reviewer should determine first 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 that those mitigation measures proposed by the reviewers for ESRP Chapters 4.0 and 5.0 will meet the criteria as a feasible alternative transmission system.

(b) The reviewer should keep in mind that an environmental review of alternative transmission 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.

(c) The reviewer should 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.

(2) Measures and Controls to Limit Adverse Impacts

(a) When considering measures identified by the reviewers for ESRP Chapters 4.0 and 5.0 to mitigate adverse environmental impacts predicted for the proposed transmission system, the reviewer's verification of the desirability of the measure should reach 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, or affected Native American tribal regulations or ordinances.

(3) Alternative Transmission Systems

(a) The initial step in the evaluation of those alternative transmission systems identified by the analysis procedure of this ESRP should be to categorize these systems as environmentally preferable or inferior to the proposed transmission 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 will comply with applicable Federal, State, regional, local, and affected Native American tribal regulations or requirements, the reviewer should conclude that there is no environmentally preferable transmission system alternative.

- When the reviewer determines that the proposed transmission system will meet regulatory 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 of the alternatives may be required 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 (1) have no unavoidable adverse impacts and (2) meet regulatory requirements.

  - *Environmental preference may be established* when an alternative that meets regulatory 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 lead to 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.

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

(b) When environmentally preferable alternative transmission 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 balance and comparison with the proposed system. This portion of the evaluation procedure should be conducted with the assistance of reviewers for ESRPs 10.4.1, 10.4.2, and 10.4.3. The reviewer should complete the economic factors portions of Table 9.4.3-1. 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 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 as a replacement for the proposed system. For those cases in which benefits of the alternative are less than those of the proposed system (e.g., increased transmission losses or decreased system reliability) or where economic costs exceed those of the proposed system, a conclusion to further consider the alternative should lead to consultation with the Environmental Project Manager and with the appropriate ESRP Chapter 4.0 and 5.0 reviewers. If this conclusion establishes that the benefit-cost balances of such alternatives are no more than equivalent to the proposed system, the alternatives should not be considered further. When alternatives have significantly decreased benefits or increased economic costs, they should be rejected for any further consideration as replacements for the proposed system.

IV. EVALUATION FINDINGS

Data for the EIS should meet the following objectives: (1) description of the alternative transmission systems that were 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.

The reviewer should prepare separate descriptions with respect to the review and analysis of each alternative system. Each item should normally describe (1) those alternatives considered by the staff, (2) those alternatives rejected by the staff as being inappropriate for the proposed project, (3) the staff's analysis and comparison of potentially appropriate alternatives seeking environmentally preferable alternatives to the proposed system or component, and (4) the staff's conclusions. For alternative routes, the reviewers should also briefly describe the applicant's process for identifying and evaluating alternative routes and the staff's conclusion with respect to the merits of the procedure.

The reviewer should discuss briefly those alternatives rejected because of specific deficiencies and state why the alternatives were rejected. The reviewer should also identify those alternatives judged inferior to the proposed system. The use of a table similar to Table 9.4.3-1 to present the staff's comparison of these potentially acceptable alternative transmission systems is recommended.

When the reviewer has concluded that an alternative is environmentally preferable and should be considered as the preferred route (or route segment) sufficient additional narrative detail should be included in the material to justify the alternative on an environmental and economic-cost basis.

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 Part 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."

18 CFR Part 50, "Regulations for Filing Applications for Permits to Site Interstate Electric Transmission Facilities.

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). 1977. *Alternative Electrical Transmission Systems and their Environmental Impact.* NUREG-0316, 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.