

Excerpts from “Standard Review Plans for
Environmental Reviews for Nuclear Power Plants”
NUREG-1555, Rev. 1 (2007)

Sections:

4.7

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U.S. NUCLEAR REGULATORY COMMISSION

ENVIRONMENTAL STANDARD REVIEW PLAN

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 foreseeable 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

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U.S. NUCLEAR REGULATORY COMMISSION
**ENVIRONMENTAL STANDARD
 REVIEW PLAN**

5.3.1.2 AQUATIC ECOSYSTEMS

REVIEW RESPONSIBILITIES

Primary—Organization responsible for the review of ecological information

Secondary—None

I. AREAS OF REVIEW

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

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

Review Interfaces

This section describes the types of interfaces needed with other staff. Interfaces require coordination primarily with the lead for hydrology, and to a lesser extent with the leads for alternatives and cumulative impacts. The reviewer for this ESRP should obtain input from or provide input to reviewers for the following ESRPs, as indicated:

- ESRP 2.4.2. Obtain a description of the aquatic ecology in the vicinity of the site, especially those resources potentially affected by the cooling-water intake system.

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5.3.1.2-1

NUREG-1555

USNRC ENVIRONMENTAL STANDARD REVIEW PLAN

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- ESRP 3.1. Obtain information about the power plant's external appearance and layout in enough detail to support the analyses made in ESRP 5.3.1.2.
- ESRP 3.4.1. Obtain a description of the cooling system and its operational modes in enough detail to support the analyses made in ESRP 5.3.1.2.
- ESRP 5.2.1. Obtain information regarding hydrological alterations from operation and the adequacy of the plant water supply for use in the evaluation of impacts to the aquatic ecosystem from the cooling system intake.
- ESRP 5.2.2. Provide information regarding impacts on the aquatic ecosystem from the cooling system intake for use in the evaluation of impacts of operation on plant water use.
- ESRP 5.3.1.1. Obtain information regarding physical impacts caused by the flow field induced by the intake system for use in the evaluation of impacts on the aquatic ecosystem from the cooling system intake.
- ESRP 5.10. Provide a list of potential adverse impacts of the cooling system intake on aquatic biota and a list of applicant commitments to limit these adverse impacts.
- ESRP 5.11. Provide information on the magnitude of potential entrapment, impingement, and entrainment impacts to "important" species and habitats on and in the vicinity of the proposed site for the cumulative impacts analysis for operation activities.
- ESRP 6.5.2. Provide a discussion of "important" species and/or habitats that likely would be affected by intake system operation.
- ESRP 9.3. Provide information on the magnitude of potential impacts to "important" species and habitats on and in the vicinity of the proposed site.
- ESRP 9.4.2. Provide a list of adverse impacts of intake system operation that could be mitigated or avoided through alternative system design, location, or operation and assist in determining appropriate alternatives **and mitigation measures**.
- ESRP 10.1. Provide a summary of the unavoidable adverse impacts on aquatic biota that are predicted to occur as a result of intake system operation.
- ESRP 10.2. Provide a summary of irreversible and irretrievable commitments of aquatic resources that are predicted to occur as a result of intake system operation.

Data and Information Needs

The type of data and information needed will be affected by site- and station-specific factors, and the degree of detail should be modified according to the anticipated magnitude of the potential impacts. The following information should be obtained:

- susceptibility of “important” aquatic species (as defined in Table 2.4.2-1) to entrainment, entrapment, and impingement (from the environmental report [ER] and the general literature)
- the economic value of the species for local or regional commercial and recreational fisheries. For species that are commercially or recreationally valuable, estimates of natural survival rates up to those life stages at which the species are recruited to the harvestable or parent stocks **and at which the species reaches reproductive maturity** (from the ER and consultation with Federal, State, regional, local, and affected Native American tribal agencies).
- for those “important” species potentially affected by plant operation, estimates of the regional standing stocks **as well as the species’ tolerance ranges and lethal thresholds for habitat requirements (e.g., salinity, temperature, currents, dissolved oxygen water depth, substrate, etc.)** (from the ER and consultation with Federal, State, regional, local, and affected Native American tribal agencies)
- transit time from the intake structure to the point of discharge to a receiving water body (from the ER).

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

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

II. ACCEPTANCE CRITERIA

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

- 10 CFR 51.45 with respect to ERs and the analysis of potential impacts contained therein
- 10 CFR 51.75 with respect to descriptions of the environment affected by the issuance of a construction permit, **early site permit, or combined license**

- 10 CFR 51.95 with respect to the preparation of supplemental environmental impact statements (EISs) in support of the issuance of an operating license
- 40 CFR 122 and 125 with respect to NPDES permit conditions specified in the Federal Water Pollution Control Act, commonly referred to as the Clean Water Act
- Coastal Zone Management Act, as amended, with respect to natural resources and land or water use of the coastal zone
- Endangered Species Act, as amended, with respect to identifying Federal threatened and endangered, and/or Federally designated critical habitats, and initiating formal or informal consultation with the U.S. Fish and Wildlife Service and/or National Marine Fisheries Service
- Federal Water Pollution Control Act, as amended, commonly referred to as the Clean Water Act, with respect to restoration and maintenance of the chemical, physical, and biological integrity of water resources
- Fish and Wildlife Coordination Act, as amended, with respect to consideration of fish and wildlife resources in the planning of development projects that affect water resources
- Magnuson-Stevens Fishery Conservation and Management Act, as amended, with respect to identifying impacts on essential fish habitat (EFH) in the vicinity of the site and initiating consultation with the National Marine Fisheries Service
- Marine Mammal Protection Act, as amended, with respect to the protection of marine mammals
- Marine Protection, Research, and Sanctuaries Act, as amended, with respect to the dumping of dredged material into the ocean.

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

- Regulatory Guide 4.2, Rev. 2, *Preparation of Environmental Reports for Nuclear Power Stations* (NRC 1976), contains guidance to the applicant concerning the analysis of potential impacts of operation of the cooling water intake system. The reviewer should ensure that the applicant's analysis is sufficient to evaluate impacts during station operation.
- Regulatory Guide 4.7, Rev. 2, *General Site Suitability for Nuclear Power Stations* (NRC 1998) contains guidance concerning the ecological systems and biota at potential sites and requires that their environs be sufficiently well known to allow reasonably certain predictions of impacts and that there would be no unacceptable or unnecessary deleterious impacts on populations or habitats of important species or on ecological systems from the operation of a nuclear power station. This guide

also provides regulatory positions concerning entrainment, impingement, entrapment, and effects of cooling systems on aquatic species, **their habitats, and their** migration routes.

- Compliance with environmental quality standards and requirements of the Clean Water Act is not a substitute for and does not negate the requirement for NRC to weigh the environmental impacts of the proposed action, including any degradation of water quality, and to consider alternatives to the proposed action that are available for reducing the adverse impacts. If an environmental assessment of aquatic impacts is available from the permitting authority, the NRC will consider the assessment in its determination of the magnitude of the environmental impacts in striking an overall benefit-cost balance. When no such assessment of aquatic impacts is available from the permitting authority, the NRC (possibly in conjunction with the permitting authority and other agencies having relevant expertise) will conduct its own assessment.
- Memorandum of Understanding Between the U.S. Army Corps of Engineers and the NRC for the Regulation of Nuclear Power Plants (40 FR 37110) provides guidance with respect to the NRC exercising the primary responsibility in conducting environmental reviews and in preparing EISs for nuclear power stations. The Corps of Engineers should be consulted regarding (1) coastal erosion and other shoreline modifications, (2) siltation and sedimentation processes, (3) dredging activities and disposal of dredged materials, and (4) location of structures affecting navigable waters.
- Second Memorandum of Understanding and Policy Statement Regarding Implementation of Certain NRC and EPA Responsibilities, serves as the legal basis for NRC decisionmaking concerning licensing matters covered by the National Environmental Policy Act (NEPA) and Section 511 of the Federal Water Pollution Control Act , commonly referred to as the Clean Water Act.
- LIC-203, Revision 1, Procedural Guidance for Preparing Environmental Assessments and Considering Environmental Impacts (NRC 2004), with respect to NRC compliance with the Endangered Species Act.

Technical Rationale

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

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

III. REVIEW PROCEDURES

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

However, compliance with environmental quality standards and requirements of the Clean Water Act is not a substitute for and does not negate the requirement for NRC to weigh the environmental impacts of the proposed action, including any degradation of water quality, and to consider mitigation measures and alternatives to the proposed action that are available for reducing the adverse impacts. If an environmental assessment of aquatic impacts is available from the permitting authority, the NRC will consider the assessment in its determination of the magnitude of the environmental impacts in striking an overall benefit-cost balance. When no such assessment of aquatic impacts is available from the permitting authority, the NRC (possibly in conjunction with the permitting authority and other agencies having relevant expertise) will conduct its own assessment.

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

The reviewer should take the following steps depending on whether or not the new facility is being located at a site close to an existing nuclear facility.

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

Determine whether the applicant has a current NPDES permit with a Clean Water Act Section 316(b) determination, if appropriate, or equivalent State permits and supporting documentation. If these documents are not available, not current, or do not reflect conditions associated with the proposed facility, continue the analysis below for a site that is not located close to an existing nuclear facility. Otherwise, prepare an assessment of entrapment, entrainment or impingement of aquatic biota for the new plant based on the records of historical data of the existing facility emphasizing the "important" aquatic organisms. The statement for the EIS would:

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

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

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

- (1) Identify the “important” aquatic organisms and their life stages susceptible to entrapment, impingement, or entrainment, coordinating efforts with the reviewer of ESRP 2.4.2 to ensure that these susceptible “important” species are also described in that ESRP.

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

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

- (2) Estimate the levels of susceptibility in either qualitative or quantitative terms, or both. Methods for quantifying entrapment and impingement susceptibilities are not well developed; therefore, it may be necessary to draw on the experience of comparable, currently operating power stations to predict the magnitude of the potential impact for the proposed plant. Methods for quantifying entrainment susceptibilities are available; however, they are generally applicable to specific habitat species station characteristics.

- Ensure that assumptions made in available model developments are valid for the case under review.
- Consider habitat type in determining levels of susceptibility.

- (3) After identifying the “important” species and determining their susceptibility, estimate the survival rates for those species entrapped, impinged or entrained by relying on experience at other stations. Certain species have been shown to be especially fragile (e.g., threadfin shad, menhaden, and bay anchovy), whereas some shellfish are much hardier (e.g., blue crab and penaeid shrimp).

- Consider the design and proposed operation of any proposed screen wash and fish return system.
- Consider the potential value of such a system, if a return system is not proposed.

- Assume 100% mortality for all entrained biota.
- (4) Consider the potential for altered hydrodynamic characteristics induced by inlet system operation (e.g., altered circulation patterns) to affect attraction and entrapment of aquatic biota, and consult with the reviewer for ESRP 5.3.1.1 to determine the extent and seasonal variation of any such hydrological alterations.
 - (5) Consult with the reviewer for ESRP 5.3.2.1 to determine if there is any potential for the recirculation of heated effluent from the plant discharge system. If recirculation is predicted, analyze the potential effects of increased impacts of entrapment, entrainment, and impingement.
 - (6) Finally, estimate the magnitude of the potential entrapment, impingement and entrainment impacts on the species populations and the aquatic ecosystem.
 - Use the results of Step 2 as the starting point (i.e., the potential station cropping rates for phytoplankton, zooplankton, and meroplankton, including vegetative spores, fish eggs and larvae, and juvenile stages of “important” species).
 - Consider these cropping rates in relation to natural mortality rates, reproductive rates, and standing stock estimates for the species populations.
 - Consider other existing stresses (cumulative mortality) to the fragile species (e.g., impacts of other electrical generating stations sited nearby).

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

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

IV. EVALUATION FINDINGS

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

applicant's measures and controls to limit adverse impacts. This information should be summarized for the reviewer of ESRP 5.10.

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

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

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

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

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

V. IMPLEMENTATION

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

VI. REFERENCES

10 CFR 51.45, “Environmental report.”

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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**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.

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- (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.

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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 51.71 with respect to the need to discuss alternatives in the environmental analysis

- 10 CFR 51, Appendix A, discussing alternatives to the proposed action
- Fish and Wildlife Coordination Act of 1958
- Marine Sanctuaries Act of 1972, 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.

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

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

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

Magnuson-Stevens Fishery Conservation and Management Act, 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 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)			