



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

### 5.3.3.2 TERRESTRIAL ECOSYSTEMS

#### REVIEW RESPONSIBILITIES

Primary—Appendix B

Secondary—Appendix B

#### I. AREAS OF REVIEW

This environmental standard review plan (ESRP) directs the staff's identification and evaluation of impacts to terrestrial ecosystems induced by the operation of heat dissipation systems, especially cooling towers and cooling ponds. The scope of the review directed by this plan will be limited to consideration of the operational aspects of heat dissipation systems in sufficient detail to form a basis for assessing potential operational impacts.

#### Review Interfaces

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

- ESRP 2.4.1. Obtain descriptive material on the terrestrial ecology of the site and vicinity to support the analyses made in ESRP 5.3.3.2.
- ESRP 3.4.2. Obtain specific information about the cooling system necessary to assess impacts to the terrestrial environment.
- ESRP 5.3.3.1. Obtain information about heat dissipation to the atmosphere necessary to determine impacts to the terrestrial environment.

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#### USNRC ENVIRONMENTAL STANDARD REVIEW PLAN

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

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

Comments and suggestions for improvement will be considered and should be sent to the U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, Washington, D.C. 20555-0001. PEF603  
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- ESRP 5.10. Provide a list of measures and controls to limit adverse impacts to terrestrial biota that are to be evaluated in regard to the licensing process and a list of applicant commitments to limit these impacts.
- ESRP 6.5.1. If potential adverse impacts due to heat-dissipation are predicted, then provide preoperational baseline monitoring program elements.
- ESRP 9.4.1. Provide a list of adverse environmental impacts that could be mitigated or avoided through use of alternative heat dissipation system designs or operational procedures, and assist in determining appropriate alternatives.
- ESRP 10.1. Provide a summary of the unavoidable impacts to terrestrial ecosystems that are predicted to occur as a result of operation of heat-dissipation systems.
- ESRP 10.2. Provide a summary of irreversible and irretrievable commitments of terrestrial biota that are predicted to occur as a result of the operation of heat-dissipation systems.

#### 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:

- concentration and chemical composition of dissolved and suspended solids in cooling tower basins or spray canals on a seasonal basis (from ESRP 3.4.2)
- isopleths of deposition at ground levels on a seasonal basis. Isopleths should extend to values at least as low as 1 kg/ha/mo (from the environmental report [ER] and ESRP 5.3.3.1).
- a list and description of the “important” terrestrial species and habitats that may be affected by the heat-dissipation system (from ESRP 2.4.1)
- descriptions of natural and managed plant communities on the site and within offsite isopleths above 20 kg/ha/yr (from ESRPs 2.4.1, 5.3.3.1, and the site visit)
- annual precipitation and its dissolved solid concentration within the drift field (from the ER)
- prediction of increased frequency and distribution of fog and icing (from ESRP 5.3.3.1)
- shoreline vegetation expected to develop along the shore of new cooling lakes and ponds (from the ER and consultation with Federal, State, and local agencies)
- proposed other uses of cooling ponds and reservoirs (from the ER).

## II. ACCEPTANCE CRITERIA

Acceptance criteria for the review of impacts on terrestrial ecosystems from the heat dissipation system are based on the relevant requirements of the following:

- 10 CFR 51.45 with respect to ERs and the analysis of potential impacts contained therein
- 10 CFR 51.75 with respect to analysis of impacts on the terrestrial environment affected by the issuance of a construction permit
- 10 CFR 52, Subpart A, with respect to analysis of impacts on the terrestrial environment affected by the issuance of an early site permit
- 10 CFR 51.95 with respect to the preparation of supplemental environmental impact statements (EISs) in support of the issuance of an operating license
- Endangered Species Act of 1973, as amended, with respect to identifying threatened or endangered species and critical habitats and formal or informal consultation with the U.S. Fish and Wildlife Service and/or National Marine Fisheries Service
- Fish and Wildlife Coordination Act of 1958 with respect to consideration of fish and wildlife resources and the planning of development projects that affect water resources

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

- Regulatory Guide 4.2, Rev. 2, *Preparation of Environmental Reports for Nuclear Power Stations* (NRC 1976), contains guidance for the preparation of ERs. With respect to the heat-dissipation system, it specifies that detailed descriptions of the expected effects of the system on the local environment with respect to fog, icing, precipitation modifications, humidity changes, cooling-tower blowdown and drift, and noise should be included in the ER. The reviewer should ensure that the appropriate data and analyses are provided in the ER.
- Regulatory Guide 4.7, Rev. 2, *General Site Suitability for Nuclear Power Stations* (NRC 1998), contains guidance on factors that should be considered in the site-selection process. In specific regard to cooling-tower drift, this guide states “The potential loss of important terrestrial species and other resources should be considered.”
- Regulatory Guide 4.11, Rev. 1, *Terrestrial Environmental Studies for Nuclear Power Stations* (NRC 1977), contains technical information for the design and execution of terrestrial environmental studies, the results of which may be appropriate for inclusion in the applicant’s ER. The reviewer should ensure that the appropriate results concerning potential effects of the heat-dissipation system on the terrestrial environment are included in the ER.

## Technical Rationale

The technical rationale for evaluating the applicant's impacts from heat-dissipation systems to terrestrial ecosystems is discussed in the following paragraph:

The EIS needs to include the results of an analysis that considers the environmental effects of the proposed heat dissipation system and the alternatives available for reducing or avoiding adverse environmental effects. Any environmental benefits that may result from the operation of the heat dissipation system should also be included. Following the acceptance criteria listed above will help ensure that the environmental impacts of the proposed heat-dissipation system are considered with respect to matters covered by such standards and requirements.

### III. REVIEW PROCEDURES

The depth and extent of the input to the EIS will be governed by the environmental characteristics of the terrestrial ecology that could be affected by operation of the station's heat dissipation systems and by the magnitude of the expected impacts to the terrestrial environment.

The most apparent effects of heat dissipation systems on terrestrial ecosystems are those associated with cooling-tower or spray pond operation. These include the effects of vapor plumes, icing, and salt drift on the terrestrial ecosystems. The potential for bird collision with cooling towers should be addressed by the reviewer for ESRP 4.3.1. To date, at stations using once through cooling systems, no adverse impacts to terrestrial ecosystems have occurred that require mitigating actions. In circumstances where once through cooling is proposed, the analysis may terminate without further consideration unless unusual environmental circumstances make more analysis necessary.

(1) Consider the impacts of drift deposition on plants.

- Drift deposition has the potential for adversely affecting plants, but the tolerance levels of native plants, ornamentals, and crops are not known with precision.
- General guidelines for predicting effects of drift deposition on plants suggest that many species have thresholds for visible leaf damage in the range of 10 to 20 kg/ha/mo of NaCl deposited on leaves during the growing season.
- These effects can be altered by the frequency of rainfall, humidity, type of salt, and sensitivity of species.
- Use maps of the site and vicinity showing drift isopleths that were produced by recognized drift-dispersion models to define areas of possible botanical injury.

- Use an order-of-magnitude approach, as follows, to analyze operational impacts from salt drift:
    - Deposition of salt drift (NaCl) at rates of 1 to 2 kg/ha/mo is generally not damaging to plants.
    - Deposition rates approaching or exceeding 10 kg/ha/mo in any month during the growing season could cause leaf damage in many species.
    - Deposition rates of hundreds or thousands of kg/ha/yr could cause damage sufficient to suggest the need for changes of tower-basin salinities or a reevaluation of tower design, depending on the amount of land impacted and the uniqueness of the terrestrial ecosystems expected to be exposed to drift deposition.
- (2) Consider the detrimental effects increased fogging could have on local vegetation if the increase in humidity induces an increase in fungal or other phytopathological infections. Increased icing can cause physical damage to vegetation due to increased structural pressure on tree branches or by damaging fruit or leaf buds.
- Use an order of magnitude approach as follows to analyze operational impacts from fog or ice:
    - Fogging or icing of vegetation on the order of a few hours per year is generally not severe.
    - Fogging or icing on the order of tens of hours per year may cause detectable damage to vegetation.
    - Fogging or icing occurring for hundreds of hours per year could be severe enough to suggest the need for design changes, depending on the amount of land impacted and the uniqueness of the terrestrial ecosystems expected to be exposed to drift deposition.
  - Consider soil salinization:
    - The risk from this source is generally considered to be low.
    - In arid areas (deserts), salts could accumulate in soils over long time intervals and cause damage.
- (3) Consider the impact to terrestrial biota when new shoreline habitats are created along ponds and reservoirs built for cooling purposes. Riparian tree/shrub communities that form around these new ponds or reservoirs may attract “important” species.

If endangered or threatened species could be affected, agency level formal or informal consultation with the U.S. Fish and Wildlife Service under Section 7 of the Endangered Species Act is required.

#### IV. EVALUATION FINDINGS

Input to the EIS should accomplish the following objectives: (1) public disclosure of any expected impact to the terrestrial ecosystem as a result of the operation of the heat dissipation system, (2) presentation of the basis of staff analysis of the project, and (3) presentation of staff conclusions, evaluations, and conditions regarding terrestrial ecosystems. These conclusions should include

- a list of adverse impacts of cooling-system heat dissipation to terrestrial ecosystems
- a list of the impacts for which there are measures or controls to limit adverse impacts and associated measures and controls
- the applicant's commitments to limit these impacts
- the staff's evaluation of the adequacy of the applicant's measures and controls to limit adverse impacts.

This information should be summarized by the reviewer for ESRP 5.10.

Evaluation of impacts should result in one of the following conclusions:

- *The impact is minor, and mitigation is not warranted.* If the degree of impact falls into the first order category (a few hours of icing or fogging each year or a few kilograms of salt drift per hectare per year), the reviewer may conclude that these impacts are not of sufficient magnitude to warrant further evaluation.
- *The impact is adverse, but can be mitigated by design and procedure modifications.* If the degree of impact falls within the second-order category (a few tens of hours per year increase in fog or ice or a few tens of kilograms of salt drift deposition per hectare per year), the reviewer may conclude that the effects are adverse and that mitigating actions should be considered. For these cases, the reviewer should consult with the Environmental Project Manager (EPM) and the reviewer for ESRP 9.4.1 for verification that the modifications are practical and will lead to an improvement in the benefit-cost balance. The reviewer should prepare a list of verified modifications and measures and controls to limit the corresponding impact. These lists should be given to the reviewer for ESRP 5.10.
- *The impact is adverse and is of such magnitude that it should be avoided, if it cannot be mitigated.* If the degree of expected impacts falls within the third order category (hundreds of hours of increase in fog and ice or hundreds of kilograms of salt drift per hectare per year), the reviewer may conclude that the impacts of operation are sufficiently adverse that consideration of alternative designs or locations to avoid the impact is warranted. When impacts of this nature are identified, the reviewer should inform the EPM and the reviewer for ESRP 9.4.1 that an analysis and evaluation of alternative designs or procedures is needed. The reviewer should participate in any such analysis and evaluation of alternatives that would avoid the impact and that could be considered practical. If no

such alternatives can be identified, the reviewer should provide this conclusion to the reviewer for ESRP 10.1.

## V. IMPLEMENTATION

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

## VI. REFERENCES

10 CFR 51.45, "Environmental report."

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

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

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

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

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

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

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

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