U.S. NUCLEAR REGULATORY COMMISSION

STANDARD REVIEW PLAN

OFFICE OF NUCLEAR REACTOR REGULATION

2.3.5 LONG-TERM DIFFUSION ESTIMATES

REVIEW RESPONSIBILITIES

Primary - Accident Evaluation Branch (AEB)

Secondary - Effluent Treatment Systems Branch (ETSB)
Radiological Assessment Branch (RAB)

I. AREAS OF REVIEW

Information is presented by the applicant and reviewed by the staff concerning atmospheric diffusion estimates for routine releases of effluents to the atmosphere. The review covers the following specific areas:

1. Atmospheric dispersion models to calculate concentrations in air and amount of material deposited as a result of routine releases of radioactive material to the atmosphere.

2. Meteorological data used as input to diffusion models.

3. Derivation of diffusion parameters.

4. Relative concentration (X/Q) and relative deposition (D/Q) values used for assessment of consequences of routine airborne radioactive releases.

A secondary review is performed by ETSB and RAB and the results are used by AEB in the overall evaluation of the long-term diffusion estimates. The ETSB reviews the points of routine release of radioactive material to the atmosphere and the characteristics of each release mode. The RAB reviews the locations of potential receptors for dose computations. The results of their analyses are transmitted to AEB for use in its independent review.

II. ACCEPTANCE CRITERIA

Characterization of atmospheric transport and diffusion conditions is necessary for estimating the radiological consequences of routine releases of radioactive

materials to the atmosphere to demonstrate compliance with the numerical guides for doses contained in 10 CFR Part 50, Appendix I (Ref. 1).

The following regulatory guides provide acceptable criteria for complying with this SRP section:

1. Regulatory Guide 1.109 (Ref. 2) presents identification criteria to be used for specific receptors of interest.

2. Regulatory Guide 1.111 (Ref. 3) provides criteria for characterizing atmospheric transport and diffusion conditions for evaluating the consequences of routine releases. Use of the model described in NUREG-0324 (Ref. 4) is acceptable.

3. Regulatory Guide 1.112 (Ref. 5) presents identification criteria to be used for release points and release characteristics.

Specifically, the following information should be provided by the applicant in the *Safety Analysis Report (SAR)*:

1. A description of the atmospheric dispersion models used by the applicant to calculate concentrations in air and amount of material deposited as a result of routine releases of radioactive gases to the atmosphere. The models should be sufficiently documented and substantiated to allow a review of their appropriateness to site, plant, and release characteristics.

2. A discussion of atmospheric diffusion parameters, such as vertical plume spread (σ_z) as a function of distance and wind speed, related to measured meteorological parameters. Use of these parameters should be substantiated as to their appropriateness for use in estimating the consequences of routine releases from the site boundary to a radius of 50 miles from the plant.

3. Meteorological data used as input to the dispersion models. Data used for this evaluation should represent hourly average values of wind speed, wind direction, and atmospheric stability which are appropriate for each mode of release and which are characteristic of annual average atmospheric transport and diffusion conditions in the vicinity of the plant. (See SRP Section 2.3.3 for data acceptability criteria, and see Regulatory Guide 1.23 (Ref. 6) for data formats.)

4. Relative concentration (X/Q) and relative deposition (D/Q) values used for assessment of consequences of routine radioactive gas releases as described in Section 2.3.5.2 of Regulatory Guide 1.70 (Ref. 7).

III. REVIEW PROCEDURES

1. Atmospheric Dispersion Models

The applicant's models are compared to the general modeling criteria presented in Regulatory Guide 1.111. The models should be suitable to

topography of the site and vicinity, plant configuration, and release characteristics. Additional information for determining model suitability may be found in standard references such as "Meteorology and Atomic Energy - 1968" (Ref. 8).

The staff performs an independent evaluation of long-term dispersion characteristics. Identification of release points and release characteristics is provided by ETSB. RAB provides the locations of receptors of interest. Each release should be characterized as continuous or intermittent. Using the criteria presented in Regulatory Guide 1.111, each release is classified as completely elevated, partially elevated, or completely ground level. Turbulent mixing of the effluent into the wake of plant structures is considered where appropriate in accordance with Regulatory Guide 1.111.

Topographic characteristics in the vicinity of the site are examined for restrictions of horizontal and/or vertical plume spread, channeling or other changes in airflow trajectories, and other unusual conditions affecting atmospheric transport and diffusion between the source and receptors of interest. Examples of conditions where modifications to standard approaches may be necessary are narrow, deep valleys, land-sea (lake) breeze regimes, and low-level subsidence inversions of temperature. "Fumigation" may be a concern for infrequent releases of short duration from elevated sources.

The standard diffusion model used by the staff is described in NUREG-0324. This model is a straight-line Gaussian model with a specific calculational procedure for estimating X/Q values for intermittent releases. Modifications to the straight-line model to consider the effects of variations in space and time in airflow are also described in NUREG-0324.

For unusual topographic and meteorological conditions, a variable trajectory model may be used on a case-by-case basis.

2. Atmospheric Diffusion Parameters

The vertical plume spread parameter, σ_z, as a function of distance and atmospheric stability is reviewed. Atmospheric stability should be defined by measurement of vertical temperature gradient, particularly during stable conditions. Other classification schemes (e.g., Refs. 9 and 10) may be used to estimate atmospheric stability class or to determine the plume spread parameter directly for unstable and neutral conditions. These alternative classification schemes are reviewed for appropriateness to site, plant, and release characteristics. Standard curves of σ_z with distance are presented in Regulatory Guide 1.111. Modified plume spread parameters may also be considered for unique terrain features such as deserts (see Ref. 11) and large bodies of water (see Ref. 12).

3. Meteorological Data

Meteorological data are reviewed for compatibility with the models utilized, representativeness of conditions within the area of interest, and representativeness of annual average meteorological characteristics in the vicinity

of the plant. General criteria for collection and presentation of on meteorological data are stated in Regulatory Guide 1.23 and in SRP Section 2.3.3, subsection III.2. If adequate onsite meteorological data are not available, the reviewer must assure that adequate conservatism is applied to prevent signficant understimates of airborne concentrations and amount of material deposited.

4. Relative Concentrations Used for Routine Releases

The X/Q and D/Q values used for assessment of the consequences of routine radioactive releases are reviewed for appropriateness to site conditions, plant configuration, and release characteristics.

Annual average X/Q and D/Q values are calculated for 16 radial sectors from the site boundary to a distance of 50 miles from the plant, as well as for specific receptor locations. RAB provides the locations of specific receptors (e.g., site boundary, residence, garden, cow). Adjustments of the X/Q and D/Q output may be necessary to relfect consideration of unusual site and/or meteorological conditions.

Annual average X/Q and D/Q values at the specified receptor locations and at standard distances in the 16 radial sectors from the site boundary to a distance of 50 miles from the plant are provided to the RAB for the calculation of appropriate doses.

IV. EVALUATION FINDINGS

The reviewer verifies that appropriate atmospheric dispersion models, with adequate onsite meteorological data as input to the models, have been used to calculate relative concentration and relative deposition at appropriate distances and directions from postulated release points during routine airborne releases of radioactive gases. The input to the Safety Evaluation Report will also include a summary of the relative concentration (X/Q) and relative deposition (D/Q) calculated by the staff, reference to diffusion models used, and a comparison between the values computed by the staff and the applicant. The reviewer's evaluation must support the following type of concluding statement, to be included in the staff's Safety Evaluation Report:

> Based on the meteorological data provided by the applicant and an atmospheric dispersion model that is appropriate for the characteristics of the site and release points, the staff concludes that representative atmospheric transport and diffusion conditions have been calculated for the locations of potential receptors. The characterization of atmospheric transport and diffusion conditions satisfies the criteria described in Regulatory Guide 1.111 and are appropriate for the evaluation to demonstrate compliance with the numerical guides for doses contained in 10 CFR Part 50, Appendix I.

Any deviation from the acceptance criteria should be explained by a statement that the applicant has provided an alternative approach that the staff has reviewed and found to be acceptable.

V. IMPLEMENTATION

The following is intended to provide guidance to applicants and licensees regarding the NRC staff's plans for using this SRP section.

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

Implementation schedules for conformance of parts of the method discussed herein are contained in the referenced regulatory guides and NUREGs.

VI. REFERENCES

1. 10 CFR Part 50, Appendix I, "Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion 'As Low As Is Reasonably Achievable' for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents."

2. Regulatory Guide 1.109, "Calculation of Annual Doses to Man From Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I."

3. Regulatory Guide 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents In Routine Releases From Light-Water-Cooled Reactors."

4. Regulatory Guide 1.112, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents From Light-Water-Cooled Reactors."

5. NUREG-0324, "XOQDOQ Program for the Meteorological Evaluation of Routine Effluent Releases at Nuclear Power Stations" (DRAFT), September 1977.

6. Regulatory Guide 1.23, "Onsite Meteorological Programs."

7. Regulatory Guide 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants."

8. D. H. Slade (ed.), "Meteorology and Atomic Energy - 1968," TID-24190, Division of Technical Information, USAEC (1968).

9. S. R. Hanna, G. A. Briggs, J. Deardorff, B. A. Egan, F.A. Gifford, and F. Pasquill, "AMS Workshop on Stability Classification Schemes and Sigma Curves--Summary of Recommendations," Bulletin of the American Meteorological Society, Vol. 58, No. 12 (December 1977).

10. F. O. Hoffman (General Chairman), "Proceedings of a Workshop on the Evaluation of Modes Used for the Environmental Assessment of Radionuclide Releases," CONF-770901, Oak Ridge National Laboratory (April 1978).

11. G. R. Yanskey, E. H. Markee, and A. P. Richter, "Climatography of the National Reactor Testing Station," IDO-12048, Idaho Operations Office, USAEC (1966).

12. R. P. Hosker, Jr., "A Comparison of Estimation Procedures for Over-Water Plume Dispersion." Paper Presented at the Symposium on Atmospheric Diffusion and Air Pollution in Santa Barbara, California, American Meteorological Society (September 9-13, 1974).