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

SECTION 2.3.5 LONG-TERM DIFFUSION ESTIMATES

REVIEW RESPONSIBILITIES

Primary - Hydrology-Meteorology Branch (HMB)

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 diffusion models to calculate relative concentrations at specified receptor locations (identified by RAB) for routine radioactive gas releases (with the release point characteristics determined by ETSB).

2. Meteorological data summaries used as input to diffusion models (Regulatory Guide 1.23).

3. Derivation of diffusion parameters from meteorological data.

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

II. ACCEPTANCE CRITERIA

This section will be acceptable if the applicant has provided realistic estimates of atmospheric diffusion at appropriate distances from the source for routine releases of radioactive materials to the atmosphere. Guidelines for acceptability of models are presented in Regulatory Guide 1.111 and NUREG-0324 (Refs. 2 and 3); National Oceanic and Atmospheric Administration (NOAA) Technical Memorandum ERL ARL-42 (Ref. 4); standard references such as "Meteorology and Atomic Energy - 1968" (Ref. 5); and Effluent Treatment Systems Branch and Radiological Assessment Branch guides (Refs. 6 and 7). The staff makes an independent evaluation of atmospheric diffusion estimates based on data from the onsite meteorological measurements program and other nearby meteorological data. It is not necessary for the applicant to duplicate the staff's estimates. However, the applicant's diffusion estimates should reasonably reflect

staff positions and general atmospheric diffusion knowledge. Specifically, the following information is required:

1. The atmospheric diffusion models used by the applicant to calculate concentrations resulting from routine airborne releases of radioactive gases must be documented in detail and substantiated so that the staff can evaluate their appropriateness to site and plant characteristics.

2. Meteorological data summaries to be used as input to the diffusion models may be presented in joint frequency distribution form or hour-by-hour listings. These summaries (or listings) must have been generated from the best available annual periods of data on record and contain data acceptable to the staff which represent appropriate hourly values of wind direction, wind speed, and atmospheric stability for each mode of routine release.

3. The atmospheric diffusion parameters, such as vertical plume spread (σ_z) as a function of distance and wind speed, must be related to measured meteorological parameters and be substantiated as to their validity for use in estimating the consequences of routine releases from the site boundary to a radius of 50 miles from the plant.

4. Relative concentration (X/Q) and relative deposition (D/Q) values used for assessment of consequences of routine radioactive gas releases must be presented as described in Section 2.3.5.2 of the "Standard Format and Contents of Safety Analysis Reports for Nuclear Power Plants" (Reference 8).

III. REVIEW PROCEDURES

1. Atmospheric Diffusion Models

The applicant's diffusion models are compared to the general Gaussian models which are contained in Regulatory Guide 1.111 (Ref. 2) for elevated releases and ground level releases with a wake correction (see also Ref. 4). The suitability of the models for mode of release, plant configuration, and site topography are reviewed. ETSB defines the modes of release to be considered.

A determination is made as to whether the release should be considered as an elevated point source, a partially-elevated release, or a ground level point source with a volumetric correction for turbulent mixing in the wake of buildings using the criteria presented in Regulatory Guide 1.111.

If a site is located such that the effluent trajectories (or vertical plume spread via diffusion) are restricted by topography (or unusual meteorological conditions), the models are examined for appropriate modification. Some of these conditions are narrow, deep valleys, "fumigation" from elevated sources, low level subsidence inversions of temperature in the vertical direction, and land-sea (lake) breeze regimes.

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2. Meteorological Data Summaries

The data summaries in joint frequency distribution form or hourly listings are reviewed for compatibility of data with the models utilized in the section above. General criteria are stated in Regulatory Guide 1.23 and III.2 of SRP Section 2.3.3.

3. Atmospheric Diffusion Parameters

The vertical plume spread parameter, σ_z as a function of distance and atmospheric stability, is reviewed. The current procedure is to relate σ_z (x) to vertical temperature difference classes as stated in Table 1 of Regulatory Guide 1.23 (Ref. 2). Departures from this procedure are reviewed for adequate reasons for the departures, such as in the case of unusual sites (e.g., valley or coastal). The curves of σ_z with distance are presented in Regulatory Guide 1.111.

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 and completeness of information.

An independent calculation of annual average X/Q and D/Q values is made for 16 radial sectors from the site boundary to a distance of 50 miles from the plant, as well as for specific receptor locations, using appropriate meteorological data in joint frequency distribution form and the computer program XOQDOQ (Ref. 3). 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 made through use of other offsite meteorological data when unusual topographic conditions surround the site or when the onsite meteorological data are found to be inadequate.

IV. EVALUATION FINDINGS

The reviewer verifies that adequate atmospheric diffusion 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. If adequate onsite meteorological data are not available for the construction permit review, the reviewer must assure that adequate conservatism has been applied to the calculated relative concentrations for routine airborne effluent releases based on available data. 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 has concluded that representative atmospheric diffusion conditions have been calculated at the potential receptor points."

The input to the Safety Evaluation Report will also include a brief 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.

V. REFERENCES

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

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

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

4. J. F. Sagendorf, "A Program for Evaluating Atmospheric Dispersion From a Nuclear Power Station," Technical Memorandum ERL ARL-42, National Oceanic and Atmospheric Administration (1974).

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

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

7. 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."

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

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