RS-002, "PROCESSING APPLICATIONS FOR EARLY SITE PERMITS"

ATTACHMENT 2

2.3.5 LONG-TERM DIFFUSION ESTIMATES

REVIEW RESPONSIBILITIES

Primary - Probabilistic Safety Assessment Branch (SPSB)

Secondary - Equipment and Human Performance Branch (IEHB)

I. AREAS OF REVIEW

For this section of the site safety assessment for an early site permit application, 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.

Annual average X/Q and D/Q values at standard distances in the 16 radial sectors from the site boundary to a distance of 50 miles from the proposed site of the nuclear power plant or plants are provided to the IEHB for calculation of doses. Because little detailed information is available on design of a plant or plants that might be constructed on the proposed site at the early site permit stage, identification of release points, release characteristics, and locations of specific receptors of interest will be addressed at the combined license (COL) stage.

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).

Regulatory Guide 1.111 (Ref. 2) provides acceptable criteria for characterizing atmospheric transport and diffusion conditions for evaluating the consequences of routine releases. Use of the model described in NUREG/CR-2919 (Ref. 3) is acceptable.

Specifically, the following information should be provided by the applicant in the safety assessment :

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 characteristics, plant characteristics (to the extent known), 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 site.

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 site. (See Section 2.3.3 of this review standard for data acceptability criteria, and see Regulatory Guide 1.23 (Ref. 4) 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. 5).

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 (to the extent known), and release characteristics. Additional information for determining model suitability may be found in standard references such as "Meteorology and Atomic Energy - 1968" (Ref. 6).

The staff performs an independent evaluation of long-term dispersion characteristics. Using the criteria presented in Regulatory Guide 1.111, each release is classified as completely elevated or completely ground level. Turbulent mixing of the effluent into the wake of plant structures is considered where appropriate and feasible given information available about plant design in accordance with Regulatory Guide 1.111.

Because little detailed information is available on plant design at the early site permit stage, any releases characterized as partially elevated or intermittent will be evaluated at the combined license (COL) stage.

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-CR-2919. 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/CR-2919.

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. 7 and 8) 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 characteristics, plant characteristics (to the extent known), 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. 9) and large bodies of water (see Ref. 10).

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 site. General criteria for collection and presentation of onsite meteorological data are stated in Regulatory Guide 1.23 and in Section 2.3.3 of this review standard, subsection III.2. If adequate onsite meteorological data are not available, the reviewer must ensure that adequate conservatism is applied to prevent significant underestimates of airborne concentrations and amount of material deposited.

4. Relative Concentrations Used for Routine Releases

The relative concentration (X/Q) and relative deposition (D/Q) values used for assessment of the consequences of routine radioactive releases are reviewed for appropriateness to site conditions, plant configuration (to the extent known), 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 site. Adjustments of the X/Q and D/Q output may be necessary to reflect consideration of unusual site and/or meteorological conditions.

Annual average X/Q and D/Q values at standard distances in the 16 radial sectors from the site boundary to a distance of 50 miles from the plant site are provided to the IEHB 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 reviewer's evaluation must support the following type of concluding statement, to be included in the staff's Safety Evaluation Report:

> As set forth above, the applicant has provided meteorological data and an atmospheric dispersion model that is appropriate for the characteristics of the site and release points. Therefore, the staff concludes that representative atmospheric transport and diffusion conditions have been calculated for 16 radial sectors from the site boundary to a distance of 50 miles from the site. 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.
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> Atmospheric transport and diffusion from specific release points having specific release characteristics, as well as specific locations of receptors of interest, will be evaluated at the combined license (COL) stage.

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 section of this review standard.

This section will be used by the staff when performing safety evaluations of early site permit applications submitted by applicants pursuant to 10 CFR Part 52. 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 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents In Routine Releases From Light-Water-Cooled Reactors."

3. NUREG/CR-2919, "XOQDOQ: Computer Program for the Meteorological Evaluation of Routine Effluent Releases at Nuclear Power Stations" (September 1982).

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

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

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

7. 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).

8. F. 0. 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).

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

10. 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).