Enclosure

Regulatory Guide Periodic Review

Regulatory Guide Number:	**1.111**
Title:	**Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors**
Office/division/branch:	**NRO/DSEA/RHMB**
Technical Lead:	**Michael Mazaika**
Recommended Staff Action:	**Reviewed with issues identified for future consideration**

1. What are the known technical or regulatory issues with the current version of the Regulatory Guide (RG)?

RG 1.111 provides guidance for two general purposes:

- Establishing site atmospheric dispersion characteristics and parameters as part of the Early Site Permit (ESP), Combined License (COL), and Design Certification (DC) application processes pursuant to 10 CFR 100.21(c)(1) requirements that airborne radiological effluent release limits associated with normal operation can be met for any individual located offsite.

- Determining X/Q and D/Q values for use in an operating plant's Offsite Dose Calculation Manual (ODCM). The ODCM establishes a facility's methodology for estimating the maximum potential annual radiation doses to the public from radioactive releases in compliance with the requirements in 10 CFR 50.36a "Technical specifications on effluents from nuclear power reactors."

RG 1.111 was first issued in March 1976. A January 1977 Errata Notice identified an error in the plume depletion and deposition curves provided with that guidance. That notice, including guidance to utilize the corrected curves in future assessments of potential annual radiation doses to the public resulting from routine releases of radioactive materials in gaseous effluents, was made part of Revision 1 when issued for comment in July 1977. The "for comment" version of Revision 1 remains the de facto current guidance.

Many licensees from among the existing fleet and applicants for new reactors base their annual average (or long-term) X/Q and D/Q analyses of routine releases following the constant mean wind direction modeling approach using the NRC-endorsed XOQDOQ dispersion model. The XOQDOQ model, which implements many of the regulatory positions discussed in Revision 1 to RG 1.111, is over 30 years old and like the PAVAN dispersion model and RG 1.145, "Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants," relies on dated dispersion algorithms.

Integral to developing a draft update to RG 1.111 are three objectives:

- revision of the current version of the computer code XOQDOQ;
- developing a corresponding technical basis document and/or user's guidance;

  and

- integrating relevant aspects of the design and method of execution of the revised dispersion model (including endorsement, as appropriate, of the model and its provisions) with other regulatory and procedural guidance into RG 1.111.

Issues and items expected to be addressed in the scope of revisions to RG 1.111 and the XOQDOQ dispersion model can be categorized as follows: (1) general technical and administrative; (2) specific to meteorological input data; (3) specific to model provisions and modeling assumptions; (4) requiring input from other internal stakeholders; and (5) items for discussion with the contractor.

General technical issues and items include, but are not limited to: a need to provide a Windows-based operating system and graphical user interface to replace the original, main-frame based coding; a need to identify and address potential compatibility issues between the XOQDOQ computer code when revised (or an alternative dispersion model, if chosen) and a commercially available version included as part of the NRCDose© suite of codes used to implement RG 1.109, "Calculation of Annual Doses to Man from Routine Release of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," (not known if the XOQDOQ code is checked by NRC when that part of the NRCDose© package is updated by the vendor); and a need to evaluate the extent to which revisions to XOQDOQ and RG 1.111 will take into consideration the modeling criteria specified in the recently issued standard ANSI/ANS-2.15-2013, "Criteria for Modeling and Calculating Atmospheric Dispersion of Routine Radiological Releases from Nuclear Facilities." Lessons-learned from the update of the PAVAN dispersion model (in process) need to be considered as well.

Administrative issues and items to be addressed in the revision of RG 1.111 include, but are not limited to: updating references (some of which may no longer be applicable) and regulatory citations (some of which are no longer valid); defining terminology; considering the need to address the scope of NRC approval or acceptance of non-NRC endorsed dispersion models; and recognizing the need to update other related guidance documents and, if necessary, developing related interim staff guidance.

Issues and items specific to meteorological input data include, but are not limited to: using hourly data instead of joint frequency distribution summaries; clarifying acceptable period(s) of record; and discussing potential implications of using non-sequential data sets. The current guidance mentions situations where it is appropriate to account for wet deposition effects although the current dispersion model has no such provisions. In that regard, the revised guidance should clearly address related terminology (e.g., a well-defined rainy season, grazing and growing seasons), the possible use of seasonal as opposed to, or in addition to, annual data sets, whether and how to select and use data from hourly precipitation measurement stations over the 50-mile radius modeling domain, and the possible need for different deposition rates by precipitation type.

Issues and items specific to model provisions and modeling assumptions include, but are not limited to: deciding whether other regulatory dispersion models (e.g., U.S. Environmental Protection Agency codes) or certain algorithms from those codes might be acceptable substitutes or alternative approaches for the XOQDOQ dispersion model; need for improvements in building wake entrainment and enhanced dispersion effects; accounting for plume dispersion and transport direction under calm wind conditions; the handling of potential recirculation effects on dispersion due to terrain; need to re-affirm the methodology used to account for diffusion due to mixed mode releases; guidance on handling routine releases not exhausted in a vertical (upward) direction; and a need to reconcile or justify different definitions between RG 1.111 and RG 1.145 for what constitutes an elevated (or stack) release.

Issues and items requiring input from other internal stakeholders (e.g., health physics Staff) include, but are not limited to: determining whether to retain the 2.26- and 8.0-day radioactive decay removal mechanism for short-lived noble gases and iodines given much shorter plume travel times out to 50 miles even under low wind speed conditions; handling of dispersion calculations for intermediate (purge) releases and any implications of basing such analyses on hourly data rather than annual average conditions; and determining whether deposition over large bodies of water represents a potentially significant dose pathway and, if so, methodologies and data needs for handling such scenarios.

Issues and items for discussion with and feedback from the contractor tasked to update the XOQDOQ model include, but are not limited to: considering whether a straight-line model should be used for site boundary and maximum exposed individual receptors within 5 miles (unless complex topography is present) and a variable trajectory model between 5 and 50 miles downwind; evaluating potential discontinuities in calculations near that transition distance; and reconciling potential differences between the plume depletion and deposition curves in Revision 0 of RG 1.111 and the curves presented in the Errata Notice included in the “for comment” version of Revision 1.

2. What is the impact on internal and external stakeholders of <u>not</u> updating the RG for the known issues, in terms of anticipated numbers of licensing and inspection activities over the next several years?

There are no large power reactor license applications anticipated in the near future (next 3 to 5 years). Thus, there is no immediate need for revising RG 1.111 at this time to address their licensing. For small modular reactors, as of March, 2014, four applications are anticipated in the next two years. Two will be design certification applications, one a construction permit application, and one a combined operating license application. Due to the small size and design of the small modular reactors atmospheric dispersion is not expected to be a significant licensing issue. Therefore, the existing version of RG 1.111 (and the XOQDOQ dispersion model which implements a number of its regulatory positions) will continue to be useful.

3. What is an estimate of the level of effort needed to address identified issues in terms of full-time equivalent (FTE) and contractor resources?

Estimates from DSEA technical staff are for a total of 2,160 hours over a timeframe of 24 months. Expect need for RES or contractor support. Estimate 80 hours of DSEA technical staff effort to support RES and review final product. Deliverable is a draft version of RG 1.111 for further processing by RES.

4. **Based on the answers to the questions above, what is the staff action for this guide (Reviewed with no issues identified, Reviewed with issues identified for future consideration, Revise, or Withdraw)?**

Reviewed with issues identified for future consideration.

5. Provide a conceptual plan and timeframe to address the issues identified during the review.

Start in FY 2016, Quarter 1.

NOTE: This review was conducted in March 2014 and reflects the staff's plans as of that date. These plans are tentative and subject to change.