American Nuclear Society

criteria for modeling and calculating atmospheric dispersion of routine radiological releases from nuclear facilities

an American National Standard

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American National Standard
Criteria for Modeling and Calculating Atmospheric Dispersion of Routine Radiological Releases from Nuclear Facilities

Secretariat
American Nuclear Society

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Foreword

(This Foreword is not a part of American National Standard "Criteria for Modeling and Calculating Atmospheric Dispersion of Routine Radiological Releases from Nuclear Facilities," ANSI/ANS-2.15-2013.)

Atmospheric dispersion modeling is the mathematical simulation of atmospheric processes involving the release, transport, diffusion, and fate of airborne pollutants. Computer programs and systems that implement atmospheric dispersion modeling have been in widespread use for decades. As a result, there are many common practices among model users. However, a national standard does not exist that provides criteria for model selection and use for different types of modeling applications (e.g., assessment of annual releases, accidental release events) or for different types of modeling domains (e.g., flat terrain, mountain/valley areas, water/land environments). Instead, atmospheric dispersion modeling practices are often based on a diverse set of regulatory guidance and other documents that date from the 1970s and 1980s.

Since the publication of these guidance documents, considerable advances have occurred in our understanding of the atmospheric processes that govern the transport, diffusion, and deposition of atmospheric pollutants. Dramatic improvements in computer technologies have resulted in the significant increase in computational processing speeds and information sharing capabilities of available models. Also, technological advances have occurred in the areas of meteorological monitoring, data collection, and data sharing that can greatly expand the capabilities of atmospheric dispersion models. As a result of these changes, atmospheric dispersion modeling selection and usage practices need to be updated to incorporate the scientific and technological enhancements, improve modeling results, and support greater consistency among model users.

Subject matter experts from the Nuclear Utilities Meteorological Data User's Group, the U.S. Department of Energy's Meteorological Coordinating Council, and other organizations began working together in 2004 to define and standardize practices that can be used to address the atmospheric dispersion modeling of radiological releases from nuclear facilities. The working group decided that several standards were needed, based on end-use considerations:

- ANS-2.15, addressing atmospheric dispersion modeling of routine releases;
- ANS-2.16, addressing atmospheric dispersion modeling of design-basis accidents;
- ANS-3.8.10, addressing atmospheric dispersion modeling of accidental releases for emergency response.

This document, on the modeling of routine releases, is the first of these dispersion modeling standards. The working group decided to create all three standards in sequence to take advantage of their similarities, to achieve consistency among the standards, and to incorporate the lessons learned from one in preparing the next.

This standard might reference documents and other standards that have been superseded or withdrawn at the time the standard is applied. A statement has been included in the references section that provides guidance on the use of references.

This standard does not incorporate the concepts of generating risk-informed insights, performance-based requirements, or a graded approach to quality assurance. The user is advised that one or more of these techniques could enhance the application of this standard.

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Criteria for Modeling and Calculating Atmospheric Dispersion of Routine Radiological Releases from Nuclear Facilities

1 Introduction and scope

In the decades prior to this standard, significant enhancements have been made in the area of atmospheric dispersion modeling. Considerable advances have occurred in our understanding of atmospheric processes that play a key role in the transport, dispersion, and deposition of atmospheric contaminants. In addition, dramatic advances in computer technologies have resulted in a significant increase in computational processing speeds and capabilities. Calculations that would have taken days or weeks of computation resources on a mainframe computer can now be completed in minutes on an inexpensive personal computer. Graphical displays of information that required hand drawing by graphics specialists are now available through the use of geographical information system (GIS) software.

In addition to the advances in modeling, technological advances have occurred in the areas of meteorological monitoring and data sharing. New digital instrumentation allows for the measurement of atmospheric parameters that were not previously measurable on a routine and widespread basis (e.g., direct measurements of turbulence). Remote monitoring, satellite measurements, and numerical modeling of meteorological parameters provide new suites of data for atmospheric dispersion modeling. More data are available in real time or close to real time from meteorological monitoring stations that were not accessible in the past. Radiotelemetry, cellular networks, and the Internet provide routine access to new sources of data.

The purpose of this document is thus to establish criteria for evaluating the atmospheric effects of routine radioactive releases at or beyond the facility site boundary. The criteria incorporate the numerous advances in technical capabilities, computer technology, data access, and information sharing.

This document begins by describing a common modeling process that explicitly defines requirements and quality assurance (QA) elements and then examines the need for more complex, variable-trajectory modeling. Ensuing document sections contain criteria for the selection of dispersion model types, relevant timescales, release modes, and removal mechanisms. The remaining sections contain criteria for geospatial data, meteorological data, meteorological networks, and finally QA. Several appendices provide additional information to help the reader choose modeling parameters.

2 Acronyms and definitions

2.1 List of acronyms[1)]

BPIPPRM: Building Profile Input Program for PRIME

DEM: Digital Elevation Model

EPA: U.S. Environmental Protection Agency

GEP: Good Engineering Practice

GIS: geographical information system

MCF: model correction factor

NRC: U.S. Nuclear Regulatory Commission

NWS: National Weather Service

PG: Pasquill-Gifford

QA: quality assurance

[1)] This listing of acronyms applies to the standard and to the appendices.