ERRATUM ISSUED
(See next page)

American Nuclear Society

REAFFIRMED
December 23, 2010
ANSI/ANS-3.11-2005
(R2010)

determining meteorological information at nuclear facilities

an American National Standard

WITHDRAWN
August 20, 2015
ANSI/ANS-3.11-2005
(W2015)

No longer being maintained as an American National Standard. This standard may contain outdated material or may have been superseded by another standard. Please contact the ANS Standards Administrator for details.

ANSI/ANS-3.11-2005

published by the
American Nuclear Society
555 North Kensington Avenue
La Grange Park, Illinois 60526 USA

ERRATUM

ANSI/ANS-3.11-2005 (R2010)
"Determining Meteorological Information at Nuclear Facilities"

A typographical error was identified in ANSI/ANS-3.11-2005 (R2010), "Determining Meteorological Information at Nuclear Facilities." The standard incorrectly cites EPA-**450**/R-99-005, "Meteorological Monitoring Guidance for Regulatory Modeling Applications." The title is correct, but the report number is incorrect. The correct citation is EPA-**454/**R-99-005, "Meteorological Monitoring Guidance for Regulatory Modeling Applications," U.S. Environmental Protection Agency (2000). The error was found in the following three references:

Section 8, Reference [6], page 16

Appendix C, Reference [C.1], page 24

Appendix E, Reference [E.1], page 28

A copy of EPA-454/R-99-005 is available at http://www3.epa.gov/scram001/guidance/met/mmgrma.pdf (current as of 8/8/15).

ANSI/ANS-3.11-2005

American National Standard for Determining Meteorological Information at Nuclear Facilities

Secretariat
American Nuclear Society

Prepared by the
American Nuclear Society
Standards Committee
Working Group ANS-3.11

Published by the
American Nuclear Society
555 North Kensington Avenue
La Grange Park, Illinois 60526 USA

Approved December 22, 2005
by the
American National Standards Institute, Inc.

American National Standard

Designation of this document as an American National Standard attests that the principles of openness and due process have been followed in the approval procedure and that a consensus of those directly and materially affected by the standard has been achieved.

This standard was developed under procedures of the Standards Committee of the American Nuclear Society; these procedures are accredited by the American National Standards Institute, Inc., as meeting the criteria for American National Standards. The consensus committee that approved the standard was balanced to ensure that competent, concerned, and varied interests have had an opportunity to participate.

An American National Standard is intended to aid industry, consumers, governmental agencies, and general interest groups. Its use is entirely voluntary. The existence of an American National Standard, in and of itself, does not preclude anyone from manufacturing, marketing, purchasing, or using products, processes, or procedures not conforming to the standard.

By publication of this standard, the American Nuclear Society does not insure anyone utilizing the standard against liability allegedly arising from or after its use. The content of this standard reflects acceptable practice at the time of its approval and publication. Changes, if any, occurring through developments in the state of the art, may be considered at the time that the standard is subjected to periodic review. It may be reaffirmed, revised, or withdrawn at any time in accordance with established procedures. Users of this standard are cautioned to determine the validity of copies in their possession and to establish that they are of the latest issue.

The American Nuclear Society accepts no responsibility for interpretations of this standard made by any individual or by any ad hoc group of individuals. Requests for interpretation should be sent to the Standards Department at Society Headquarters. Action will be taken to provide appropriate response in accordance with established procedures that ensure consensus on the interpretation.

Comments on this standard are encouraged and should be sent to Society Headquarters.

Published by

American Nuclear Society
555 North Kensington Avenue
La Grange Park, Illinois 60526 USA

Printed in the United States of America

Foreword

(This Foreword is not a part of the American National Standard, "Determining Meteorological Information at Nuclear Facilities," ANSI/ANS-3.11-2005, but is included for information purposes only.)

Meteorological data collected at nuclear facilities play an important role in determining the effects of radiological effluents on workers, facilities, the public, and the environment. Accordingly, meteorological program design is normally based on the needs and objectives of the facility and the guiding principles for making accurate and valid meteorological measurements. The American National Standard, "Determining Meteorological Information at Nuclear Power Sites," ANSI/ANS-2.5-1984, R1990;W2000, was issued in 1984 to address nuclear power facility meteorological data acquisition programs. ANSI/ANS-2.5-1984, R1990; W2000 was referenced by second proposed Revision 1 to Regulatory Guides 1.23, "Meteorological Measurement Program for Nuclear Power Plants." ANSI/ANS-2.5-1984 was, however, narrowly focused on commercial nuclear power plant siting considerations and did not provide much guidance on meteorological data application from startup to operations to decommissioning (i.e., life cycle).

In 1996, the Nuclear Utility Meteorological Data Users Group and the U.S. Department of Energy (DOE) Meteorological Coordinating Council undertook comprehensive reviews of the applicability of ANSI/ANS-2.5-1984, R1990;W2000 and recommended major refinements in the following areas:

(1) operational data applications (especially emergency preparedness) in addition to siting applications;

(2) availability of guidance for both public and private sector entities;

(3) life cycle considerations of meteorological monitoring systems;

(4) addressing the need to monitor multiple locations to acquire sufficient data for models to characterize three-dimensional flows in regions of complex terrain;

(5) inclusion of state-of-the-art meteorological monitoring equipment, including remote sensing instrumentation.

The meteorological data that are acquired, according to ANSI/ANS-2.5-1984;R1990;W2000 principles, are primarily used in supporting licensing applications of commercial nuclear power plants. More common operational applications to support protection of the health and safety of site personnel and the public, such as emergency preparedness consequence assessments and environmental compliance analyses, were not addressed since these programs had not fully matured at that time. Meteorological data required to support consequence assessments associated with emergency response differ significantly from the archived data used for climate characterization, environmental impact assessment, and compliance analysis purposes in that data must be available in *real time*. Real-time meteorological data availability may require significant upgrades to existing monitoring systems to limit data loss and to focus attention on the diurnal and seasonal effects that complex terrain, if present, have on the meteorological wind fields (and therefore plume trajectory) in the region of transport.

Nuclear facilities in the public sector and nonregulatory domains of the DOE and the U.S. Department of Defense were not represented in ANSI/ANS-2.5-1984, R1990, W2000. Government agencies resorted to issuing their own technical guidance (such as "Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance," DOE EH-0173T, in which Chapter 4 addressed meteorological measurements). The need to develop a standard that was also applicable to the public sector was enhanced by the recent DOE initiative, through its Technical Standards Program, which set a goal of operating DOE facilities under voluntary standards by 2000, in compliance with the Federal guidance contained in the Office of Management and Budget's circular OMB-119A, "Federal Participation in the Development and Use of Voluntary Consensus Standards and in Conformity Assessment Activities."

Meteorological data monitored at public sector nuclear facilities are used for

(1) routine radiological and chemical release consequence analyses;

(2) real-time consequence assessments of accidental releases of radiological and chemical species;

(3) potential environmental impacts resulting from design-basis accidents from projected new facilities or from modifications to existing facilities.

The use of meteorological data can also play an important role in various types of environmental, decontamination and decommissioning, air quality, wind loading, and engineering studies. Other uses of meteorological data include assessments of environmental remediation activities, industrial hygiene, construction, and waste management. A comprehensive meteorological monitoring system requires instrumentation that will meet the programmatic purposes for which it is intended.

Meteorological measurements are most commonly taken with in situ sensors that are mounted on towers and are directly in contact with the atmosphere. Additionally, atmospheric properties can be inferred with "remote" sensors, which emit or propagate electromagnetic or acoustic waves into the atmosphere. The criteria for upgrading a sensor include improved accuracy, durability, dependability, or a decrease in required maintenance that would increase the level of data recovery and cost-effectiveness of the measurement system while maintaining or improving appropriate measurement capabilities. When it becomes necessary to replace, upgrade, or supplement the meteorological monitoring system equipment, the most effective technology available that is appropriate to meet the objectives is normally employed. In the case where a new type of sensor replaces an existing sensor, a demonstration of the effectiveness of the new sensor is necessary before the replacement is completed (see ASTM D4430-96, "Standard Practice for Determining the Operational Comparability of Meteorological Measurements").

ANSI/ANS-3.11-2000 was developed to address life cycle issues associated with nuclear facility meteorological monitoring programs. This standard was also developed to address technological advances for in situ and remote sensing instrumentation to monitor meteorological parameters (e.g., sonic anemometers, lidar, Doppler sodar, radar wind profilers, etc.), modifications in analytical requirements, and other considerations. The aforementioned remote sensing systems provide the nuclear facility meteorologist, or meteorological program manager, with additional means to acquire sufficient data to characterize the three-dimensional wind field in the vicinity of the facility and within the region of transport. ANSI/ANS-3.11-2000 also provides additional information on instrument siting and measurement issues, based on the results of wind tunnel studies, which have given insight into the aerodynamic effects of obstacles on a local wind field.

ANSI/ANS-3.11-2000 was designed with sufficient depth and breadth to address the needs of the entire meteorological monitoring community associated with all nuclear facilities nationwide, including commercial electric generating stations and nuclear installations at federal sites, ranges, and reservations. It does not attempt to define the exact monitoring criteria for every possible type of facility or site environment. It does identify the minimum information that comprises a successful monitoring program and requires that the details of such programs be delegated to subject matter expert meteorologists who analyze each particular site and application in order to arrive at an acceptable program for that particular application.

The ANS-3.11 Working Group was reconstituted in February 2003 to evaluate the currency of the 3-yr-old standard and to determine whether it should be simply reaffirmed on its February 18, 2005, sunset or whether it needed to be updated to account for new reference standards, advances in ex situ and in situ instrumentation, advances in data management equipment and techniques, advances in meteorological program management, integration with facility programs (e.g., configuration management), and other considerations. The working group unanimously determined to update the standard, and ANSI/ANS-3.11-2005 is a result of this work. In 2008, the ANS-3.11 Working Group will again reevaluate the actions to be taken on the standard prior to its 5-yr sunset in December 2010.

The ANS-3.11 Working Group of the Standards Committee of the American Nuclear Society had the following membership:

S. Marsh (Cochair), *Southern California Edison Company*
C. Mazzola (Cochair), *Shaw Environmental & Infrastructure, Incorporated*

M. Abrams, *ABS Consulting, Incorporated*
R. Addis, *Savannah River National Laboratory*
D. Bailey, *U.S. Environmental Protection Agency*
R. Banta, *National Oceanic and Atmospheric Administration*
R. Baskett, *Lawrence Livermore National Laboratory*
R. Baxter, *T & B Systems, Incorporated*
T. Bellinger, *Illinois Emergency Management Agency*
B. Carson, *Pennsylvania Power & Light Company*
K. Clawson, *Air Resources Laboratory, Field Research Division*
J. Crescenti, *Florida Power & Light Company*
M. Duranko, *First Energy Corporation*
J. Fairobent, *National Nuclear Security Administration*
P. Fransioli, *Bechtel SAIC Company, LLC*
C. Glantz, *Pacific Northwest National Laboratory*
R. Harvey, *U.S. Nuclear Regulatory Commission*
J. Holian, *Science Applications International Corporation*
J. Irwin, *National Oceanic and Atmospheric Administration*
D. Katz, *Climatronics Corporation*
S. Krivo, *U.S. Environmental Protection Agency*
M. Parker, *Savannah River National Laboratory*
D. Pittman, *Tennessee Valley Authority*
D. Randerson, *Air Resources Laboratory, Special Operations & Research Division*
W. Schalk, *Air Resources Laboratory, Special Operations & Research Division*
R. Swanson, *Climatological Consulting Corporation*
G. Vasquez, *U.S. Department of Energy*
S. Vigeant, *Shaw Environmental & Infrastructure, Incorporated*
P. Wan, *Bechtel Power Corporation*
K. Wastrack, *Tennessee Valley Authority*
R. Yewdall, *Public Service Electric & Gas Company*

Subcommittee ANS-25, Siting, had the following membership at the time of its approval of this standard:

C. Mazzola (Chair), *Shaw Environmental & Infrastructure, Incorporated*

J. Bollinger, *Savannah River National Laboratory*
C. Costantino, *City University of New York*
P. Fledderman, *Westinghouse Savannah River Company*

K. Hanson, *Geomatrix Consultants, Incorporated*
J. Litehiser, *Bechtel Power Corporation*
S. Marsh, *Southern California Edison Company*
M. McCann, *Jack R. Benjamin Associates*
D. Ostrom, *Individual*
D. Pittman, *Tennessee Valley Authority*
R. Spence, *UT-Battelle, LLC (Oak Ridge National Laboratory)*
J. Stevenson, *J. D. Stevenson Consultants*

The Nuclear Facility Standards Committee (NFSC) had the following membership at the time of its approval of this standard:

D. J. Spellman (Chair), *Oak Ridge National Laboratory*
R. M. Ruby (Vice-Chair), *Constellation Energy Company*

W. H. Bell, *South Carolina Electric & Gas Company*
J. R. Brault, *Savannah River National Laboratory*
C. W. Brown, *Southern Nuclear Operating Company*
R. H. Bryan, Jr., *Tennessee Valley Authority*
M. T. Cross, *Westinghouse Electric Company*
T. Dennis, *Individual*
D. R. Eggett, *AES Engineering, Incorporated*
R. W. Englehart, *U.S. Department of Energy*
R. Hall, *Exelon Generation Company, LLC*
P. S. Hastings, *Duke Energy Company*
R. A. Hill, *ERIN Engineering and Research, Incorporated*
N. P. Kadambi, *U.S. Nuclear Regulatory Commission*
M. La Bar, *General Atomics Company*
E. M. Lloyd, *Exitech Corporation*
E. P. Loewen, *Idaho National Laboratory*
S. A. Lott, Los *Alamos National Laboratory*
J. E. Love, *Bechtel Power Corporation*
C. A. Mazzola, *Shaw Environmental & Infrastructure, Incorporated*
R. H. McFetridge, *Westinghouse Electric Company, LLC*
C. H. Moseley, Jr., *BWXT Y-12*
D. G. Newton, *AREVA/Framatome-ANP*
W. N. Prillaman, *Framatome-ANP*
W. B. Reuland, *Individual*
D. M. Reynerson, *Phoenix Index*
J. C. Saldarini, *Bechtel SAIC Company, LLC*
R. E. Scott, *Scott Enterprises*
S. L. Stamm, *Shaw Stone & Webster, Incorporated*
J. D. Stevenson, *J. D. Stevenson Consultants*
C. D. Thomas, *Individual*
J. A. Werenberg, *Southern Company Services*
M. J. Wright, *Entergy Operations, Incorporated*

Contents

Determining Meteorological Information at Nuclear Facilities

1 Scope

This document provides criteria for gathering and assembling meteorological information at commercial nuclear electric generating stations, U.S. Department of Energy / National Nuclear Security Administration nuclear facilities, and other national or international nuclear facilities. Meteorological data collected, stored, and displayed through implementation of this standard are utilized to support the siting, operation, and decommissioning of nuclear facilities. The meteorological data are employed in determining environmental impacts, consequence assessments supporting routine release and design-basis accident evaluations, emergency preparedness programs, and other applications.

2 Definitions

calm: Any wind speed below the starting threshold of the wind speed or direction sensor, whichever is greater.

damped natural wavelength: A characteristic of a wind vane empirically related to the delay distance and the damping ratio (see [1]).[1)]

damping ratio: Ratio of the actual damping, related to the inertial-driven overshoot of wind vanes to direction changes, to the critical damping, the fastest response where no overshoot occurs.

delay distance: The distance that air flowing past a wind vane moves while the vane is responding to 50% of the step change in the wind direction (see [1]).

gravity wave: A wave disturbance in which buoyancy acts as the restoring force on parcels displaced from hydrostatic equilibrium.

instrument system: All components from sensor to and including data recording and display. (Herein referred to as "system.")

mesoscale: The scale of atmospheric phenomena having overall horizontal dimensions from a few kilometers to several hundred kilometers.

sensor accuracy: The accuracy of the sensor used to make a meteorological measurement. Sensor accuracy can be based on manufacturer specifications, test results, or direct comparison with a standard (i.e., calibration).

shall, should, and may: The word "shall" is used to denote a requirement; the word "should" is used to denote a recommendation; and the word "may" is used to denote permission, neither a requirement nor a recommendation.

sigma phi: The standard deviation of the vertical wind direction.

sigma theta: The standard deviation of the horizontal wind direction.

stability class: A classification of atmospheric stability, or the amount of turbulent mixing in the atmosphere and its effect on effluent dispersion.

starting threshold: The minimum wind speed above which the measuring instrument is performing within its minimum specification.

survival speed: The maximum wind speed at which the sensor can operate properly.

system accuracy: The extent to which results of a calculation or the readings of an instrument approach the true values of the calculated or measured quantities. System accuracy encompasses all components of the system (i.e., sensor, data processing equipment, computer, calibrations, etc.). System accuracy is compared with applicable requirements to evaluate the adequacy of the monitoring program.

[1)]Numbers in brackets refer to corresponding numbers in Section 8, "References."