American Nuclear Society

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determining meteorological information at nuclear facilities

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American National Standard for Determining Meteorological Information at Nuclear Facilities

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American National Standard

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Foreword

(This Foreword is not a part of the American National Standard for Determining Meteorological Information at Nuclear Facilities, ANSI/ANS-3.11-2000, 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. American National Standard for Determining Meteorological Information at Nuclear Power Sites, ANSI/ANS-2.5, was issued in 1984 to address nuclear power facility meteorological data acquisition programs. However, ANSI/ANS-2.5 was 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).

The Nuclear Utility Meteorological Data Users Group (NUMUG) and the Department of Energy (DOE) Meteorological Coordinating Council (DMCC) undertook comprehensive reviews of the applicability of ANSI/ANS-2.5 and recommended major refinements in the following areas:

- Operational data applications (especially emergency preparedness) in addition to siting applications;
- Availability of guidance for both public and private sector entities;
- Life cycle considerations of meteorological monitoring systems;
- Addressing the need to monitor multiple locations to acquire sufficient data for models to characterize three-dimensional flows in regions of complex terrain; and,
- 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 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, has on the meteorological wind fields (and therefore plume trajectory) in the region of transport.

Nuclear facilities in the public sector, non-regulatory domains of the Department of Energy and the Department of Defense (DoD), were not represented in ANSI/ANS-2.5. Government agencies resorted to issuing their own technical guidance (such as *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance*, DOE EH-0173T). 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 (TSP), 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.

Meteorological data are used for:

(1) routine radiological and chemical release consequence analyses;
(2) real-time consequence assessments of accidental releases of radiological and chemical species; and,
(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, 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 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 addresses life cycle issues associated with nuclear facility meteorological monitoring programs. This standard has been 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), 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 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 is 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 but dictates 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.

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Determining Meteorological Information at Nuclear Facilities

1. Scope

This document provides criteria for gathering and assembling meteorological information at commercial nuclear electric generating stations and Department of Energy (DOE) 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 measured wind speed below the starting threshold of the wind speed or direction sensor, whichever is greater.

capable of measurement. Condition where the instrument system (i.e., sensor to recorded data) is within the channel accuracy specified in this standard.

damped natural wavelength. A characteristic of a wind vane empirically related to the delay distance and the damping ratio.

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 percent of the step change in the wind direction.

distance constant. The distance that air flows past a rotating anemometer during the time it takes the cup wheel or propeller to reach 63 percent of the equilibrium speed after a step change in wind speed.

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

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

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.

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

system. See "instrument system."

system accuracy. The accuracy to which a system provides the true value of the measured quantity as measured by a traceable National Institute of Standards and Testing (NIST) calibration system.

system calibration. An operation which determines the system accuracy and allows for correction of bias differences to meet the specifications contained in this standard.

traceability. The documented ability to trace the history, application, or location of an entity. In a calibration sense, traceability relates measuring equipment to national or international standards, primary standards, basic physical constants or properties, or reference materials. In a data collection sense, it relates calculations and data generated throughout the process back to the requirements for quality for the project (see reference [1][1]).

wind direction. The direction from which the wind is blowing. Wind direction data should be reported in degrees azimuth measured clockwise from true north and ranging from 0° to 360° (e.g., north is 0° or 360°, east is 90°, etc). See also "sigma theta."

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