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DRAFT REGULATORY GUIDE

Contact: R.B. Harvey
(301) 415-4118

DRAFT REGULATORY GUIDE DG-1164

[Third Proposed Revision 1 of Regulatory Guide 1.23 (Safety Guide 23), dated February 1972]

METEOROLOGICAL MONITORING PROGRAMS FOR NUCLEAR POWER PLANTS

A. INTRODUCTION

For stationary power reactor site applications submitted before January 10, 1997, Title 10, Section 100.10(c)(2), of the *Code of Federal Regulations* [10 CFR 100.10(c)(2)] states that meteorological conditions at the site and in the surrounding area should be considered in determining the acceptability of a site for a power reactor. As an aid in evaluating a proposed site, 10 CFR 100.11(a) states that meteorological conditions pertinent to the site should be used, along with an assumed fission product release from the core and the expected containment leak rate, to ensure that prescribed dose limits for the exclusion area and low-population zone, as defined in 10 CFR 50.2, "Definitions," are met.

For stationary power reactor site applications submitted on or after January 10, 1997, 10 CFR 100.20(c)(2) requires consideration of the meteorological characteristics of the site that are necessary for safety analysis or that may have an impact upon plant design in determining the acceptability of a site for a nuclear power plant. In addition, 10 CFR 100.21(c) requires the evaluation of site atmospheric dispersion characteristics and the establishment of dispersion parameters such that (1) radiological effluent release limits associated with normal operation from the type of facility proposed to be located at the site can be met for any individual located off site, and (2) radiological dose consequences of postulated accidents meet the prescribed dose limits at the exclusion area and low-population zone distances set forth in 10 CFR 50.34(a)(1).

The "General Design Criteria [GDC] for Nuclear Power Plants" set forth in Appendix A to 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," establish minimum requirements for the principal design criteria for water-cooled nuclear power plants. Specifically, GDC 19, "Control Room," of Appendix A requires that a control room be provided from which actions can be taken to operate the nuclear power unit safely under normal conditions and to maintain it in a safe condition under accident conditions. Adequate radiation protection must be provided to permit access to and occupancy of the control room for the duration of accident conditions. For plants that use alternate source terms, 10 CFR 50.67(b)(2)(iii) provides similar criteria. Atmospheric dispersion estimates are significant inputs in assessments performed to demonstrate compliance with this requirement.

In 10 CFR Part 50, Paragraphs 50.47(b)(4), 50.47(b)(8), and 50.47(b)(9), as well as Section IV.E.2 of Appendix E, "Emergency Planning and Preparedness for Production and Utilization Facilities," require each applicant for an operating license or combined license to describe its plans for coping with radiological emergencies. These plans must include provisions for equipment for determining the magnitude and continuously assessing the impact of the release of radioactive materials to the environment. These plans must also include a standard emergency classification and action level scheme for determining minimum initial offsite response measures. In addition, if plant meteorological program parameters (i.e., wind speed, wind direction, and an indicator of atmospheric stability) are available on in-plant computer systems, they must be made available in a digital data stream to the Emergency Response Data System (ERDS) maintained by the U.S. Nuclear Regulatory Commission (NRC), pursuant to Section VI of Appendix E to 10 CFR Part 50.[1] In this regard, it is necessary for the applicant to establish and maintain a meteorological program capable of rapidly assessing critical meteorological parameters.

In addition, in 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," provides numerical guidance for the design objectives of equipment intended to control releases of radioactive material in effluents from nuclear power reactors. An assessment of the maximum potential annual radiation dose to the public resulting from the routine release of radioactive materials in gaseous effluents is required to assist in demonstrating that operations will be or are being conducted within the limits of 10 CFR Part 20, "Standards for Protection Against Radiation," and Appendix I to 10 CFR Part 50 and to ensure that effluent control equipment design objectives and proposed operating procedures meet the Commission's requirements for keeping levels of radioactive material in effluents to unrestricted areas as low as practicable. In addition, 10 CFR 50.36a(a)(2) requires nuclear power plant licensees to submit a report to the Commission annually that specifies the quantity of each of the principal radionuclides released to unrestricted areas in liquid and gaseous effluents during the previous 12 months, including any other information that the Commission may need to estimate maximum potential annual radiation doses to the public resulting from effluent releases. A knowledge of meteorological conditions in the vicinity of the reactor is important to provide the basis for estimating maximum potential annual radiation doses resulting from radioactive materials released in gaseous effluents.

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[1] The ERDS is a direct, near-real-time electronic data link between the licensee's onsite computer system and the NRC Operations Center that provides for the automated transmission of a limited data set of selected plant parameters in the event of a radiological emergency.

In order for the Commission to fulfill its responsibilities under the National Environmental Policy Act of 1969, as amended, and in accordance with the requirements of Subpart A, "National Environmental Policy Act — Regulations Implementing Section 102(2)," of 10 CFR Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions," basic meteorological information must be available for use in assessing (1) the environmental effects of radiological and nonradiological emissions and effluents resulting from the construction or operation of a nuclear power plant and (2) the benefits of design alternatives.

Thus, each nuclear power plant site has multiple needs for an onsite program to measure and document basic meteorological data. These data may be used to develop atmospheric transport and diffusion parameters that, with appropriate atmospheric dispersion models, may be used to estimate potential radiation doses to the public resulting from actual routine or accidental releases of radioactive materials to the atmosphere or to evaluate the potential dose to the public and control room as a result of hypothetical reactor accidents. These data may also be used to assess nonradiological environmental effects resulting from the construction or operation of a nuclear power plant, such as the impacts of the plant's heat dissipation system. This regulatory guide describes a suitable onsite program to provide meteorological data needed to estimate these potential impacts.

The NRC issues regulatory guides to describe to the public methods that the staff considers acceptable for use in implementing specific parts of the agency's regulations, to explain techniques that the staff uses in evaluating specific problems or postulated accidents, and to provide guidance to applicants. Regulatory guides are not substitutes for regulations, and compliance with regulatory guides is not required. The NRC issues regulatory guides in draft form to solicit public comment and involve the public in developing the agency's regulatory positions. Draft regulatory guides have not received complete staff review and, therefore, they do not represent official NRC staff positions.

This regulatory guide contains information collections that are covered by the requirements of 10 CFR Parts50 and 52, which the Office of Management and Budget (OMB) has approved under OMB control numbers 3150-0011 and 3150-0151, respectively. The NRC may neither conduct nor sponsor, and a person is not required to respond to, an information collection request or requirement unless the requesting document displays a currently valid OMB control number.

B. DISCUSSION

An onsite meteorological measurements program at a nuclear power plant site should be capable of providing the meteorological information needed to make the following assessments:

- a conservative assessment by both the applicant and the regulatory staff of the potential dispersion of radioactive material from, and the radiological consequences of, design-basis accidents to aid in evaluating the acceptability of a site and the adequacy of engineered safety features for a nuclear power plant in accordance with 10 CFR Part 100 criteria[2]
- an assessment by both the applicant and the regulatory staff of the maximum potential annual radiation dose to the public resulting from the routine release of radioactive materials in gaseous effluents to assist in demonstrating that operations will be or are being conducted within the limits of 10 CFR Part 20 and Appendix I to 10 CFR Part 50, and to ensure that effluent control equipment design objectives and proposed operating procedures meet the Commission's requirements for keeping levels of radioactive material in effluents to unrestricted areas as low as practicable[3]
- a conservative assessment by both the applicant and the regulatory staff of the habitability of the control room during postulated design-basis radiological accidents and hazardous chemical releases to demonstrate that the control room can remain occupied under accident conditions in accordance with GDC 19[4]
- a near-real-time ongoing assessment by the licensee of atmospheric transport and diffusion immediately following an accidental release of airborne radioactive materials to provide input to the evaluation of the consequences of radioactive releases to the atmosphere and to aid in the implementation of emergency response decisions in accordance with the requirements in Appendix E to 10 CFR Part 50
- an assessment by the licensee of natural phenomena being experienced or projected beyond usual levels (e.g., high winds) for the purposes of emergency classification in accordance with 10 CFR 50.47(b)(4) and Section IV.B of Appendix E to 10 CFR Part 50

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[2] Regulatory Guide 1.145, "Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants," Revision 1, issued November 1982, provides specific guidance on atmospheric dispersion modeling for evaluating the potential offsite radiological consequences of design-basis reactor accidents.

[3] Regulatory Guide 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors," Revision 1, issued July 1977, provides specific guidance on atmospheric dispersion modeling for evaluating the potential offsite radiological consequences of routine releases from power reactors.

[4] Regulatory Guide 1.194, "Atmospheric Relative Concentrations for Control Room Radiological Habitability Assessments at Nuclear Power Plants," issued June 2003, provides specific guidance on atmospheric dispersion modeling for design-basis control room radiological habitability assessment. Regulatory Guide 1.78, "Evaluating the Habitability of a Nuclear Power Plant Control Room During a Postulated Hazardous Chemical Release," Revision 1, issued December 2001, provides guidance on assessing the habitability of the control room during and after a postulated external release of hazardous chemicals.

- a realistic assessment by both the applicant and the regulatory staff of the potential dispersion of radioactive materials from, and the radiological consequences of, a spectrum of accidents to aid in evaluating the environmental risk posed by a nuclear power plant in accordance with Subpart A to 10 CFR Part 51
- a realistic assessment by both the applicant and the regulatory staff of nonradiological environmental effects, such as fogging, icing, and salt drift from cooling towers or ponds, to aid in evaluating the environmental impact of a nuclear power plant in accordance with Subpart A to 10 CFR Part 51

While the specific types of meteorological information needed differ for each of the above assessments, a single set of instruments can generally be used to obtain the basic data needed for all of them. For this reason, when establishing a meteorological program for an initial site survey, careful consideration should be given to the operational needs for meteorological information. In particular, care should be taken to locate the instrumentation where the measurements will accurately represent the overall site meteorology and, if possible, where singular topographic features and vegetation or the construction of additional structures at a later date will not significantly influence wind patterns.

The minimum amount of meteorological data needed at docketing for a construction permit is a representative consecutive 12-month period. The minimum amount of meteorological data needed at docketing for an operating license, early site permit, or combined license that does not reference an early site permit is a representative consecutive 24-month period, including the most recent 1-year period. However, 3 or more years of data are preferable and, if available, should be submitted with the application.

C. REGULATORY POSITION

This section describes a suitable onsite program to collect the basic meteorological data needed to determine the environmental impacts of the plant, perform consequence assessments supporting routine release and design-basis accident evaluations, and support emergency preparedness programs and other applications at power reactor sites.

1. Definitions

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

Dew Point: The temperature to which a given parcel of air must be cooled at constant pressure and constant water-vapor content in order for saturation to occur.

Gaussian Plume Model: A basic atmospheric dispersion model that assumes that the plume spread has a Gaussian distribution in both the horizontal and vertical directions and, therefore, uses the standard deviations of plume concentration distribution in the horizontal (σ_y) and vertical (σ_z).

Precipitation: Any of the forms of water particles, whether liquid or solid, that fall from the atmosphere and reach the ground.

Relative Humidity: The ratio of the vapor pressure to the saturation vapor pressure with respect to water.

Pasquill 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.

System Accuracy: The amount by which a measured variable deviates from a value accepted as true or standard. System accuracy encompasses all the components of the system, from sensors through processors, data recorders, and displays.

System Calibration: The process of validating the output of an observing system against known reference observations or standards.

Temperature: A measure of the hotness or coldness of the ambient air as measured by a suitable instrument.

Vertical Temperature Difference (ΔT): The measured difference in air temperature between two elevations on the same tower. It is defined as the upper level temperature measurement minus the lower level temperature measurement.

Water Equivalent: The amount of water, in inches, measured at ground level from rain and/or melted frozen precipitation (e.g., snow, freezing precipitation).

Wet-Bulb Temperature: The lowest temperature an air parcel could achieve if cooled by the release of latent heat caused by evaporation of all its available moisture. The bigger the difference between the actual temperature (or dry-bulb temperature) and the wet-bulb temperature, the relatively drier the air.

Wind Direction: The direction from which the wind is blowing. Wind direction is 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.).

Wind Speed: The rate at which air is moving horizontally past a given point.

2. Meteorological Parameters

This section discusses the criteria for a basic meteorological monitoring system.

Wind speed, wind direction, and vertical temperature difference should be measured on one open-lattice tower or mast. Wind speed and wind direction should be measured at heights of approximately 10 meters (33 feet) and 60 meters (197 feet) above ground level and at a representative level for releases significantly greater than 60 meters (197 feet).[5] Vertical temperature difference (ΔT) should be measured between the 10-meter (33-foot) level and 60-meter (197-foot) levels and, if necessary, between the 10-meter (33-foot) level and a higher level that is representative of diffusion conditions from release points significantly greater than 60 meters (197 feet).[6] Table 1 provides a definition of Pasquill stability classes as a function of ΔT.

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[5] The 10-meter (33-foot) level is generally accepted throughout the world as a standard meteorological reference measurement level. The 60-meter (197-foot) level generally coincides with assumptions regarding releases from light-water reactors. A measurement height other than 60 meters (197 feet) may be appropriate for those plants where the most probable atmospheric release height is other than 60 meters (197 feet).

[6] Vertical temperature difference is the preferred method for determining Pasquill stability classes at nuclear power plants for licensing purposes because it is an effective indicator for the worst case stability conditions (e.g., Pasquill stability classes E, F, and G), and certain Gaussian plume models endorsed by the NRC (such as the models referenced in Regulatory Guides 1.145 and 1.194) are based on empirically derived plume meander factors from field tracer studies that used ΔT to classify atmospheric stability. Alternative methods may be used to classify atmospheric stability if appropriate justification is provided. However, the use of alternative methods to classify atmospheric stability may require modifications of the models described in Regulatory Guides 1.145 and 1.194.

Table 1. Classification of Atmospheric Stability

Stability Classification	Pasquill Stability Category	Temperature change with height (°C/100m)
Extremely unstable	A	$\Delta T \leq -1.9$
Moderately unstable	B	$-1.9 < \Delta T \leq -1.7$
Slightly unstable	C	$-1.7 < \Delta T \leq -1.5$
Neutral	D	$-1.5 < \Delta T \leq -0.5$
Slightly stable	E	$-0.5 < \Delta T \leq 1.5$
Moderately stable	F	$1.5 < \Delta T \leq 4.0$
Extremely stable	G	$\Delta T > 4.0$

Ambient temperature should be monitored at approximately 10 meters (33 feet). Precipitation should be measured at ground level near the base of the mast or tower.[7] At sites where there is a potential for fogging or icing from the release of water vapor caused by plant operations (e.g., because of the operation of a cooling tower or cooling pond), instrumentation should be provided for measuring temperature and humidity (e.g., dew point, wet-bulb temperature, or relative humidity) at heights representative of water-vapor release.

3. Siting of Meteorological Instruments

To the extent practical, meteorological measurements should be made in locations that can provide data representative of the atmospheric conditions into which material will be released and transported. The tower or mast should be sited at approximately the same elevation as finished plant grade. Factors to be considered in selecting the appropriate measurement locations and installation of the instruments include the prevailing wind direction, the topography, and the location of manmade and vegetation obstructions.

Whenever possible, wind measurements should be made at locations and heights that avoid airflow modifications by obstructions such as large structures, trees, or nearby terrain with heights exceeding one-half the height of the wind measurement. The separation between the wind sensor and such obstructions should be 10 times the obstruction height.[8] Wind sensors should be located on top of the measurement tower or mast or extended outward on a boom to reduce airflow modification and turbulence induced by the supporting structure itself.

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[7] While routine release or design-basis accident assessments of offsite dose consequences do not typically consider precipitation, the presence or absence of precipitation and its amount are important for severe accident assessments that are included in the applicant's environmental report and the staff's environmental impact assessment pursuant to Subpart A to 10 CFR Part 51. Severe accident dose consequence computer codes, such as Version 2 of the MELCOR Accident Consequence Code System (MACCS2) (see D. Chanin and M.L. Young), account for the efficient removal of particulate radionuclides from the plume by wet deposition.

[8] For example, trees 15 meters (49 feet) in height should be no closer than 150 meters (492 feet) from the tower or mast.

Because the tower structure can affect downwind measurements, sensors on the side of a tower should be mounted at a distance equal to at least twice the longest horizontal dimension of the tower (e.g., the side of a triangular tower). The sensors should be on the upwind side of the mounting object in areas with a dominant prevailing wind direction. In areas with two distinct prevailing wind directions (e.g., mountain valleys), the sensors should be mounted in a direction perpendicular to the primary two directions.

Air temperature and humidity measurements should be made to avoid air modification by heat and moisture sources (e.g., ventilation sources, cooling towers, water bodies, large parking lots). For this reason, the tower or mast should not be located on or near permanent manmade surfaces, such as concrete or asphalt, or temporary land disturbances, such as coal piles, plowed fields, or storage areas. Temperature sensors should be mounted in fan-aspirated radiation shields to minimize the adverse influences of thermal radiation and precipitation. The aspirated temperature shields should either be pointed downward or laterally towards the north.

Precipitation gauges should be equipped with wind shields to minimize the wind-caused loss of precipitation. Where appropriate, precipitation gauges should also be equipped with heaters to measure water equivalent during freezing conditions.

4. Instrument Accuracy and Range

The time-average accuracies for digital systems should meet the criteria listed in Table 2. These accuracies are stated in terms of overall system accuracies and should include, where applicable, the errors introduced by sensors, cables, signal conditioners, temperature environments for signal conditioning and recording equipment, recorders, processors, data displays, and the data reduction process.

The instrumentation should be capable of operating over the expected range of climatic conditions based on regional climatology.

If the accuracies of the signal conditioning equipment and/or data acquisition system are sensitive to changes in temperature, they should be housed in a climate-controlled environment.

Table 2. Meteorological System Accuracies and Resolutions

Measurement	System Accuracy	Measurement Resolution
Wind Speed	±0.22 m/s (±0.5 mph) for speeds < 2.2 m/s (5 mph) ±5% for speeds ≥ 2.2 m/s (5 mph) starting threshold < 0.45 m/s (1 mph)	0.1 m/s or 0.1 mph
Wind Direction	±5 degree starting threshold < 0.45 m/s (1 mph)	1.0 degree
Temperature	±0.5 °C (±0.9 °F)	0.1 °C or 0.1 °F
Vertical Temperature Difference	±0.1 °C (±0.18 °F)	0.01 °C or 0.01 °F
Dew Point	±1.5 °C (±0.27 °F)	0.1 °C or 0.1 °F
Wet-Bulb Temperature	±0.5 °C (±0.9 °F)	0.1 °C or 0.1 °F
Relative Humidity	±4%	0.1%
Precipitation (water equivalent)	±10% for a volume equivalent to 2.54 mm (0.1 in.) of precipitation at a rate < 50 mm/h (<2 in./h)	0.25 mm or 0.01 in.
Time	±5 min	1 min

5. Instrument Maintenance and Servicing Schedules

Meteorological instruments should be inspected and serviced at a frequency that will ensure data recovery of at least 90 percent on an annual basis.[9] The 90-percent rate applies to the composite of all variables (e.g., the joint frequency distribution of wind speed, wind direction, stability class) needed to model atmospheric dispersion for each potential release pathway. In addition, the 90-percent rate applies individually to the other meteorological parameters.

Channel operability checks should be performed daily and channel calibrations should be performed semiannually, unless the operating history of the equipment indicates that either more or less frequent calibration is necessary. System calibrations should encompass entire data channels and may be performed by a series of sequential, overlapping, or total channel steps such that each channel from sensors to recorders and displays is calibrated. Where applicable, guyed wires and anchors used to support guyed towers should be inspected annually.

6. Data Reduction and Compilation

Meteorological monitoring systems should use electronic digital data acquisition systems as the primary data recording system. Data may be recorded and displayed in either English units (e.g., miles per hour, degrees Fahrenheit, inches) or metric units (e.g., meters per second, degrees Celsius, millimeters) and should meet the resolution criteria listed in Table 2.

[9] The use of redundant sensors and/or recorders is an acceptable approach to achieve the 90-percent data recovery goal.

A backup recording system (either analog or digital) may be used to provide a high assurance of valid data. Where analog data recording systems are used, wind speed and wind direction should be recorded on continuous trace strip charts. Other variables may be recorded on multipoint charts with a sampling rate of at least once per minute.

The basic data should be compiled and archived as hourly values for use in historical climatic and dispersion analyses. Digital hourly values should consist of a sampling of data at intervals no longer than 60 seconds, and the mean values for the accumulated data should be determined using no less than 30 instantaneous values spaced equally over not less than a 15-minute period. The hourly values may be generated by using one 15-minute value per hour (if the same 15-minute period is used each hour) or by averaging all of the 15-minute values recorded during the hour. For precipitation, the hourly value should represent the total amount of precipitation (water equivalent) measured during the hour. Hourly maximum wind speed gust values may also be archived for use in the analysis of wind loading for the design of buildings and other structures. Appendix A shows the format for the electronic copy of the hourly database that should be submitted as a supplement to the application.

The basic data should also be compiled into annual joint frequency distributions of wind speed and wind direction by atmospheric stability class. Table 3 gives an example of a suitable format for data compilation and reporting purposes. Similar tables of joint frequency distribution should be prepared for each of the other atmospheric stability classes.[10]

To aid in assessing the impact of plant operation on the environment, joint frequency distribution types of data summaries should be compiled, which will permit the description of the frequency and extent of fogging and icing conditions caused by plant operation.

7. Special Considerations for Complex Terrain Sites

The plant's preoperational meteorological monitoring program should provide an adequate basis for atmospheric transport and diffusion estimates for the exclusion area distance, the outer boundary of the low-population zone, and the hypothetical maximally exposed member of the public (e.g., the site boundary and the nearest resident, vegetable garden, and milk and meat animals within 8 kilometers (5 miles) in each downwind sector).

At some sites, because of complex flow patterns in nonuniform terrain, additional wind and temperature instrumentation and more comprehensive programs may be necessary. For example, the representation of circulation for a hill-valley complex or a site near a large body of water may need additional measuring points to determine airflow patterns and spatial variations of atmospheric stability. Occasionally the unique diffusion characteristics of a particular site may also warrant the use of special meteorological instrumentation and/or studies.

The plant's operational meteorological monitoring program should provide an adequate basis for atmospheric transport and diffusion estimates within the plume exposure emergency planning zone [i.e., within approximately 16 kilometers (10 miles)].[11]

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[10] For those sites with a high frequency of low wind speeds, the joint frequency distributions of wind speed, wind direction, and atmospheric stability data should have a larger number of wind speed categories at the lower wind speeds to avoid having all the data listed in the lowest wind speed classes.

[11] For example, if the comparison of the primary and supplemental meteorological systems indicates convergence in a lake breeze setting, then a "keyhole" protective action recommendation may not be appropriate.

8. Special Considerations to Support Emergency Preparedness

In order to identify rapidly changing meteorological conditions for use in performing emergency response dose consequence assessments, 15-minute average values should be compiled for real-time display in the appropriate emergency response facilities (e.g., control room, technical support center, and emergency operations facility). The 15-minute averaged values should be calculated using at least 30 equally spaced samples. All the meteorological channels required for input to the dose assessment models should be available and presented in a format compatible for input to the models. Regulatory Guide 1.97, "Criteria for Accident Monitoring Instrumentation for Nuclear Power Plants," Revision 4, issued June 2006, provides additional criteria for the display of meteorological data in control rooms.

If the basis for any of the emergency action levels includes the monitoring of onsite meteorological conditions (e.g., the occurrence of measured hurricane-force winds onsite as a basis for declaring an Unusual Event), the tower and its instrumentation should be capable of surviving, monitoring, and displaying the meteorological condition.

If the plant computer system collects wind speed, wind direction, and atmospheric stability data, these data should be submitted as inputs to the NRC ERDS as provided for in Section VI of Appendix E to 10 CFR Part 50.

The applicant should have provisions in place to obtain representative meteorological data from alternative sources during an emergency if the site meteorological monitoring system is unavailable.

9. Documentation

The safety analysis report should document the onsite meteorological measurements program, in accordance with 10 CFR 50.34(a)(1) and 50.34(b)(1).

Table 3. Example Joint Frequency Distribution of Wind Direction, Wind Speed, and Stability Class

Site/Plant Name: _____

Extremely Stable (ΔT exceeds 4.0 °C/100 m)
Pasquill Stability Class G

Period of Record: _____

Wind Direction	Wind Speed (m/s) at __ Meter Level; ΔT between __ Meters and __ Meters											
	<0.5	0.5–1.0	1.1–1.5	1.6–2.0	2.1–3.0	3.1–4.0	4.1–5.0	5.1–6.0	6.1–8.0	8.1–10.0	>10.0	TOTAL
N												
NNE												
NE												
ENE												
E												
ESE												
SE												
SSE												
S												
SSW												
SW												
WSW												
W												
WNW												
NW												
NNW												
VARIABLE												
Total												
Number of Calms:												
Number of Missing Hours:												

Values in this table can be in counts or percent of total valid hours.

D. IMPLEMENTATION

This section provides information to applicants and licensees regarding the NRC staff's plans for using this draft regulatory guide. No backfitting is intended or approved in connection with its issuance.

The NRC has issued this draft guide to encourage public participation in its development. Except in those cases in which an applicant or licensee proposes or has previously established an acceptable alternative method for complying with specified portions of the NRC's regulations, the methods to be described in the active guide will reflect public comments and will be used in evaluating (1) submittals in connection with applications for construction permits, standard plant design certifications, operating licenses, early site permits, and combined licenses, and (2) submittals from operating reactor licensees who voluntarily propose to initiate system modifications if there is a clear nexus between the proposed modifications and the subject for which guidance is provided herein.

REGULATORY ANALYSIS

1. Statement of the Problem

The NRC issued the original version of Regulatory Guide 1.23 in February 1972 to describe a suitable onsite meteorological measurements program to collect the basic meteorological data needed to determine the environmental impacts of the plant, perform consequence assessments supporting routine release and design-basis accident evaluations, and support emergency preparedness programs and other applications at power reactor sites. That original issuance is currently the official version of Regulatory Guide 1.23. However, the NRC issued a proposed Revision 1 to Regulatory Guide 1.23 for public comment in September 1980 in response to the accident at Three Mile Island. That first proposed Revision 1 to Regulatory Guide 1.23 contained "special considerations for emergency planning," which included (1) provisions for remote interrogation of the meteorological system by the NRC and other emergency response organizations during emergency situations, and (2) a viable backup system to obtain real-time local meteorological data.

Although the NRC never officially adopted its first proposed Revision 1 of Regulatory Guide 1.23, the agency issued a second proposed Revision 1 for public comment in April 1986. That second proposed Revision 1 endorsed, with some minor exceptions, the "Standard for Determining Meteorological Information at Nuclear Power Sites," which the American National Standards Institute/American Nuclear Society (ANSI/ANS) promulgated as ANSI/ANS-2.5-1984. Although ANSI/ANS-2.5-1984 did not contain the "special considerations for emergency planning" included in the first proposed Revision 1 of Regulatory Guide 1.23, it did update other provisions of the earlier revision. Nonetheless, the NRC never officially adopted the second proposed Revision 1 of Regulatory Guide 1.23, and ANSI/ANS-2.5-1984 has since been withdrawn and is currently inactive.

The agency has now drafted a third proposed Revision 1 of Regulatory Guide 1.23 to replace the original (and still official) version of Regulatory Guide 1.23. As such, Draft Regulatory Guide DG-1164 clarifies regulatory requirements and updates regulatory guidance regarding the criteria for an onsite meteorological measurements program to collect the basic meteorological data needed to support plant licensing and operation. Compared to the original (and still official) version of Regulatory Guide 1.23, this proposed revision better reflects current regulatory requirements and best practices.

2. Objective

The objective of this regulatory action is to update the NRC's guidance with respect to the criteria for an onsite meteorological measurements program for the collection of basic meteorological data needed to support plant licensing and operation. The updated regulatory guide better reflects current regulatory requirements and best practices compared to the original (and official) version of Regulatory Guide 1.23.

3. Alternative Approaches

The NRC staff considered the following three alternative approaches to the problem of outdated guidance regarding the criteria for a suitable onsite meteorological measurements program:

(1) Do not revise Regulatory Guide 1.23.

(2) Endorse ANSI/ANS-3.11-2005, "Determining Meteorological Information at Nuclear Facilities."

(3) Update Regulatory Guide 1.23.

3.1 Alternative 1: Do Not Revise Regulatory Guide 1.23

Under this alternative, the NRC would not revise this guidance, and applicants and licensees would continue to use the original version of this regulatory guide. This alternative is considered the baseline or "no action" alternative and, as such, involves no value/impact considerations.

3.2 Alternative 2: Endorse ANSI/ANS-3.11-2005

Under this alternative, the NRC would endorse ANSI/ANS-3.11-2005. Whereas ANSI/ANS-2.5-1984 was primarily intended to support licensing applications of commercial nuclear power plants, ANSI/ANS-3.11-2005 has an expanded scope that includes nuclear installations at Federal sites, ranges, and reservations (e.g., U.S. Department of Energy and Department of Defense facilities). Because the nature and extent of the radiological and hazardous chemical materials present at Federal sites can differ significantly from similar materials present at commercial nuclear power plants, ANSI/ANS-3.11-2005 provides additional guidance beyond what the NRC considers to be basic meteorological monitoring program criteria applicable to commercial nuclear power plants. Consequently, wholesale NRC endorsement of ANSI/ANS-3.11-2005 would place unnecessary regulatory burden on NRC applicants and licensees. Partial endorsement of ANSI/ANS-3.11-2005 would be confusing.

3.3 Alternative 3: Update Regulatory Guide 1.23

Under this alternative, the NRC would update Regulatory Guide 1.23 to better reflect current regulatory requirements and best practices. The revision would use guidance provided in ANSI/ANS-3.11-2005, where appropriate, with explicit references to NRC regulatory requirements.

The benefit of this action would be the added assurance that the meteorological data collected by applicants and licensees are adequate to represent onsite meteorological conditions needed to determine environmental impacts of the plants, perform consequence assessments supporting routine release and design-basis accident evaluations, and support emergency preparedness programs and other applications at power reactor sites. Guidance would be specific to commercial nuclear power plants.

The cost to the NRC would be relatively small, limited to the one-time cost of issuing the revised regulatory guide. Applicants and licensees would incur little cost in implementing the updated guidance (compared to the current official version of Regulatory Guide 1.23) because the only additional meteorological channel specified in the third proposed Revision 1 of Regulatory Guide 1.23 is precipitation.

4. Conclusion

Based on this regulatory analysis, the staff recommends that the NRC revise Regulatory Guide 1.23. The staff concludes that the proposed action will add assurance that the meteorological data collected by applicants and licensees are adequate to represent onsite meteorological conditions.

BACKFIT ANALYSIS

This draft regulatory guide provides licensees and applicants with new guidance that the NRC staff considers acceptable for use in collecting meteorological data at nuclear power plant sites. The application of this guide is voluntary. Licensees may continue to use the original version of this regulatory guide if they so choose. No backfit, as defined in 10 CFR 50.109, "Backfitting," is either intended or implied.

REFERENCES

ANSI/ANS-2.5-1984, "Standard for Determining Meteorological Information at Nuclear Power Sites," American National Standards Institute/American Nuclear Society, 1984.[12]

ANSI/ANS-3.11-2005, "Determining Meteorological Information at Nuclear Facilities," American National Standards Institute/American Nuclear Society, 2005.[12]

D. Chanin and M.L. Young, "A Code Manual for MACCS2," NUREG/CR-6613, SAND97-0954, U.S. Nuclear Regulatory Commission, Washington, DC, May 1998.[13]

National Environmental Policy Act of 1969, Pub. L. 91-190, 42 U.S.C. 4321-4347, United States Senate and House of Representatives, Washington, DC, January 1, 1970.[14]

Regulatory Guide 1.78, "Evaluating the Habitability of a Nuclear Power Plant Control Room During a Postulated Hazardous Chemical Release," Revision 1, U.S. Nuclear Regulatory Commission, Washington, DC, December 2001.[15]

Regulatory Guide 1.97, "Criteria for Accident Monitoring Instrumentation for Nuclear Power Plants," Revision 4, U.S. Nuclear Regulatory Commission, Washington, DC, June 2006.

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[12] Copies may be purchased from the American National Standards Institute/American Nuclear Society, 555 North Kensington Avenue, La Grange Park, Illinois 60526 [phone: (708)352-6611; fax: (708)352-0499]. Purchase information is available through the ANS Web site at http://www.ans.org/store/vc-stnd.

[13] NUREG/CR-6613 was developed by Sandia National Laboratories and published by the U.S. Nuclear Regulatory Commission. Copies are also available for inspection or copying for a fee from the NRC's Public Document Room at 11555 Rockville Pike, Rockville, MD; the PDR's mailing address is USNRC PDR, Washington, DC 20555; telephone (301) 415-4737 or (800) 397-4209; fax (301) 415-3548; email PDR@nrc.gov. In addition, copies are available at current rates from the U.S. Government Printing Office, P.O. Box 37082, Washington, DC 20402-9328, telephone (202) 512-1800; or from the National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161, http://www.ntis.gov, telephone (703) 487-4650.

[14] The National Environmental Policy Act of 1969 is available electronically through the NEPAnet Web site at http://ceq.eh.doe.gov/nepa/regs/nepa/nepaeqia.htm.

[15] All regulatory guides listed herein were published by the U.S. Nuclear Regulatory Commission. Where an ADAMS accession number is identified, the specified regulatory guide is available electronically through the NRC's Agencywide Documents Access and Management System (ADAMS) at http://www.nrc.gov/reading-rm/adams.html. All other regulatory guides are available electronically through the Public Electronic Reading Room on the NRC's public Web site, at http://www.nrc.gov/reading-rm/doc-collections/reg-guides/. Single copies of regulatory guides may also be obtained free of charge by writing the Reproduction and Distribution Services Section, ADM, USNRC, Washington, DC 20555-0001, or by fax to (301)415-2289, or by email to DISTRIBUTION@nrc.gov. Active guides may also be purchased from the National Technical Information Service (NTIS)on a standing order basis. Details on this service may be obtained by contacting NTIS at 5285 Port Royal Road, Springfield, Virginia 22161, online at http://www.ntis.gov, or by telephone at (703) 487-4650. Copies are also available for inspection or copying for a fee from the NRC's Public Document Room (PDR), which is located at 11555 Rockville Pike, Rockville, Maryland; the PDR's mailing address is USNRC PDR, Washington, DC 20555-0001. The PDR can also be reached by telephone at (301) 415-4737 or (800) 397-4205, by fax at (301) 415-3548, and by email to PDR@nrc.gov.

Regulatory Guide 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors," Revision 1, U.S. Nuclear Regulatory Commission, Washington, DC, July 1977.

Regulatory Guide 1.145, "Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants," Revision 1, U.S. Nuclear Regulatory Commission, Washington, DC, November 1982 (reissued February 1983 to correct page 1.145-7).

Regulatory Guide 1.194, "Atmospheric Relative Concentrations for Control Room Radiological Habitability Assessments at Nuclear Power Plants," U.S. Nuclear Regulatory Commission, Washington, DC, June 2003.

***U.S. Code of Federal Regulations*,** Title 10, "Energy," Part 20, Standards for Protection Against Radiation."[16]

***U.S. Code of Federal Regulations*,** Title 10, "Energy," Part 50, "Domestic Licensing of Production and Utilization Facilities."

***U.S. Code of Federal Regulations*,** Title 10, "Energy," Part 50, Appendix A, "General Design Criteria for Nuclear Power Plants."

U.S. Code of Federal Regulations, Title 10, "Energy," Part 50, Appendix E, "Emergency Planning and Preparedness for Production and Utilization Facilities."

***U.S. Code of Federal Regulations*,** Title 10, "Energy," 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."

***U.S. Code of Federal Regulations*,** Title 10, "Energy," Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

***U.S. Code of Federal Regulations*,** Title 10, "Energy," Part 100, "Reactor Site Criteria."

[16] All cited sections of Title 10 of the *Code of Federal Regulations* are available through the NRC's public Web site at http://www.nrc.gov/reading-rm/doc-collections/cfr/.

APPENDIX A

RECOMMENDED FORMAT FOR HOURLY METEOROLOGICAL DATA TO BE PLACED ON ELECTRONIC MEDIA

Hourly meteorological data should be submitted to the NRC on mutually agreed-upon media. The file is a formatted, sequential access, ASCII text data file. Comma-delimited or binary data files should not be submitted. The data should be in files that are of a size that are convenient for use and storage. Annual data files are acceptable.

At the beginning of each file, use the first five records to give a file description. Include plant name, location (latitude, longitude), dates of data, information explaining data contained in the "other" fields if they are used, heights of measurements, and any additional information pertinent to the identification of the file (e.g., type of moisture measurements). Ensure that all five records are included, even if some are blank. Use 160A1 as the format for the first five records. The remaining records, one per hour, contain the meteorological data in the format A4, I4, I3, I4, 25F5.1, F5.2, 3F5.1. Check the file to ensure quality (e.g., compare against the raw data to ensure that the electronic file has been properly formatted, unit conversions are correct, and invalid data are properly identified).

Provide all data to the tenth of a unit, except solar radiation, which should be provided to a hundredth of a unit. This does not necessarily indicate the accuracy of the data (e.g., wind direction is usually given to the nearest degree). Use all nines in any field to indicate a lost record (99999). Use all sevens in a wind direction field to indicate calm (77777). If there are only two levels of data, use the upper and lower levels. If there is only one level of data, use the upper level.

NOTE: The sigma theta, moisture, solar radiation, and visibility measurements listed in the following pages are not required measurements but should be provided if they are available.

METEOROLOGICAL DATA ON ELECTRONIC MEDIA

LOCATION:

DATE OF DATA RECORD:

A4	Identifier (can be anything)	
I4	Year	
I3	Julian Day	
I4	Hour (on 24-hour clock)	
		ACCURACY
F5.1	Upper Measurements: Level = _____ meters	_____
F5.1	Wind Direction (degrees)	_____
F5.1	Wind Speed (meters/second)	_____
F5.1	Sigma Theta (degrees)	_____
F5.1	Ambient Temperature (°C)	_____
F5.1	Moisture: _____	_____
F5.1	Other: _____	_____
F5.1	Intermediate Measurements: Level = _____ meters	_____
F5.1	Wind Direction (degrees)	_____
F5.1	Wind Speed (meters/second)	_____
F5.1	Sigma Theta (degrees)	_____
F5.1	Ambient Temperature (°C)	_____
F5.1	Moisture: _____	_____
F5.1	Other: _____	_____
F5.1	Lower Measurements: Level = _____ meters	_____
F5.1	Wind Direction (degrees)	_____

METEOROLOGICAL DATA ON ELECTRONIC MEDIA (Continued)

F5.1	Wind Speed (meters/second)	_____
F5.1	Sigma Theta (degrees)	_____
F5.1	Ambient Temperature (°C)	_____
F5.1	Moisture: _____	_____
F5.1	Other: _____	_____
F5.1	Temp. Diff. (Upper-Lower) (°C/100 meters)	_____
F5.1	Temp. Diff. (Upper-Intermediate) (°C/100 meters)	_____
F5.1	Temp. Diff. (Intermediate-Lower) (°C/100 meters)	_____
F5.1	Precipitation (millimeters)	_____
F5.1	Solar Radiation (calories/square centimeter/minute)	_____
F5.1	Visibility (kilometers)	_____
F5.1	Other: _____	_____
F5.1	Other: _____	_____

DESCRIPTION OF CHANGES

The following is a list of changes from the current official version of Regulatory Guide 1.23, issued in February 1972. The amount of substantial changes from the current official version make it impractical to indicate the changes within the document.

	Proposed Change	Basis
1.	Update discussion of applicable regulations.	Many of the current applicable regulations did not exist in 1972 (e.g., Appendix A and Appendix I to 10 CFR Part 50; 10 CFR Part 51).
2.	Update references to associated regulatory guides.	Many of the current associated regulatory guides did not exist in 1972 (e.g., Regulatory Guides 1.111, 1.145, 1.194).
3.	Add a list of definitions for a number of terms used within the regulatory guide.	This change clarifies some of the terms used in the regulatory guide.
4.	Specify the minimum amount of data needed at docketing for 10 CFR Part 52 early site permit and combined license applications.	The minimum amount of data needed at docketing for early site permit and combined license applications under 10 CFR Part 52 is similar to the minimum amount of data needed at docketing for operating license applications under 10 CFR Part 50.
5.	Provide additional guidance for siting meteorological instruments (e.g., separation distance between wind sensors and obstructions to airflow such as buildings, trees, and nearby terrain; instrument boom length and orientation; avoidance of nearby heat and moisture sources such as cooling towers and parking lots; use of aspirated radiation shields for temperature sensors; use of heaters and wind shields for precipitation gauges).	The agency adopted much of this enhanced guidance from ANSI/ANS-3.11-2005.
6.	Delete the criterion for using standard deviation of horizontal wind direction (σ_θ) as a basis for classifying atmospheric stability.	Vertical temperature difference is the preferred method for determining Pasquill stability classes at nuclear power plants for licensing purposes because it is an effective indicator for the worst case stability conditions (e.g., Pasquill stability classes E, F, and G), and certain Gaussian plume models endorsed by the NRC (such as the models referenced in Regulatory Guides 1.145 and 1.194) are based on empirically derived plume meander factors from field tracer studies that used ΔT to classify atmospheric stability. Alternative methods may be used to classify atmospheric stability if appropriate justification is provided. However, the use of alternative methods to classify atmospheric stability may require modifications of the models described in Regulatory Guides 1.145 and 1.194.

	Proposed Change	Basis
7.	Add a criterion that precipitation should be measured at ground level near the base of the tower.	Severe accident calculations now included in an applicant's environmental report and the staff's environmental impact statement use precipitation.
8.	Clarify the definition of system accuracy, update some of the system accuracy criteria (e.g., add wind direction accuracy for time-average values, specify wind direction sensor starting threshold, decrease wind speed accuracy criteria for wind speeds $\geq$ 2.2 m/s, decrease dew-point accuracy criteria, add precipitation accuracy criteria) and specify measurement resolutions.	The agency adopted much of this enhanced guidance from ANSI/ANS-3.11-2005.
9.	Provide guidance that the tower and instrumentation should be capable of surviving, monitoring, and displaying any onsite meteorological conditions used as a basis for any emergency action levels.	Where applicable, this change ensures that the meteorological monitoring system can effectively support providing the meteorological data that are used as a basis for any emergency action levels in accordance with 10 CFR 50.47(b)(4) and Section IV.B of Appendix E to 10 CFR Part 50.
10.	Provide guidance on sampling frequencies and eliminate the criterion for redundant recorders.	The agency adopted much of this enhanced guidance from ANSI/ANS-3.11-2005.
11.	Update the specified format for wind speed, wind direction, and stability joint frequency distribution summaries and add a criterion that an electronic copy of the hourly database should be submitted with the application.	This change adds a finer category breakdown for the lower wind speeds, which is an important input to the Regulatory Guide 1.145 atmospheric dispersion models. The NRC is moving the criterion to submit an electronic copy of the hourly database, already discussed in Standard Review Plan Section 2.3.3, into Regulatory Guide 1.23.
12.	Clarify that the preoperational monitoring program should provide an adequate basis for atmospheric transport and diffusion estimates for the exclusion area boundary, the outer boundary of the low-population zone, and the hypothetical maximally exposed member of the public.	This change ensures that the meteorological monitoring system can effectively support the collection of meteorological data for use in developing site atmospheric dispersion characteristics as specified in 10 CFR 100.21(c).
13.	Clarify that the plant's operational meteorological monitoring program should provide an adequate basis for atmospheric transport and diffusion estimates within the plume exposure emergency planning zone.	This change ensures that the meteorological monitoring system can effectively support the collection of meteorological data for use in determining the magnitude of and for continuously assessing the impact of the accidental release of radioactive materials to the environment as specified in Appendix E to 10 CFR Part 50.

	Proposed Change	Basis
14.	Add a criterion that 15-minute average values of all the meteorological channels required for input to the emergency response dose models should be available for real-time display in the appropriate emergency response facilities.	This change ensures that the meteorological monitoring system can effectively support the collection of meteorological data for use in determining the magnitude of and for continuously assessing the impact of the accidental release of radioactive materials to the environment as specified in Appendix E to 10 CFR Part 50. Most currently operating nuclear power plants use the 15-minute average criterion for meteorological data as specified in the first proposed Revision 1 to Regulatory Guide 1.23.