SAFETY GUIDE 23
ONSITE METEOROLOGICAL PROGRAMS

A. INTRODUCTION

Subparagraph 100.10(c)(2) of 10 CFR Part 100 states that, in determining the acceptability of a site for a power or testing reactor, the Commission will take into consideration meteorological conditions at the site and in the surrounding area.

Subparagraph 50.36a(a)(2) of 10 CFR Part 50 requires nuclear power plant licensees to submit semiannual reports specifying the quantity of each of the principal radionuclides released to unrestricted areas in liquid and in gaseous effluents, and such other information as may be required by the Atomic Energy Commission 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 in providing a basis for estimating maximum potential annual radiation doses resulting from radioactive materials eleased in gaseous effluents.

In order for the Commission to fulfill its responsibilities under the National Environmental Policy Act of 1969, and in accordance with the requirements of Appendix D to 10 CFR Part 50, "Statement of General Policy and Procedure: Implementation of the National Environmental Policy Act of 1969 (Public Law 91-190)," basic meteorological information must be available for use in assessing potentially adverse environmental effects of a radiological and nonradiological nature resulting from the construction or operation of a nuclear power plant.

Appendix E to 10 CFR Part 50, "Emergency Plans for Production and Utilization Facilities," requires each applicant for an operating license to include in its final safety analysis report required by § 50.34(b) of 10 CFR Part 50, plans for coping with radiological emergencies. The plans must include criteria for determining when protective measures should be considered within and outside the site boundary to protect health and fety and prevent damage to property. In this egard, it is necessary for the applicant to establish and maintain a meteorological program capable of rapidly assessing critical meteorological parameters.

Thus, at each nuclear power plant site there are multiple needs for an onsite program which will adequately measure and document basic meteorological data. These data may be used to develop atmospheric diffusion parameters which, with an appropriate diffusion model,[1] 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 poential dose to the public as a result of hypothetical reactor accidents. This safety guide describes a suitable onsite meteorological program to provide meteorological data needed to estimate these potential radiation doses.

B. DISCUSSION

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

1. A conservative assessment by 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.
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 to assure that effluent control equipment design objectives and proposed operating procedures meet the Commission's requirements for keeping levels of radioactive material in effluents to

[1] Safety Guide 3, "Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss of Coolant Accident for Boiling Water Reactors," November 2, 1970; Safety Guide 4, "Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss of Coolant Accident for Pressurized Water Reactors," November 2, 1970; "Meteorology and Atomic Energy 1968," TID 24190.

unrestricted areas as low as practicable.

3. A realistic assessment by 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 Appendix D to 10 CFR Part 50.
4. A realistic assessment by the applicant and the regulatory staff of other than radiological environmental effects, such as fogging, icing, and salt drift from cooling towers, to aid in evaluating the environmental impact of a nuclear power plant in accordance with Appendix D to 10 CFR Part 50.
5. A rapid, conservative assessment by the licensee and other appropriate persons of the radiological consequences of an accidental release of radioactive material to the atmosphere. The assessment should be used to provide early guidance to persons assigned to licensee's emergency organization and to appropriate local, State and Federal agencies with responsibilities for coping with emergencies, for use in determining (i) the need for notification and participation of local and State agencies and the Commission and other Federal agencies, and (ii) when appropriate measures should be taken to protect public health and safety and prevent damage to property in accordance with Appendix E to 10 CFR Part 50. Onsite meterological measurements should provide an adequate basis for short distance atmospheric diffusion calculations. (Regional meteorological data will be needed in the event it should become necessary to make diffusion estimates for long distances. To assure that the required data are readily available, the applicant should establish and maintain contact with the nearest National Weather Service Focal Point Air Pollution Meteorologist.)[2]

[2] The name and address of the nearest Focal Point Air Pollution Meteorologist may be obtained by contacting the Air Pollution Meteorologist, Weather Analysis and Prediction Division, National Weather Service, National Oceanographic and Atmospheric Administration, Silver Spring, Maryland 20910.

Specific guidance for evaluating t potential radiological consequences of desi basis reactor accidents is given in Safety Guide 3 and 4. The basic diffusion model described in these guides may also be used to estimate the dispersion of radioactive materials in the atmosphere following the routine or accidental release of such materials. When using the model for evaluating short-term releases, the actual meteorological parameters measured during the release period should be used. For long-term releases the observed joint frequency distribution of wind speed and direction and atmospheric stability for the period should be used. In the event of large variations in the rate of release, it may be necessary to subdivide the meteorological data into periods of approximately uniform release rate.

While there are differences in the specific types of meteorological information required 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 of the plant for meteorological information. In particular, care should be taken to locate the stations at positions where the measurements will accurately represent the overall site meteorology and, if possible, where wind patterns will not be significantly influenced by plant structures.

The number of locations on a site at which meteorological measurements are necessary will depend largely on the complexity of the terrain in the vicinity of the site. For example, the study of a hill-valley complex, or a site near a large body of water would require a larger number of measuring points to determine air flow patterns and spatial variations of atmospheric stability.

The minimum amount of meteorological data needed for siting evaluation is considered to be that amount of data gathered on a continuous basis for a representative consecutive 12 month period. Two full annual cycles of data are desirable.

C. REGULATORY POSITION

This section describes a suitable onsite meteorological program to provide meteorological data needed to estimate potential radiation doses to the public as a result of the routine or accidental release of radioactive

erials to the atmosphere and to assess other ronmental effects.

1. **Meteorological Parameters.**
   To obtain the meteorological information required for a valid estimate of atmospheric diffusion at a particular site, instrumentation should be provided that is capable of measuring wind direction, wind speed, and ambient air temperature at a minimum of two levels on at least one tower or mast. At sites where there is a potential for fogging or icing due to an increase in atmospheric moisture content caused by plant operation, instrumentation should be provided for measuring the dew point (or humidity) on the tower or mast.

2. **Siting of Meteorological Instruments.**
   The tower or mast should be sited at approximately the same elevation as finished plant grade and in an area where plant structures will have little or no influence on the meteorological measurements. The lower set of instruments should sense wind speed and direction, termperature, and dew point (where required) at an elevation of 10 meters above the ground and the upper set should sense wind speed and direction and temperature at the height of release of radioactive material (plant vent height) but should be positioned not less than 30 meters above the lower sensor set. For stack releases, another set of sensors should be located at an elevation such that meteorological conditions at stack height can be represented.

3. **Data Recorders**
   Either analog (strip chart) or digital recording of data may be used as a basis for analysis. In lieu of providing redundant digital recorders, digital outputs may be supplemented by strip chart recorders to minimize possible loss of data due to instrument malfunction. Recorders (analog or digital) for wind direction and speed and temperature difference (two temperatures or one temperature difference measurement on a tower or mast) should be located in the reactor control room for use during plant operation.

4. **Instrument Accuracy**

   a. Wind direction accuracy for instantaneous recorded values ±5°.
   b. Wind speed accuracy for time averaged values ±0.5 mph. Starting speed of anemometer < 1 mph.
   c. Temperature accuracy for time averaged values ±0.5°C. Temperature difference accuracy from either difference between averaged temperatures or average temperature difference ±0.1°C.
   d. Dew point accuracy for time averaged values ±0.5°C.

5. **Instrument Maintenance and Servicing Schedules**
   Meteorological instruments should be inspected and serviced at a frequency which will assure at least a 90% data recovery and which will minimize extended periods of instrument outage. The use of redundant sensors and/or recorders may be another acceptable means of achieving the 90% data recovery goal. The instruments should be calibrated at least semiannually.

6. **Data Reduction and Compilation**
   a. Wind, temperature and humidity data should be averaged over a period of at least 15 minutes at least once each hour.
   b. The basic reduced data should be compiled into monthly or seasonal and annual joint frequency distributions of wind speed and wind direction by atmospheric stability class. Table 1 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. Table 2 presents a classification of the various atmospheric stability categories.
   c. 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.

d. When evaluating the acceptability of a site for a nuclear power plant, because of unique meteorological conditions at the site, it is sometimes necessary or desirable to depart from the meteorological assumptions provided in Safety Guides 3 and 4. In these cases, when reducing the data, it is necessary to analyze the joint frequency of persistent wind direction, wind speed, and atmospheric stability to determine appropriately conservative atmospheric diffusion factors (χ/Q) for time periods over which the release is assumed to occur (up to 30 days).

e. An analysis of meteorological conditions and atmospheric diffusion factors (χ/Q) for accidental and annual average releases of effluents should be provided and the assumptions and calculation procedures described. The probability distributions of χ/Q estimates for appropriate time periods should be presented.

7. **Special Considerations**

At some sites, due to complex flow patterns in nonuniform terrain, additional wind and temperature instrumentation and more comprehensive programs may be necessary. Also, measurements of precipitation and/or solar radiation may be desirable at some locations.

Occasionally the unique diffusion characteristics of a particular site may warrant use of special meteorological instrumentation and/or studies. Proposed studies of this nature should be described in the application for a construction permit.

8. **Documentation**

The onsite meteorological measurements program should be fully documented in the safety analysis report, in accordance with subparagraphs 50.34(a)(1) and 50.34(b)(1) of 10 CFR Part 50.

TABLE 1

Extremely Stable (ΔT exceeds 4.0° C/100m)
Period of Record:

Wind Direction	Wind Speed (mph) at 10m Level 1-3	4-7	8-12	13-18	19-24	>24	TOTAL
N							
NNE							
NE							
ENE							
E							
ESE							
SE							
SSE							
S							
SSW							
SW							
WSW							
W							
WNW							
NW							
NNW							
VARIABLE							
Total							

Periods of calm (hours) -

Hours of missing data -

TABLE 2

Classification of Atmospheric Stability

Stability Classification	Pasquill Categories	σ_θ* (degrees)	Temperature change with height (°C/100m)
Extremely unstable	A	25.0°	<-1.9
Moderately unstable	B	20.0°	-1.9 to -1.7
Slightly unstable	C	15.0°	-1.7 to -1.5
Neutral	D	10.0°	-1.5 to -0.5
Slightly stable	E	5.0°	-0.5 to 1.5
Moderately stable	F	2.5°	1.5 to 4.0
Extremely stable	G	1.7°	>4.0

* Standard deviation of horizontal wind direction fluctuation over a period of 15 minutes to 1 hour. The values shown are averages for each stability classification.