5.2.1.2 Meteorological Monitoring

A permit applicant should collect on-site meteorological data, if possible. However, if this is not possible, representative data may be available from a nearby facility, a university, or a governmental agency. On-site meteorological data should be collected in accordance with procedures set forth in the following documents:

- *Meteorological Monitoring Guidance for Regulatory Modeling Applications*. (EPA 2000).

- *Ambient Monitoring Guidelines for Prevention of Significant Deterioration (PSD)*. (EPA 1987).

The amount and level of detail of meteorological data required will vary, depending on an applicant's specific circumstances. Generally, meteorological data for use in air dispersion modeling analyses must be complete and accurate. Summarized below are the requirements for on-site meteorological data for use in an air dispersion modeling analysis. If meteorological data are collected for a purpose other than modeling, the permit writer should assess the specific needs and determine the associated data requirements. For example, if on-site precipitation data are needed to evaluate leaching potential, and other meteorological variables are available and adequate to characterize the atmospheric conditions at the site, an applicant may collect only the on-site precipitation data. However, the guidelines presented below generally can be applied to all meteorological monitoring requirements.

Siting and Exposure

The primary goal of collecting on-site data is to obtain valid, representative data on the atmospheric conditions at the facility and at locations where exposure to contaminants is expected to occur. There are four main criteria for determining the representativeness of on-site meteorological data: (1) the proximity of the station to the facility and exposure areas, (2) the topography of the area, (3) the exposure of the instrument, and (4) the time period of data collection. The data should be evaluated against criteria to determine whether the data are representative of the site.

The location of the meteorological station should be such that measurements made represent the atmospheric conditions at the site. If a monitoring station is located too far from the site, the data may not represent the atmospheric patterns at the site adequately.

Topography can change the meteorological variables drastically if complex terrain is present, or in coastal areas. The local terrain must be considered in selecting the location of the station. In some cases, when atmospheric conditions differ considerably over the area of interest, more than one meteorological station should be used for data collection. For example, if complex terrain influences meteorology in the immediate vicinity of the facility, the airflow patterns in the complex terrain may require evaluation, in addition to the patterns at the facility.

The location of instruments relative to terrain, obstructions, and the elements is referred to as exposure. Standard exposure parameters have been developed to ensure that meteorological parameters are represented comparably from site to site. Generally, instruments should be located away from the influence of buildings, trees, towers, or other obstructions. The standard exposure of wind instruments is 10 meters above ground, with obstructions located a distance of at least 10 times the height of the obstruction. If such positioning is not possible, the anemometer may be located above

the obstruction. Temperature gauges usually should be located 2 meters above the ground, away from obstructions, and must be protected from direct thermal radiation. The protective equipment must provide adequate ventilation. Precipitation gauges should be located on level ground, horizontal to the sky, and away from obstructions.

Data Requirements

The type and amount of meteorological data necessary will depend on the needs for a specific site. Data requirements should be determined on a case-by-case basis. However, the minimum requirements for most refined dispersion modeling analyses include collecting data over a period of a year for the following atmospheric parameters: wind speed, wind direction, temperature, temperature differential, solar radiation, and precipitation. Other common variable factors for which data are collected at on-site stations include atmospheric water vapor, barometric pressure, cloud cover, and cloud ceiling. Upper air measurements also are required to calculate mixing heights for dispersion modeling, but those data usually are obtained from the nearest National Weather Service station rather than collected on-site. Recent technological developments, however, allow collection of upper air measurements by remote sensing. One such remote sensing device that has become popular is the Doppler Sound Detection and Ranging (SODAR). Remote sensing is a practicable means of collecting data that should be evaluated on a case-by-case basis. The cost of remote sensing, however, may make other methods of data collection more desirable.

System Performance

The accuracy of meteorological instruments is highly dependent on their quality. EPA has developed recommendations for system accuracy (EPA 2000) for on-site meteorological monitoring. Table 5.1 lists the recommended accuracies, along with recommended measurement resolutions for the

meteorological parameters. The values listed in Table 5.1 apply to digital systems (analog systems are permitted 50 percent additional error).

Quality Assurance

For data collected on site, adequate quality assurance (QA) records should be provided that demonstrate that the data were collected properly. Typically, a QA plan is developed for the monitoring effort. A QA plan should include the following information (EPA 1987):

- Project description, that is, how the meteorological data are to be used
- Project organization, that is, how validity of the data is supported
- QA objective, that is, how QA will document validity
- Calibration method and frequency for each piece of equipment
- Data flow from samples to archived valid values
- Validation and reporting methods for meteorological data
- Audits, both performance and system
- Preventive maintenance
- Procedures for implementing QA objectives, in detail
- Management support for corrective action and reports

Should the permit writer determine that either the meteorological sampling or the QA program is inadequate, he or she should issue a NOD to specify the appropriate corrective action necessary. Areas that the permit writer might address include:

TABLE 5.1
RECOMMENDED SYSTEM ACCURACIES AND RESOLUTIONS

Meteorological Parameters	System Accuracy	Measurement Resolution
Wind Speed (horizontal and vertical)	± (0.2 m/s + 5% of observed)	0.1 m/s
Wind Direction (azimuth and elevation)	± 5 degrees	1 degree
Ambient Temperature	± 0.5°C	0.1 °C
Vertical Temperature Difference	± 0.1°C	0.02 °C
Dew Point Temperature	± 1.5°C	0.1 °C
Precipitation	± 10% of observed	0.3 mm
Pressure	± 3 millibar (mb) (0.3 kPa)	0.5 mb
Radiation	± 5% of observed	10 W/m^2
Time	± 5 minutes	-

Source: *Meteorological Monitoring Guidance for Regulatory Modeling Applications*

- The location of the station
- The use of separate historical data sources for particular parameters
- The sampling frequency
- The period of time represented by the data set from the station
- The adequacy of various aspects of the QA plan or its components