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U.S. NUCLEAR REGULATORY COMMISSION
STANDARD REVIEW PLAN
OFFICE OF NUCLEAR REACTOR REGULATION

SECTION 2.3.3 ONSITE METEOROLOGICAL MEASUREMENTS PROGRAMS

REVIEW RESPONSIBILITIES

Primary - Site Analysis Branch (SAB)

Secondary - None

I. AREAS OF REVIEW

Information is presented by the applicant and reviewed by the staff concerning the onsite meteorological measurement programs including instrumentation, data summaries, and, at the operating license (OL) stage, provisions of the technical specifications. The review covers the following specific areas:

1. The meteorological instrumentation review includes siting of sensors, sensor performance specifications, methods and equipment for recording sensor output, the quality assurance program for sensors and recorders, and data acquisition and reduction procedures.

2. The review of meteorological data summaries includes consideration of the period of record and amenability of the data for use in making atmospheric diffusion estimates.

3. The review of meteorological technical specifications includes consideration of instrument siting, instrument specifications, control room monitoring, and data reporting and storage.

II. ACCEPTANCE CRITERIA

1. Generally the onsite meterological programs must produce data which can be summarized to provide an adequate meteorological description of the site and its vicinity for the purpose of making atmospheric diffusion estimates for accidental and routine airborne releases of effluents. Guidance on an adequate program is given in Regulatory Guide 1.23. More specifically:

   a. The siting of meteorological sensors should satisfy the intent and recommendations of Regulatory Guide 1.23 or state-of-the-art procedures.

b. The meteorological sensors should meet the sensitivity recommendations of Regulatory Guide 1.23 and be capable of withstanding the expected range of environmental conditions at the site such that adequate data recovery is anticipated. Any deviation from Regulatory Guide 1.23 must be justified.

c. The meteorological recording systems must be capable of providing accurate, reliable data.

d. The instrument surveillance and calibration procedures must provide reasonable assurance that adequate, accurate data will be obtained.

e. The data acquisition and reduction procedures should provide average data which are within the accuracy guidelines of Regulatory Guide 1.23. Any deviation must be justified.

2. The following criteria are used to judge the acceptability of meteorological data summaries for atmospheric diffusion estimates.

a. For the preliminary safety analysis report (PSAR), if adequate onsite meteorological data are not available at docketing, the best available (onsite and offsite) meteorological data to describe the atmospheric diffusion characteristics of the site in the form of joint frequency distributions of wind direction and wind speed by atmospheric stability class must be presented. Evidence of how well these data represent long-term conditions at the site must be presented. Adequate onsite meteorological data must be provided prior to or with the scheduled response to the first set of requests for additional information in the PSAR review.

For site suitability reviews, at least six months of onsite meteorological data with evidence of how well these data represent long-term conditions at the site must be presented (See Regulatory Guide 4.2.1).

b. For the final safety analysis report (FSAR), at docketing, or for the PSAR if adequate onsite meteorological data have been collected, one year (and, preferably, two or more whole years) of onsite meteorological data must be provided in the form of joint frequency distributions of wind direction and wind speed by atmospheric stability class. Evidence of how well these data represent long-term conditions of the site must also be presented.

Regulatory Guide 1.23 provides guidance on an acceptable format for meteorological data summaries and adequacy of data.

III. REVIEW PROCEDURES

1. Meteorological Instrumentation

The basic meteorological parameters measured by instrumentation at all sites should include wind direction and wind speed at two levels, ambient air temperature difference between two levels, temperature, and atmospheric moisture (at sites where water vapor is emitted, as from cooling towers or spray ponds).

a. Instrument Siting

Instrument types, heights, and locations are compared generally to the recommendations of Regulatory Guide 1.23, Sections C.1 and C.2. Detailed review procedures follow.

(1) Local Exposure of Instruments

The local exposure of the wind and temperature sensors is reviewed to assure that the measurements will represent the general site area. A determination is made whether the tower which supports the sensors will influence the wind or temperature measurements. Professional experience and studies have shown that wind sensors should be mounted on booms such that the sensors are at least one tower width away from an open-latticed tower and at least two stack or tower widths away from a stack or closed tower. For temperature sensors, mounting booms need not be as long as those for wind sensors but must be unaffected by thermal radiation from the tower itself. No temperature sensors may be mounted directly on stacks or closed towers. Mounting booms for all sensors should be oriented normal to the prevailing wind at the site.

A determination is made whether the terrain at or near the base of the tower will unnaturally affect the wind or temperature measurements. Heat reflection characteristics of the surface underlying the meteorological tower (grass, soil, gravel, paving, etc.) are estimated to assure that localized influences on measurements are minimal. The position, size, and materials used in the construction of the recorder shack and nearby trees are also examined for potential localized influence on the measurements.

(2) General Exposure of Instruments

Since the objective of the instrumentation is to provide measurements which represent the overall site meteorology without plant structure interference, the tower position(s) must have been selected with this general objective in mind. Examination of topographical maps, which have been modified to show finished plant grade, and a site visit along with professional judgement on airflow patterns are used to determine and evaluate the representativeness of the location(s).

The plant structure layout including structure heights are examined for potential influence on meteorological measurements. In general, sensors should be located at least five building heights away from the buildings to minimize this influence.

b. Meteorological Sensors

The type and performance specifications of the sensors are evaluated. Manufacturers' specifications and analysis, and operating experience for these sensors are considered in evaluation of adequacy with respect to accuracy and the potential for acceptable data recovery. Standardized evaluations such as Reference 5 and operational experience reports contained in research papers are utilized.

The suitability of the specific type of sensor for use in the environmental conditions at the site is evaluated. To this end, the range of wind conditions and the ability of the sensors to withstand corrosion, blowing sand, salt, air pollutants, birds, and insects are considered.

If the sensors are new and unique, a meteorological instrumentation expert (e.g., NOAA, Idaho Falls) is consulted.

c. Recording of Meteorological Sensor Output

The methods of recording (e.g., digital or analog, instantaneous or average, engineering units or raw voltages) and the recording equipment including performance specifications and location of this equipment are evaluated. Manufacturers' specifications and operating experience for the recorders are considered in evaluation of adequacy with respect to accuracy and the potential for acceptable data recovery.

The controlled environmental conditions in which the recorders are kept (instrument shack or control room) are reviewed for adequacy in accordance with the manufacturers' specifications. The ability to obtain a direct readout from the recorders in situ during routine inspection of systems is checked so that the inspector will be able to relate the recorder output directly to what the sensor should be seeing. Some specific recommendations are contained in Regulatory Guide 1.23, Section C.3.

The reviewer determines that there are provisions for proper monitoring of wind direction, wind speed, and vertical temperature difference in the control room during plant operation.

d, Instrumentation Surveillance

The inspection, maintenance, and calibration procedures and their frequency are evaluated. These surveillance procedures and the frequency of attention that the instrumentation systems receive are compared to operating experience at this site and other sites with similar instrumentation with the objective of determining that acceptable data recovery with acceptable accuracy will be obtained throughout the duration of the meteorological program. Guidelines for acceptable accuracy and acceptable data recovery are specified in Regulatory Guide 1.23, Sections C.4 and 5. Any deviations from Regulatory Guide 1.23 must be justified.

e. Data Acquisition and Reduction

The procedures, including both hardware and software, for data acquisition and reduction are evaluated. Since there are many methods of acquiring data from meteorological measurement systems which are acceptable to the staff, the review procedure varies. The basic components of the program which are reviewed to ascertain the acceptability of data acquisition and reduction are:

(1) Accuracy of measuring in units of direct measurement and their precision.
(2) Accuracy in conversion of direct measurement units to meteorological units.
(3) Accuracies involved in frequency and mode (instantaneous or average) of sampling.
(4) Time over which system outputs are averaged for final disposition and accuracy of these data.

Since the instrument accuracy suggestions in Regulatory Guide 1.23 refer to overall system accuracy for instantaneous recorded values or time averaged values, the overall system accuracy is evaluated in addition to the component (sensor, recorder, and reduction) accuracies. The evaluation consists primarily of using statistical procedures for compound errors based on sensor accuracy, recorder accuracy, conversion of units accuracy, and frequency and mode of sampling (Ref.6).

2. Meteorological Data Summaries

Annual (representing the annual cycle) joint frequency distributions of wind direction and wind speed by atmospheric stability class are evaluated from the viewpoint of sufficiency of detail to permit the staff to make an independent determination of the atmospheric diffusion conditions and relative concentrations for accidental and routine atmospheric releases of radioactive effluents from the reactor and its facilities. The distributions are to be based wholly on onsite data, a combination of onsite and offsite data, or offsite data in accordance with the criteria of sections II.2.a and b of this plan. The joint frequency distributions are compared to the example distribution given in Regulatory Guide 1.23.

"Calm" wind conditions (which should be defined as wind speeds less than the starting speed of the anemometer or vane, whichever is higher) are checked for appropriateness and appearance in the distributions as a separate speed class, without directional assignment, by atmospheric stability class.

Annual joint frequency distributions for each expected mode of release (i.e., ground level and elevated) are checked for appropriateness of heights of measurements of wind direction, wind speed, and atmospheric stability. Winds at the 10-meter level and temperature difference (ΔT) between the vent height and the 10-meter level are used for vent and penetration releases. Winds from near release height and ΔT between release height and the 10-meter level are used for stack releases. A stack is defined as a release point which is greater than twice the height of adjacent structures.

The climatic representativeness of the joint frequency distribution is checked by comparison with nearby stations which have collected reliable meteorological data over a long period of time (10-20 years). The distributions are compared with sites in similar geographical and topographical locations to assure that the data are reasonable.

3. Meteorological Technical Specifications

The applicant's technical specifications are reviewed at the OL stage to determine if the operational meteorological monitoring program meets the recommendations of Regulatory Guide 1.23 with respect to tower siting, instrumentation specifications, and control room monitoring, and if the reporting requirements meet the recommendations of Regulatory Guide 1.21, Rev. 1. Deviations from the Regulatory Guides may be accepted if justified.

IV. EVALUATION FINDINGS

The reviewer verifies that sufficient information has been provided in accordance with the requirements of this review plan and that his evaluation supports the following type of concluding statement, to be used in the staff's safety evaluation report:

> "The onsite meteorological measurements program has been compared with the recommendations and intent of Regulatory Guide 1.23. The staff concludes that the meteorological measurements program (is expected to produce/has produced) data which, in turn (can be summarized/have been summarized) to provide an adequate meteorological description of the site and its vicinity for the purpose of making atmospheric diffusion estimates for accidental and routine airborne releases of effluents from the nuclear facility."

For the CP review, if adequate meteorological data have not been acquired by the applicant and presented to the staff, a statement requiring the applicant to obtain adequate data in a timely manner will be added.

The input to the safety evaluation report will also include a brief summary description of the onsite meteorological measurements program covering the following items:

1. Height and location of meteorological sensors by type.
2. Period of data record.
3. Data recovery.
4. Period of data record and meteorological parameters used for atmospheric diffusion estimates.

V. REFERENCES

1. Regulatory Guide 1.21, "Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants."

2. Regulatory Guide 1.23, "Onsite Meteorological Programs."

3. Regulatory Guide 4.2.1, "Additional Guidance - Environmental Data."

4. R. C. Hilfiker, "Exposure of Instruments," Chapter in Air Pollution Meteorology Manual, Training Course 411 conducted by USEPA Air Pollution Training Institute, Research Triangle Park, North Carolina, August 1973.

5. D. H. Slade (ed.), "Meteorology and Atomic Energy - 1968," TID-24190, Division of Technical Information, USAEC (1968).

6. C. E. P. Brooks and N. Caruthers, "Handbook of Statistical Methods in Meteorology," M.O. 538, Her Majesty's Stationary Office, London (1953).

7. D. A. Mazzarella, "An Inventory of Specifications for Wind Measuring Instruments," Bull. Amer. Meteor. Soc. 53, 860 (1972).

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