Meteorological Data Requirements and Regulatory Conformance Issues in Preparing Early Site Permit & Combined Operating License Applications

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1.0 INTRODUCTION

Nuclear power generation has become an increasingly attractive alternative in the United States (U.S.) power market due to several factors: growing demand for electric power, increasing global competition for fossil fuels, concern over greenhouse gas emissions and their potential impact on global warming, and the desire for energy independence.

Recognizing the needs to accelerate the development of new nuclear power facilities, the U.S. Congress has enacted the Energy Policy Act of 2005, which aims to streamline the application process for new nuclear construction. The U.S. Department of Energy announced a "Nuclear Power 2010 Initiative", and has offered financial incentives for new nuclear power generation. As a result, more than 20 utilities and nuclear energy groups have announced plans for new plants to submit applications for Early Site Permits (ESP) and/or Combined Construction/Operating Licenses (COL) under the new streamlined process.

This paper summarizes the regulatory requirements and associated guidance for providing meteorological data to be included in these submittals. Common regulatory conformance issues, particularly regarding the use of existing meteorological data, will be fully discussed. A descriptive summary of available computer modeling tools and analytical methodologies for performing atmospheric dispersion calculations for radiological releases, control room habitability evaluations due to both radiological and chemical releases, and environmental impact assessments of cooling tower operation is also provided.

2.0 REGULATORY REQUIREMENTS AND OTHER GUIDANCE

For all nuclear power generating plants in the U.S., an onsite meteorological monitoring program is required to provide the data needed to determine meteorological dispersion conditions in the vicinity of the plant for assessment of safety and environmentally-related factors prior to plant operation and the data needed in considering protection of the public health and safety, and property during the operational phase of the plant (USNRC, Regulatory Guides 1.23). Specifically, meteorological measurement programs at a nuclear power plant site are used to make assessments summarized below.

Table 1 – Use of Meteorological Data

Use of Data	Application Development	Regulatory Review	Plant Operation
Atmospheric dispersion estimates for both postulated accidental and routine airborne releases of effluents	X	X	X
Comparison with offsite sources to determine the appropriateness of climatological data used for design considerations	X	X	
Evaluation of environmental risks from the radiological consequences of a spectrum of accidents	X	X	
Evaluation of non-radiological environmental impacts	X	X	
Development of emergency response plans	X	X	X

Pertinent NRC regulations, regulatory guidance and industry standards for meteorological data and related issues are summarized in Tables 2 & 3.

Table 2 – Conformance with Regulatory Requirements

NRC Regulations	NRC Regulatory Guidance
10 CFR 100.20(c)(2), 100.21(c), and 100.21(d) regarding meteorological data collected for use in characterizing meteorological conditions of the site and surrounding area.	Regulatory Guide 1.23, "Onsite Meteorological Programs," Rev. 0, dated February 1972, and Proposed Revision 1 to R.G. 1.23, dated September 1980 provides criteria for an acceptable onsite meteorological measurements program
10 CFR 50, Appendix I, regarding meteorological data used in determining compliance with numerical guides for doses to meet the criterion of "as low as is reasonably achievable" (ALARA).	RG 1.70, Rev. 3, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants LWR Edition," dated November 1978, Section 2.3.3 provides information regarding preoperational and operational programs for meteorological measurements at the site and how to provide joint frequency distributions of wind speed and direction by atmospheric stability class
10 CFR 50.47 and 10 CFR 50, Appendix E, regarding additional meteorological measurement requirements taken for emergency preparedness planning.	Draft RG DG-1145, "Combined License Applications for Nuclear Power Plants (LWR Edition)," dated June 2006 • Part I.2, Site Characteristics, Regulatory Position C.I.2.3.3, Onsite Meteorological Measurements Program, provides information regarding preoperational and operational programs for meteorological measurements at the site, including offsite satellite facilities, and • C.III.1 Information Needed for a COL Application Referencing a Certified Design, Chapter 2, Site Characteristics, Section 2.3.3, Onsite Meteorological Measurement Program provides detailed information required regarding met tower and instrument siting, description of sensors and system performance specification, data recording and transmission, data acquisition and reduction, and instrumental surveillance. Information required includes the period and actual data submittal at docketing.
10 CFR 51 regarding meteorological data used to assess site acceptability, and ultimately, plant construction and operational impacts	Regulatory Guide 4.2, Rev. 2, "Preparation of Environmental Reports for Nuclear Power Stations," July 1976
10 CFR 52.17(a)(1)(vi) regarding seismic, meteorological, hydrologic and geologic characteristics of the proposed site	Regulatory Guide 4.7, Rev. 2, "General Site Suitability Criteria for Nuclear Power Stations," April 1998.
	Appendix 2 to NUREG-0654, Rev. 1, "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants," dated November 1980
	NUREG-0696, "Functional Criteria for Emergency Response Facilities," dated February 1981, and NUREG-0737, "Clarification of TMI Action Plan Requirements," dated October 1980 provides criteria with respect to meteorological measurements taken for emergency preparedness planning

Table 3 – Conformance with Other Documents

NRC Review Guidance	Industry Standards
RS-002, "Processing Applications for Early Site Permits," May 2004, Section 2.3.3 provides review criteria of early site permit applications of onsite meteorological measurements programs, including instrumentation and measured data	An industry standard, ANS/ANSI 3.11-2000/2005, "Determining Meteorological Information at Nuclear Facilities" provides guidance relative to nuclear facility meteorological monitoring programs. This standard supersedes ANSI/ANS-2.5-1984, which the NRC planned to endorse in a proposed revision to RG 1.23, which has not been finalized.
NUREG–0800, Standard Review Plan (SRP), Section 2.3.3, "Onsite Meteorological Measurements Program," Rev. 2, July 1981 provides NRC review criteria for construction permit (CP) and operating license (OL) reviews of onsite meteorological measurements programs, including instrumentation and measured data	Nuclear Energy Institute , NEI 01-02, Industry Guideline For Prepare An Early Site Permit Application – 10 CFR Part 52, Subpart A", September 2001.
NUREG-0800, Draft Revision 3 to Standard Review Plan (SRP), Section 2.3.3, "Onsite Meteorological Measurements Program," April 1996 provides NRC review criteria for CP, OL, combined license (COL), or early site permit (ESP) reviews of onsite meteorological measurements programs, including instrumentation and measured data	NEI 04-01, "Standard Format for COL Application Outlines, Section 2.3.3 – Onsite Meteorological Measurement Program" provides written summary of onsite meteorological program, and determines if any additional onsite monitoring is required to support the planned unit and provide descriptive information.
NUREG-1555, "Standard Review Plans for Environmental Reviews for Nuclear Power Plants," issued in October 1999 • Section 2.7, "Meteorology and Air Quality," provides NRC review criteria for evaluating construction and operational impacts that involve meteorology • Section 6.4, "Meteorological Monitoring," provides NRC review criteria for evaluating meteorological monitoring programs	

3.0 USE OF EXISTING METEOROLOGICAL DATA FOR PERMITTING NEW NUCLEAR PLANTS

The special case provision noted in NUREG-1555, Environmental Standard Review Plan 9.3 (Subsection III(8)) states that a new facility can be located at an existing nuclear power plant site that was previously found to be acceptable from a National Environmental Policy Act (NEPA) review, and/or that had satisfactory environmental operating experience.

At an existing nuclear power plant site, environmental conditions (e.g., air, water, and ecology) have been fully characterized, and the environmental impacts of the operating plant are well known and adequately documented based on prior years of monitoring. The majority of existing plants should have collected onsite meteorological data for more than 20 years. These long-term onsite data represent a good source of data that could be used for new plant permitting. However, it is extremely important for every ESP and/or COL applicant to ensure that a valid, accurate, representative and recent meteorological data base is available when relying on measurements from an existing monitoring program. Precautions and recommendations to consider are discussed below.

3.1 Representativeness of the Data

For a new plant, the status of regulatory conformance when using measurements from an existing tower should be carefully assessed for the following areas: topography, surrounding natural- and man-made obstructions (including the existing and proposed unit complex), and operation of any existing and/or proposed heat dissipation systems.

- Meteorological Tower and Instrument Siting

  The objective of the instrumentation is to provide measurements that represent the overall site meteorology without any interference from the existing and proposed plant structures, surrounding trees and nearby terrain, and construction activities such as those related to operation of concrete batch plants, earthmoving activities, and heavy equipment haul routes.

  To determine the representativeness of the onsite meteorological data for the proposed unit(s), instrument types, heights, and locations of the existing data collection system (relative to the proposed unit(s)) should be compared to the positions stated in R.G. 1.23, Positions C.1 and C.2. Specifically, the meteorological tower site should represent, as closely as possible, the same meteorological characteristics as the area of the proposed unit(s) into which any airborne material will be released.

  The essential tower and sensor siting criteria to be met are briefly summarized below:

  - The base of the tower is at approximately the same elevation as the finished plant grade of the proposed unit(s).
  - Location of the tower is not directly downwind of the existing and proposed plant cooling systems under the prevailing downwind wind direction.
  - Sensors are located at least 10 obstruction heights away from such obstructions (including the existing and proposed unit complex) to minimize any airflow modification (i.e., turbulent wake effects).
  - Wind sensors are located on top of the measurement tower or mast to reduce airflow modification and turbulence induced by the supporting structure itself.
  - Air temperature and relative humidity sensors are located in such a way to avoid modification by the existing and proposed heat and moisture sources, such as ventilation systems, water bodies, or the influence of large parking lots or other paved surfaces.

- Meteorological Parameters Measured

  On the primary tower, the basic meteorological parameters measured should include wind speed and wind direction at two levels (at 10 meters and the elevation of the vent height), and at the stack release height (if applicable); ambient air temperature difference between 10 meters and the vent height (with separation from the lower sensor no less than 30 meters), and 10 meters and the stack release height (if applicable); ambient temperature at 10 meters; and atmospheric moisture at 10 meters (at sites where water vapor, as from cooling towers or spray ponds, is emitted). Visibility and solar radiation measurements may be necessary in conjunction with cooling system assessments. Precipitation measurements are to be made at or near the tower.

  At the back-up tower, measurements should include wind speed, wind direction, and horizontal wind direction fluctuation (sigma theta, an alternate indicator of atmospheric stability) at 10 meters.

A visit to the existing meteorological tower site of interest should be conducted by a professional meteorologist to determine if the meteorological measurements are or could have been affected by the surrounding terrain, nearby trees, and plant structures. The visit should also include inspection of the proposed unit(s) location to verify if the meteorological tower site(s) and the proposed unit(s) location have similar meteorological exposure that would adequately support a data representativeness demonstration. Based on the reactor technology of the proposed unit(s), confirm that the sensor elevations and the measurements made on the existing tower meet the regulatory requirements for the new unit(s). Otherwise, the need for either additional instrumentation to be installed on the existing tower, or a new data collection system, or use of data from a representative offsite source should be identified.

3.2 Data Quality

A quality assurance program that is consistent with the provisions of Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to 10 CFR Part 50 is required for the meteorological measurement program prior to and in support of nuclear power plant operation.

In order to be reasonably sure that the data to be used in an ESP or a COL application are valid and accurate, the following activities should be considered:

- A face-to-face meeting with the responsible meteorologist and/or the designated personnel for the data collection system to gain a good understanding of the system performance and operating experience,
- Review of all relevant quality assurance-related documents to determine if adequate procedures have been established and properly implemented regarding instrumentation surveillance and data acquisition and reduction,
- Determining that acceptable data recovery has been obtained through the duration of the meteorological program,
- Making direct comparisons between data accuracy (including direct measurements, unit conversion, sampling frequency and averaging time) and the relevant requirements from R.G. 1.23 and the guidance from ANS/ANSI 3.11 to determine the acceptability of the data acquisition and reduction program that has been used,
- Making a reasonableness determination of the procedures and methodologies used for data substitution including identification and handing of suspect data, and
- Review of a suitable length of data (i.e., about one week to a month) to confirm that the data substitution procedures for the existing data collection system have been carried out properly.

3.3 Completeness of the Data Set

Meteorological data recovery for wind speed, wind direction, atmospheric stability class, and temperature difference are required to be at least 90% on an annual basis. Furthermore, this 90% criterion applies to individual parameters as well as the joint recovery of wind speed, wind direction, and stability class which are used in the compilation of joint frequency distributions that are used in some of the dispersion modeling analyses. This 90% criterion applies to all measurement levels that are used in the consequence assessments.

For other parameters (i.e., temperature, dew point, precipitation, and etc.), the recovery rate are to be at least 90%.

In preparing an ESP or a COL Application using existing onsite meteorological data, it is recommended that the most recent 5 to 10 years of annual data recovery rates (with and without data substitutions) be reviewed to identify a suitable period of record that is most defendable and complete for use in the application.

4.0 CONFORMANCE CHALLENGES

The following discussion briefly addresses some conformance challenges that have recently been encountered in preparing ESP and COL licensing documents.

4.1 Length and Currentness of Meteorological Records Required

Submittal Requirements

For an ESP application, at least one annual cycle of onsite meteorological data should be provided at docketing (RS-002, Attachment 2; Section 2.3.3). Meteorological data required for dispersion analyses should be provided in the form of joint frequency distributions of wind speed and wind direction by atmospheric stability class as described in R.G. 1.23. An electronic listing of each hour of the hourly-averaged data for all parameters should also be submitted.

For a COL application, at least two consecutive annual cycles (and preferably three or more whole years), including the most recent 1-year period, should be provided at docketing. The data reporting format is identical to that required for the ESP application.

Conformance Issues

Although the regulatory guidance provided in both Draft DG-1145 and Draft Standard Review Plan (SRP) Rev.3 (NUREG-0800) stipulates that data for “the most recent 1-year period” is to be used, the NRC has indicated a willingness to be flexible on this point in order to assure that the data used is defendable, representative and complete.

In general, the use of 3 years of data is considered to be sufficient to ensure that meteorological conditions have been adequately represented for use in dispersion calculations and that the need to include the most recent 1-year period could be relaxed (with agency approval), provided that there are no significant man-made obstructions and/or moisture sources additions in the surrounding environment that could caused any weather modifications.

4.2 Meteorological Parameters Measured

- Wind Speed, Wind Direction and Ambient Temperature Difference

  Regulatory Requirements

  On the primary tower, wind speed and wind direction should be monitored at approximately 10 and 60 meters and at a representative higher level for stack releases. The 60-meter level generally coincides with the routine release level for LWRs. Ambient temperature difference is measured between 10 and 60 meters, and between 10 meters and the stack release height. (R.G. 1.23, C. Regulatory Position 2)

  Conformance Issue

  R.G. 1.23 requires at least two levels of wind measurements; the upper measurement level is implicitly indicated to be at the level of the routine releases. Guidance from ANS/ANSI 3.11

states that additional wind measurements should be made at the level representative of the most probable atmospheric release height applicable to radiological activities.

It is conceivable that accidental releases from some of the new reactor designs (e.g., AP1000), which are being considered in ESP/COL Applications, are at a level higher than the implied routine release height. Caution must be exercised to ensure that representative data has been captured by the existing data collection system in order to perform the required X/Q estimates.

On the other hand, radioactive releases from certain new reactor designs (e.g., ABWR) can be relatively low when compared to the typical 60-meter routine release level for LWRs. Nevertheless, care must be taken to ensure that the separation between the temperature difference measurement levels (i.e., 10 meter and the release height) is no less than 30 meters.

- Dew Point

  Regulatory Requirements

  Ambient moisture should be monitored at approximately 10 meters and at a height where the measurement will represent the resultant atmospheric moisture content if cooling towers are to be used for heat dissipation. (R.G. 1.23, C. Regulatory Position 2)

  Conformance Issue

  In general, onsite dew point measurements are only made at the 10-meter level at existing nuclear power plants. The majority of nuclear power plants in the U.S. employed a once-through cooling system design (e.g., ocean, bay, lake, reservoir, and ponds) as their heat dissipation system.

  In recent ESP reviews, onsite dew point measurements at two levels have been requested by NRC in support of their review of cooling tower impact analyses. Direct measurement at the height where the cooling tower plume exits the tower presents significant technical challenges, especially for natural-draft cooling towers which are typically in a range of 400 to 500 feet tall. Requirements for measurements at these elevations above ground are impractical.

  Regulatory guidance for vertical extrapolation of low-level-measured dew point data to higher elevations, as well as agency explanation of exactly how such data will be used, and how the agency has approached this in the past without such data being available, would be very helpful.

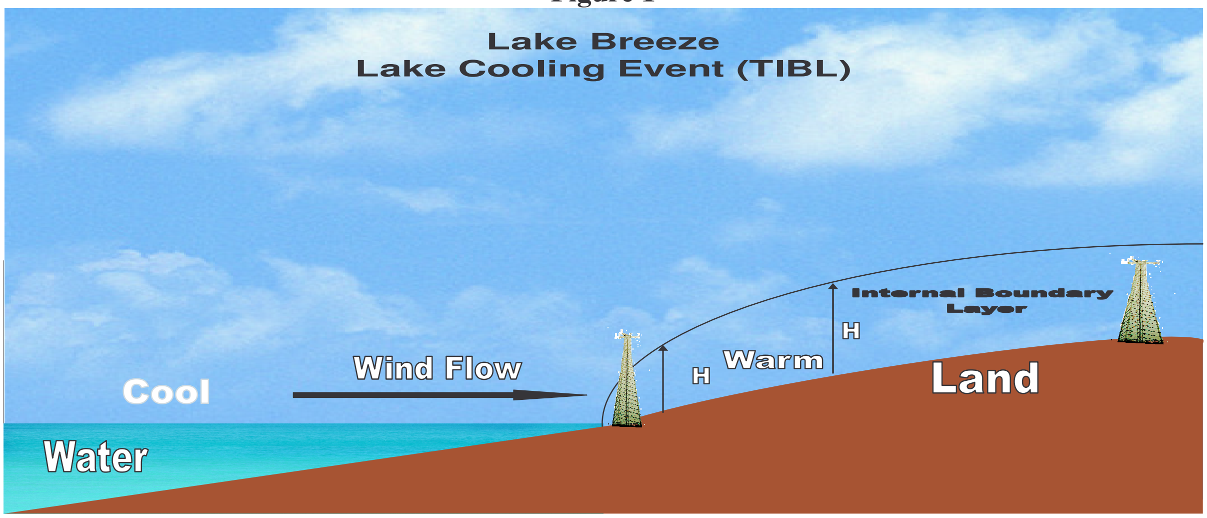
  In addition, it is commonly known from operating experience that dew point sensors are difficult to maintain. The availability of acceptable dew point data from an onsite monitoring program may be low. Therefore, early determination by ESP and COL applicants of the availability of reliable and acceptable onsite moisture measurements is advisable, as is the need to raise moisture data requirements with the agency early in the planning process.

4.3 Thermal Internal Boundary Layer Effects

When cooler air over a large body of water (e.g., ocean, bay, natural or man-made lake) moves inland conditions, a thermal internal boundary layer (TIBL) begins to develop due to mechanical and thermal effects at the land-water interface. This is referred to as sea breeze or lake breeze conditions. The properties and growth of a TIBL will depend upon a number of factors, such as the land-water temperature difference, depth of the water body, strength and direction of the geostrophic wind, time of day (this is a daytime rather than a nighttime phenomenon), roughness of the terrain, and curvature of the coast- or shore-line relative to the proposed site.

The diffusion characteristics within a TIBL are noticeably different than those above the TIBL. Figure 1 illustrates a typical shape for a TIBL in relation to the land-water interface and how the representativeness of the meteorological data measured during the influence of a TIBL could be affected by the distance of the tower from the shore or coastline and the parameter measurement levels.

Figure 1



Regulatory Requirements

At coastal or lakeshore sites, the primary meteorological tower should be in such a location that the upper measurement level is within the TIBL during onshore flow conditions. Heights of the TIBL should be confirmed experimentally before the tower site is chosen. (R.G. 1.23, C. Regulatory Position 2)

Conformance Issue

For a new plant located near a large body of water, the X/Q estimates for the new unit(s) based on the existing onsite meteorological data could be under-predicted, over-predicted or unaffected depending on the relative locations of the tower to the TIBL over the course of the period of record used, and to the proposed unit(s). Therefore, under these circumstances, it is essential that the representativeness of the existing data be fully analyzed. The impacts from under-predictions will need to be accurately quantified and considered in making the site-specific X/Q estimates. The potential implications on facility design due to over-predictions need to be evaluated as well.

4.4 Data Substitution

When meteorological data from an existing primary tower are not available, values may be substituted from an alternative source where it can be demonstrated that the alternative data are representative of conditions at the proposed site.

Industry Guidance

If it becomes necessary to replace onsite meteorological data, one of the following methods should be used (in the order shown) as recommended by ANS/ANSI 3.11, (2005).

- If the site location has a multiple-level meteorological tower or a back-up tower, valid measurements from a redundant sensor at the same level (if installed) or measurements from another level should be used. If the measurement height is different, adjustments should be made based on vertical profiles of the parameter of concern. Site- specific profiles based on 3 years of onsite data should be used, if possible.

- If the missing data period is short (i.e., up to two hours), the missing data might be resolved using linear interpolation. If the missing data period occurs during the day-night transition period or during a weather event such as a thunderstorm, linear interpolation may not be appropriate.

- When there are nearby monitoring sites, such as National Weather Service (NWS) stations or military bases where monitoring programs are operated under a well-documented quality assurance program, it may be possible to substitute these data for missing periods. These data substation techniques should only be used when studies have confirmed that data for parameters from both sites compare favorably. Differences in instrument thresholds or data collection procedures could make some data from two stations incompatible.

Conformance Issue

The majority of the existing nuclear plants in the U.S. have a 10-meter back-up tower located onsite, measuring wind speed, wind direction, and wind direction fluctuation (sigma theta, an alternative indicator of atmospheric stability). While substitution of stability class data is allowed, replacement of a large amount of missing temperature difference data from the primary tower with sigma-theta data collected from the back-up tower should be avoided.

4.5 Use of Nearby Existing or Regional Data

If it is necessary to use nearby existing offsite or regional data sources, it is advisable that a comparison or confirmatory study be performed to demonstrate their repersentativeness of conditions at the proposed site. However, regulatory guidance regarding the methodologies that should be used for such comparisons or confirmation studies is unclear.

Conformance Issue

In Draft DG-1145, Sections C.I.2.3.3, C.I.2.3.4, and C.I. 2.3.5, NRC has indirectly suggested the following approaches for meteorological conditions related to atmospheric dispersion:

- Wind rose comparisons (both seasonal and yearly)
- X/Q calculations based on the XOQDOQ, PAVAN, and/or ARCON96 models

ESP and/or COL applicants may consider using the Design Control Document (DCD) limitation values for their technology design of choice in lieu of making direct comparisons of the X/Q values calculated by the regulatory models listed above. However, one could lose the design margin that use of onsite meteorological data potentially affords by taking the DCD limitation values approach.

4.6 Climatic Representativeness

Regulatory Requirements

Evidence should be provided to show how well the existing meteorological data that are to be used in preparing input to an ESP or a COL permit applications, represent long-term conditions at the site of the proposed unit(s). (Draft DG-1145, Sections C.I.2.3.3)

Conformance Issue

The climatic representativeness of the onsite joint frequency distribution of wind speed, wind direction and atmospheric stability class and other data used in the permit application should be checked by comparison with nearby stations with similar geographical locations and topographical settings that have collected reliable long-term (e.g., 30 years) meteorological data.

Alternatively, a demonstration of the climatic representativeness of the joint frequency distributions to be used can be made using onsite data because most of the existing nuclear power plants would have collected these data for more than 20 years. However, caution must be exercised to ensure the quality of the data used as it will be scrutinized by the NRC and the public once included in the application and submitted for review.

In some cases, there may be sufficient coverage of offsite first-order NWS stations and cooperative network observing stations to adequately characterize non-dispersion related conditions representative of a proposed site (e.g., normals, means and extremes of temperature, rainfall and snowfall).

4.7 Issuance of Third Proposed Revision 1 to R.G. 1.23

Safety Guide 23 (February 12, 1972), the predecessor to R.G. 1.23, still has regulatory standing although in practice the requirements in Proposed Revision 1 to R.G. 1.23 (September 1980) are expected to be implemented by the regulated community. With respect to R.G. 1.23, the NRC plans to issue a third proposed Revision 1 in the near future, which could be as soon as by the end of 2006.

Conformance Issue

NRC understands that the guidance for onsite meteorological programs in support of nuclear power plants will be coming late for those applicants who plan to submit their applications during 2007 and 2008. NRC also indicated that there are no major changes expected in the proposed Revision 1. However, NRC has suggested that applicants should be prepared to address any changes in the revised regulatory guide, if any are made.

Close coordination and cooperation between the regulatory agency and permit applicants is highly desirable during the licensing process.

5.0 ATMOSPHERIC DISPERSION MODELING TECHNIQUES / TOOLS

A sample list of commonly used atmospheric dispersion modeling techniques and tools are briefly discussed below.

5.1 Routine and Accidental Radiological Releases

- XOQDOQ (for simple terrain) – R.G. 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors."

  An Atmospheric Dispersion Program for Evaluation of Routine Releases at Nuclear Power Stations, the XOQDOQ model is a straight-line Gaussian distribution program designed to calculate X/Q (relative concentration) values. A combined thermal and mechanical turbulent effect is calculated via vertical and lateral diffusion coefficients as determined by atmospheric stability conditions. Model source characteristics include: topography, radioactive decay, plume

depletion through dry deposition, local air recirculation and stagnation. Releases from a single source may be at ground level, elevated, or mixed mode.
Meteorological input includes joint frequency distribution of wind speed, wind direction and stability class.

MESODIF-II (for complex terrain) Plume Segmented Trajectory model in conjunction with XOQDOQ has been used to determine terrain re-circulation factors.

- PAVAN – R.G. 1.145, "Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants."

  An Atmospheric Dispersion Program for Evaluating Design Basis Accidental Releases of Radioactive Materials from Nuclear Power Stations, PAVAN is a straight-line Gaussian distribution program designed to calculate X/Q (relative concentration) values. A combined thermal and mechanical turbulent effect is calculated via vertical and lateral diffusion coefficients as determined by atmospheric stability conditions. Model source characteristics include: Wake effects due to nearby buildings, plume meandering due to low wind speeds, and adjustments due to non-straight plume trajectories. Releases from a single source may be at ground level or elevated. X/Q values are calculated at the exclusion area boundary (EAB) and at the outer boundary of the low population zone (LPZ). Meteorological input includes joint frequency distribution of wind speed, wind direction and stability class.

5.2 Control Room Habitability Evaluation (for radiological and chemical releases)

- ARCON96 – R.G. 1.194, "Atmospheric Relative Concentrations for Control Room Radiological Habitability Assessments at Nuclear Power Plants."

  The program was developed for the NRC for use in control room habitability assessments following accidental releases of radioactive or chemical material from sources such as steam pipe, containment building, vent stack, water tank, equipment hatch door, atmospheric dump valve, etc. The model has been used in the existing nuclear power plants for re-design purposes. This model has been described in NUREG/CR-6331. Unlike the past NRC methods, the program uses an entire year of meteorological data as input to estimate short-term and long-term (up to 30 days) X/Qs.

- R.G. 1.78, Rev. 1, "Evaluating the Habitability of a Nuclear Power Plant Control Room during a Postulated Hazardous Chemical Release", USNRC 2001

- NUREG-0570 – "Toxic Vapor Concentration in the Control Room Following a Postulated Accidental Release", USNRC, Wing, J., 1979.

- HABIT (NUREG/CR-6210) is a Pacific Northwest Laboratory developed and NRC-sponsored code for estimating concentrations of toxic substances at control room air intakes.

5.3 Real-time Dispersion Modeling (Emergency Planning)

- MESODIF-II, "A Variable Trajectory Plume Segment Model to Assess Ground-Level Air Concentrations and Deposition of Effluent Releases from Nuclear Power Facilities" – In the model, calculated particle trajectories vary as synoptic scale wind varies. At all sampling times the particles are connected to form a segmented plume centerline and the lateral and vertical dimensions of the plume are determined by a parameterization of turbulence scale diffusion. The emissions are simulated by discrete particle emissions are for a user-specified time interval. The model assumptions are outlined in R.G. 1.111.

- CALPUFF Model - CALPUFF is a non-steady-state air dispersion model will be implemented by the EPA for assessing air quality impacts involving complex terrain, light and calm wind conditions, long range transport, visibility assessments, etc. The model has 3 main components: CALMET (a diagnostic 3-D meteorological model), CALPUFF (the transport and dispersion model), and CALPOST (a post processing package). There are other processors that are used to prepare geophysical (land use and terrain) data in many standard formats, meteorological data (surface, upper air, precipitation, and buoy data), and interfaces to other models. Hourly meteorological data includes data from a single meteorological station or a network of stations.

  CALPUFF has been formally proposed by the EPA for inclusion in Appendix A of the Guideline on Air Quality Models as a preferred model. Both the EPA and the U.S. Park Service have indicated that this model will be mandatory for air permit applications involving complex terrain, national parks, and other pristine areas.

5.4 Heat Dissipation System Impact Analysis

- SACTI (EPRI) - The Seasonal/Annual Cooling Tower Impact Model consists of three programs: PREP (data pre-processor), PLUME (plume program), and TABLES (table generation). The pre-processor determines plume categories and generates representative cases for each category based on meteorological data (hourly surface and twice-daily mixing height). The plume program determines plume drift predictions for each plume category. The generation program for tables uses the enhanced database to produce tables of predicted impact by distance and wind directions for user-specified season(s). SACTI can also calculate rates of salt deposition based on user-specified drift size distributions (drop size distributions for natural daft cooling towers are provided as default values in the SACTI model).

  Note the model applies to the conventional cooling towers, but not the plume abated towers.

6.0 CONCLUSIONS

In support of an ESP and/or a COL application, it is vitally important that the applicant has a valid, accurate, adequate and representative meteorological data base or has implemented a meteorological data collection program that is capable of generating such information.

When an existing meteorological data collection system is used in an application for a new nuclear plant, a thorough examination of the data from this collection system by a professional meteorologist is highly recommended. The review should include an evaluation of the quality, adequacy and representativeness of the data against the regulatory requirements.

Since 2003 several ESP applications have been undergoing NRC review and a number of lessons from the application preparation process have been learned. Recommended changes to industry and NRC guidance, and other related comments, regarding the ESP demonstration process have been documented. Thus far, the COL Application process has not been tested.

Currently, available guidance from both the NRC and nuclear industry for an ESP and/or a COL Application is not comprehensive and precise. When room is left for interpretation, the opportunity exists for creating confusion and inconsistency in the draft, or even final, work products. Furthermore, the issuance of the 3rd Proposed Revision 1 of R.G. 1.23 is expected by the end of 2006. Applicants should be prepared to address any changes in the revised regulatory guide, if any are made. Therefore, close coordination and cooperation between the regulatory agency and permit applicants is highly desirable in order to refine the streamlined licensing process as well as to ensure a successful permit application.

REFERENCES

- Regulatory Guide 1.23, "Onsite Meteorological Programs," Rev. 0, dated February 1972, and Proposed Revision 1 to R.G. 1.23, dated September 1980
- NUREG-0800, Draft Revision 3 to Standard Review Plan (SRP), Section 2.3.3, "Onsite Meteorological Measurements Program," April 1996
- NUREG-1555, "Standard Review Plans for Environmental Reviews for Nuclear Power Plants," ESRP 9.3 (Subsection III(8)), October 1999
- RS-002, "Processing Applications for Early Site Permits," May 2004
- Draft RG DG-1145, "Combined License Applications for Nuclear Power Plants (LWR Edition)," dated June 2006
- An industry standard, ANS/ANSI 3.11-2000/2005, "Determining Meteorological Information at Nuclear Facilities"
- Nuclear Energy Institute (NEI), NEI 01-02, Industry Guideline For Prepare An Early Site Permit Application – 10 CFR Part 52, Subpart A", September 2001.
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