Meteorological Information Needs For An Early Site Permit Application

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ABSTRACT

The DOE's Nuclear Power 2010 Initiative announced by the Secretary of Energy focuses on building new nuclear plants in the United States before the end of the decade. An Early Site Permit (ESP) demonstration could be qualified for potential government funding up to 50% of its cost. A brief description of the advanced nuclear technologies with the potential for deployment by 2010 is provided. 10 CFR 52, Subpart A, specifies the requirements and procedures for the ESP applications. However, no regulatory guidance documents for format/content and meteorological information requirements are readily available for an ESP application. This paper addresses the meteorological information needs from the author's perspective and the pertinent regulatory and industrial guidance for preparing such an application. Since extensive and long-term site-specific environmental information exist in all nuclear power plant sites, substantial saving in cost and schedule could be realized from collocating a new plant at an existing site. This paper also provides cautionary notes for leveraging meteorological information collected at existing nuclear sites.

1.0 INTRODUCTION

US Electric power industry has recently faced an unsettled environment, including unprecedented high fuel prices, increasing environmental controls, and deregulation of the industry. Despite these impacts, electricity demand in the Unites States continues to grow in support of the ever-growing economy. To meet the future demand and achieve energy security, the Bush administration's National Energy Policy calls for expanding nuclear energy.

Presently domestic nuclear power industry generates approximately 20% of the nation's electricity demand. The DOE's Nuclear Power 2010 initiative unveiled by the Secretary of Energy focuses on building new nuclear plants in the United States before the end of the decade. As part of the initiatives, the Nuclear Energy Research Advisory Committee has recommended ESP demonstrations as an area for potential government-industry cost shared activities.

Historically, extensive environmental information has been collected at nuclear power plant sites. Given the readily available transmission system, plant structures, and public acceptance of an operating plant, there could be a substantial cost and schedule saving by using an existing nuclear site. Thus, these sites can be considered as the preferential candidates for additional new units. The potential government funding support further provides a strong incentive for those companies that are interested in moving ahead with site suitability evaluations and ESP applications.

This paper addresses the meteorological information needs and the pertinent regulatory and industrial guidance for an Early Site Permit (ESP) application. It also provides a brief description of the advanced nuclear technologies and cautionary notes for leveraging meteorological information collected at an existing nuclear site where the new plant will be located.

2.0 PERTINENT ESP GUIDANCE INFORMATION

Regulatory Guidance Documents

10 CFR 52, Subpart A, specifies the requirements and procedures for ESP Applications. However, no standard format and content for preparing the application is available. Based on the requirements in 10 CFR 52.17, an ESP application can be divided into four major parts:

Part 1. Administration Information - Provides an introduction to the Application and its subparts.

Part 2. Site Safety Analysis Report - Describes the features of the new reactor design that interface with the site, identifies the capabilities of the design to withstand environmental and man-made hazards, and evaluates the expected and potential impacts of the design on the site.

Part 3. Environmental Report - Describes the environmental effects of construction and operation of the new reactor facility, and evaluations alternatives.

Part 4. Emergency Response Plan - Provides a complete and integrated Emergency Response Plan.

It has been generally accepted that a proposed site could be considered for a spectrum of nuclear reactor types in an ESP Application by taking plant parameters enveloping approach.

Although the NRC considered that the Part 52 licensing process was ready to be used, there is no single regulatory guidance document that specifically defines the meteorological information requirements for an ESP Application. However, detailed guidance on meteorological information required for assessing siting, licensing, plant design, and radiological emergency response can be found in the following:

- RG 1.70 – Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants, 1978
- RG 4.2 – Preparation of Environmental Reports for Nuclear Power Stations, 1976
- RG 1.3 – Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss-Of-Coolant Accident for Boiling Water Reactors
- RG 1.4 – Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss-Of-Coolant Accident for Pressurized Water Reactors
- RG 1.23 – Onsite Meteorological Programs, Revision 1, 1980
- RG 1.27 – Ultimate Heat Sink for Nuclear Power Plants, 1976
- RG 1.76 – Design Basis Tornado for Nuclear Power Plants
- RG 1.117 – Tornado Design Classification
- RG 1.111 – Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases for Light-Water-Cooled Reactors, July 1977
- RG 1.145 – Atmospheric Models for Potential Accident Consequence Assessments at Nuclear Power Plants, November 1982
- RG 4.7 – General Site Suitability Criteria for Nuclear Power Stations, Revision 2, April 1998
- NUREG 1555 – Environmental Standard Review Plan, October 1999

Industry Guidance Documents

In parallel with the NRC's efforts in the area of new plant licensing activities, the nuclear industry has been working on a number of fronts to foster a climate that supports new nuclear generation. The industry initiatives are partly expressed in the documents below:

- NEI 01-02 (Revision A) – Industry Guideline For Preparing An Early Site Permit Application, September 2001
- ANSI/ANS 2.5 – Standard for Determining Meteorological Information At Nuclear Power Sites, September 1984
- ANSI/ANS 3.11 – American National Standard For Determining Meteorological Information At Nuclear Facilities, February 1999

3.0 METEOROLOGICAL INFORMATION NEEDS

The nation's fleet of existing commercial nuclear power plants were all licensed mostly during the 60s through the early 80s, under the NRC process commonly referred to as "Part 50". The NRC has concluded that regulatory guides and associated guidance documents should be updated to support new licensing activities.

Since there is no single up-to-date regulatory guidance document that specifically defines meteorological information requirements for an ESP application, the NRC expects and encourages potential ESP applicants to engage in pre-application dialog to help flush out these and related requirements. The following summarizes the author's interpretation of the meteorological information needs

Meteorological Information Requirements

In preparation of an ESP Application, meteorological information is used in a number of plant design and safety/environmental evaluations, including estimating dispersion and downwind effluent concentrations, evaluating accident impacts, determining cooling system performance, providing a design bases for severe weather phenomena, estimating environmental impacts of cooling system, plant construction/operation, and supporting consequence assessment. The required meteorological information is summarized below:

- Regional Climatology – General climate, regional meteorological conditions for design and operating bases, data used in evaluating Ultimate Heat Sink performance, and design basis tornado information
- Local Meteorology - Normal and extreme values of meteorological parameters (e.g., wind, temperature, humidity, precipitation, and atmospheric stability), local meteorological conditions for design and operating bases, and assessing potential influence of the plant and its facilities on local meteorology and its surrounding environment
- Onsite Meteorological Monitoring Program – Description of facilities and equipment, and hourly data summaries
- Short-term Diffusion Estimates
- Long-term Diffusions Estimates
- Emergency Response

Potential Additional Data Requirements

- Visibility and solar radiation measurements may be necessary in conjunction with cooling system assessments.

- Sites with unusual air quality characteristics (such as high concentrations of airborne particulates or corrosive chemicals) could require air quality monitoring instrumentation.

- Ambient air salt concentration and deposition measurements should be made at sites with cooling towers or spray pond using brackish or saline water.

- Additional meteorological information could be required for making realistic estimates of meso-scale atmospheric transport and diffusion to a distance of 50 miles from the plant site.

Source Of Meteorological Information

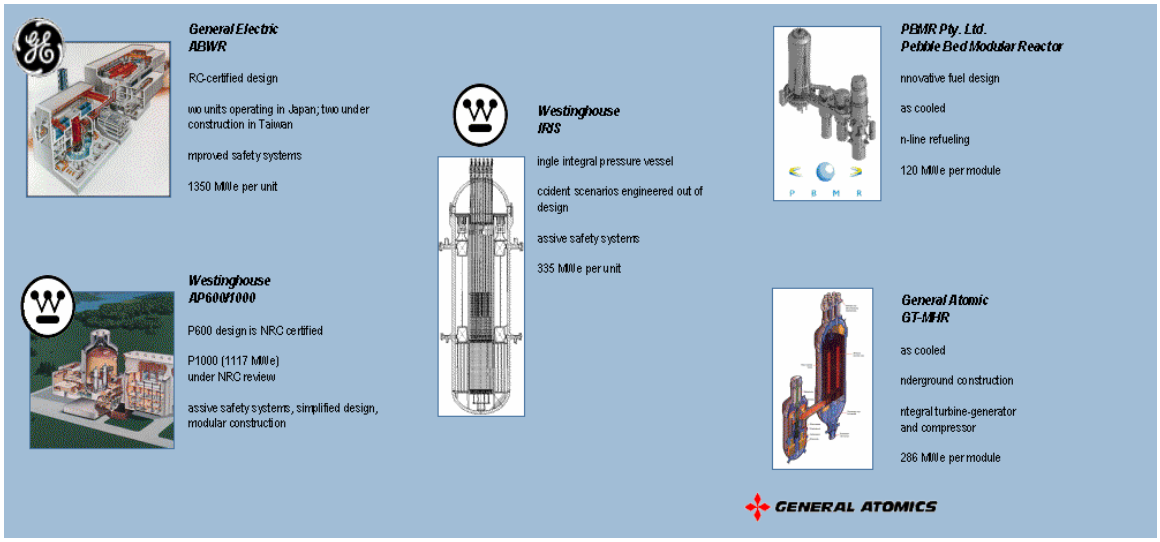
Meteorological information is developed from a variety of sources, including published summaries available from the National Oceanic and Atmospheric Administration, commercial weather data stations, and nuclear facilities in-house meteorological monitoring systems.

Meteorological conditions for design and operating bases are generally extracted from existing long-term data, which is obtained from meteorological stations proximal to the proposed site, and is interpolated or extrapolated to infer meteorological conditions at the site.

Meteorological data collected onsite is utilized in evaluating the environmental impacts, providing diffusion estimates for assessing the routine/accident radioactivity releases impacts, and for dealing with emergency response. In general, a minimum of one-year of onsite meteorological data is required. Note that meteorological data required to support consequence assessments associated with emergency response differ significantly from the archived data used for climate characterization, environmental impact assessment and compliance analysis purposes, in that this data must be available in real-time.

4.0 Advanced Nuclear Technologies

New nuclear technology with the potential for deployment by 2010 includes General Atomics Gas Turbine-Modular Helium Reactor, Westinghouse AP600 and AP1000, International Reactor Innovative and Secure, General Electric Advanced Boiling Water Reactor (ABWR) and Pebble Bed Modular Reactor.



The design and configuration of these new generation reactors are significantly different from the conventional existing commercial nuclear power plants. Besides the ABWR and the AP600/1000 reactors, the remaining reactor types are much smaller in generating capacity, approximately 300 MWe or less in modular units.

5.0 LEVERAGING EXISTING METEOROLOGICAL DATA

As previously discussed, extensive and long-term site-specific environmental information exist at all nuclear power plants. Substantial saving in cost and schedule could be realized from collocating a new plant at an existing site. However, one must ensure the applicability of the existing data for the new plant before using.

A sample list of issues that could affect the results of the evaluation regarding representativeness and accuracy of the data collected is provided. Special considerations for data validation are also briefly discussed below.

Location of the meteorological tower(s)

Regulatory Guidance: The meteorological tower site shall represent as closely as possible the same meteorological characteristics as the region into which any airborne material will be released. For no discernible influence on measurements, towers should be located at least ten obstruction heights away from major obstructions and at a location upwind of the heat dissipation system to be used during new plant operation.

Data validation should include the following activities:

- Verify that the tower position will allow the instrumentation to provide measurements that represent the overall site meteorology without interference from any existing and planned new plant structures, modifications of the local airflow patterns resulted from the finished plant grade of the new plant, and nearby terrain features.

- Confirm that supplementary instrumented-towers are not required in order to better define atmospheric conditions in the site vicinity, including emergency planning zones.

- Examine the proximity and heights of nearby trees that have grown since the erection of the tower. Confirm that the physical separation requirement between the tower and the nearby obstructions is still being met.

- Avoid placing the cooling towers directly upwind of the existing tower for potential localized influence on the measurements, if cooling towers are to be used for the new plant.

Instrument Siting

Regulatory Guidance: Detail guidance is provided in RG 1.23 and ANSI/ANS 2.5 and 3.11.

Data validation should include the following tasks:

- Examine the local exposure of the wind and temperature sensors and confirm that the measurements collected will represent the general site area after new plant construction.

- Verify that wind speed and direction measurements collected for the existing plant were at 10-meter level and also at the representative levels of the new plant releases.

- Evaluate the heat reflection characteristics of the surface underlying the meteorological tower (grass, soil, gravel, paving, etc.) and confirm that localized influences on measurements are minimal. Often surface area at or near the base of a meteorological tower has been altered from its original conditions over the years.

- Verify that the measurements of ambient moisture content (e.g., relative humidity, dew point or wet-bulb temperature) made for the existing plant were at approximately 10 meters and also at a height representative of the cooling tower moisture release height, if cooling towers are to be used for the new plant,

Instrument Maintenance and Quality Assurance

Regulatory Guidance: Meteorological instruments should be inspected and serviced at a frequency that will minimized extended periods of outage and ensure at least an annual 90 percent joint data recovery for atmospheric stability, wind speed, and wind direction

Data validation should include the following activities:

- Verify that the quality assurance program employed for the existing nuclear power plant is consistent with the provisions of Appendix B to 10 CFR Part 50.

- Examine system inspection, instrument maintenance, and instrument calibration records and confirm that the data collected are valid.

Diffusion Estimates

Diffusion estimate is a function of wind speed, wind direction, stability class and downwind distances as well as releases characteristics and receptor location.

One must proceed with great caution when using or extrapolating existing diffusion estimates. Verify that the meteorological data used in the existing estimates continue to represent the dispersion conditions at the new plant and the nature of the releases and the releases-receptor pair relationship remain unchanged.

6.0 CONCLUSIONS

As noted previously, there is no single up-to-date regulatory guidance that specifically defines meteorological information requirements for an ESP Application and a significant portion of the NRC guidance (which were written to support the 10 CFR Part 50 licensing process) is dated or only indirectly relevant. Therefore, actively seeking regulatory guidance and maintaining close coordination with NRC are strongly recommended when preparing such an application.

Since extensive and long-term site-specific environmental information exist at all nuclear power plants, substantial cost and schedule saving can be realized by collocating a new nuclear plant in an existing site. However, applicant must ensure that the existing meteorological data also represent the dispersion conditions of the new proposed plant prior to using.

7.0 REFERENCES

- 10 CFR Part 50, Domestic Licensing of Protection and Utilization Facilities
- 10 CFR Part 51, Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions
- 10 CFR Part *52,* Early Site Permits: Standard Design Certifications; and Combined Licenses for Nuclear Power Plants
- 10 CFR Part 100, Reactor Site Criteria
- NRC Regulatory Guide 4.2, Preparation of Environmental Reports for Nuclear Power Stations, Revision 2, July 1976 and Supplement1, September 2000
- NRC Regulatory Guide 1.70, Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants, November 1978
- NRC Regulatory Guide 1.3, Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss-Of-Coolant Accident for Boiling Water Reactors
- NRC Regulatory Guide 1.4, Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss-Of-Coolant Accident for Pressurized Water Reactors
- NRC Regulatory Guide 1.23, Onsite Meteorological Programs, Revision 1, 1980
- NRC Regulatory Guide 1.27, Ultimate Heat Sink for Nuclear Power Plants, 1976
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- NRC Regulatory Guide 1.145, Atmospheric Models for Potential Accident Consequence Assessments at Nuclear Power Plants, November 1982
- ANSIIANS *2.5,* Standard for Determining Meteorological Information At Nuclear Power Sites, September 1984
- NRC Regulatory Guide 4.7, General Site Suitability Criteria for Nuclear Power Stations, Revision 2, April 1998
- ANSI/ANS 3.11, American National Standard For Determining Meteorological Information At Nuclear Facilities, February 1999
- NUREG-1555, Standard Review Plans for Environmental Reviews for Nuclear Power Plants, U.S. Nuclear Regulatory Commission, October 1999
- NEI 01-02 (Revision A), Industry Guideline For Preparing An Early Site Permit Application, September 2001