



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

3.3.1 WIND LOADINGS

REVIEW RESPONSIBILITIES

Primary - Structural Engineering Branch (SEB)

Secondary - None

I. AREAS OF REVIEW

The following areas relating to the design of structures that have to withstand the effects of the design wind\* specified for the plant are reviewed to assure conformance with the requirements of General Design Criterion 2 (Ref. 1).

1. The design wind velocity and its recurrence interval, the velocity variation with height, and the applicable gust factors are reviewed from the standpoint of use in defining the input parameters for the structural design criteria appropriate to account for wind loadings. The bases for the selection and the values of these parameters are within the review responsibility of the Meteorology Section of the Accident Evaluation Branch (AEB) as stated in SRP Sections 2.3.1 and 2.3.2.
2. The procedures that are utilized to transform the design wind velocity into an effective pressure applied to structures are reviewed taking into consideration the geometrical configuration and physical characteristics of the structures and the distribution of wind pressure on the structures.

II. ACCEPTANCE CRITERIA

SEB accepts the design of structures that must withstand the effects of the design wind load if the relevant requirements of General Design Criterion 2 concerning natural phenomena are complied with. The criteria necessary to meet the relevant requirements of GDC 2 are as follows:

\*Referred to as 100-year return period "fastest mile of wind" in SRP Section 2.3.1.

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USNRC STANDARD REVIEW PLAN

Standard review plans are prepared for the guidance of the Office of Nuclear Reactor Regulation staff responsible for the review of applications to construct and operate nuclear power plants. These documents are made available to the public as part of the Commission's policy to inform the nuclear industry and the general public of regulatory procedures and policies. Standard review plans are not substitutes for regulatory guides or the Commission's regulations and compliance with them is not required. The standard review plan sections are keyed to the Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants. Not all sections of the Standard Format have a corresponding review plan.

Published standard review plans will be revised periodically, as appropriate, to accommodate comments and to reflect new information and experience.

Comments and suggestions for improvement will be considered and should be sent to the U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, Washington, D.C. 20555.

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1. The wind used in the design shall be the most severe wind that has been historically reported for the site and surrounding area with sufficient margin for the limited accuracy, quantity, and period of time in which historical data has been accumulated.
2. The acceptance criteria for the design wind velocity and its recurrence interval, the velocity variation with height, the applicable gust factors, and the bases for determining these site-related parameters, are established by the Accident Evaluation Branch (AEB) and are contained in SRP Sections 2.3.1 and 2.3.2. The approved values of these parameters should serve as basic input to the review and evaluation of the structural design procedures.
3. The procedures utilized to transform the wind velocity into an effective pressure to be applied to structures and parts and portions of structures, as delineated in ANSI A58.1, "Building Code Requirements for Minimum Design Loads in Buildings and Other Structures" (Ref. 2), are acceptable. In particular, the procedures utilized are acceptable if found in accordance with the following:

For a design wind velocity of  $V_{30}$  mph specified at a height of 30 feet above the ground, the velocity pressure,  $q_{30}$ , is given by:

$$q_{30} = 0.00256 V_{30}^2 \text{ psf}$$

The effective pressure for structures,  $q_f$ , and for portions thereof,  $q_p$ , at various heights above the ground should be in accordance with Table 5 and Table 6 of ANSI A58.1, respectively. Since most nuclear power plants are located in relatively open country, Exposure C, as defined in ANSI A58.1, should be selected for both tables.

Depending upon the structure geometry and physical configuration, pressure coefficients may be selected in accordance with Section 6.4 of ANSI A58.1. Geometrical shapes that are not covered in this document are reviewed on a case-by-case basis. ASCE Paper No. 3269, "Wind Forces on Structures" (Ref. 3), may be used to obtain the effective wind pressures for cases which ANSI A58.1 does not cover.

### III. REVIEW PROCEDURES

The reviewer selects and emphasizes material from the review procedures described below as may be appropriate for a particular case.

1. The site-related parameters described in subsection I.1 are reviewed by the Accident Evaluation Branch (AEB) under SRP Sections 2.3.1 and 2.3.2. The structural reviewer examines the approved values of these parameters to assure that they are consistent with those contained in SRP Sections 2.3.1 and 2.3.2.

2. After the acceptability of the site-related parameters is established, the reviewer proceeds with the evaluation of the structural aspects of wind design. The procedures used by the applicant to transform wind velocities into effective pressures are reviewed and compared with those procedures delineated in subsection II of this plan.

#### IV. EVALUATION FINDINGS

The reviewer verifies that sufficient information has been provided to satisfy the requirements of this SRP section, and concludes that his evaluation is sufficiently complete and adequate to support the following type of conclusive statement to be included in the staff's safety evaluation report:

The staff concludes that the plant design is acceptable and meets the requirements of General Design Criterion 2. This conclusion is based on the following:

The applicant has met the requirements of GDC 2 with respect to the capability of the structures to withstand design wind loading so that their design reflects

1. appropriate consideration for the most severe wind recorded for the site with an appropriate margin;
2. appropriate combinations of the effects of normal and accident conditions with the effects of the natural phenomena; and
3. the importance of the safety function to be performed.

The applicant has met these requirements by using ANSI A58.1 and ASCE paper No. 3269, which the staff has reviewed and found acceptable, to transform the wind velocity into an effective pressure on structures and for selecting pressure coefficients corresponding to the structures geometry and physical configuration.

The applicant has designed the plant structures with sufficient margin to prevent structural damage during the most severe wind loadings that have been determined appropriate for the site so that the requirements of Item 1 listed above are met. In addition, the design of seismic Category 1 structures, as required by Item 2 listed above, has included in an acceptable manner load combinations which occur as a result of the most severe wind load and the loads resulting from normal and accident conditions.

The procedures used to determine the loadings on structures induced by the design wind specified for the plant are acceptable since these procedures have been used in the design of conventional structures and proven to provide a conservative basis which together with other engineering design considerations assures that the structures will withstand such environmental forces. The use of these procedures provides reasonable assurance that in the event of design basis winds, the structural integrity of the plant structures that have to be designed for the design wind will not be impaired and, in consequence, safety-related systems and components located within these structures are adequately protected and will perform their intended safety functions if needed, thus satisfying the requirement of Item 3 listed above.

## V. IMPLEMENTATION

The following is intended to provide guidance to applicants and licensees regarding the NRC staff's plans for using this SRP section.

Except in those cases in which the applicant proposes an acceptable alternative method for complying with specified portions of the Commission's regulations, the method described herein will be used by the staff in its evaluation of conformance with Commission regulations.

## VI. REFERENCES

1. 10 CFR Part 50, Appendix A, General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena."
2. ANSI A58.1, "Building Code Requirements for Minimum Design Loads in Buildings and Other Structures," Committee A58.1, American National Standards Institute.
3. ASCE Paper No. 3269, "Wind Forces on Structures," Transactions of the American Society of Civil Engineers, Vol. 126, Part II (1961).