Earthquake Instrumentation Criteria for Nuclear Power Plants

REAFFIRMED

November 16, 2020

ANSI/ANS-2.2-2016 (R2020)

An American National Standard

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American National Standard Earthquake Instrumentation Criteria for Nuclear Power Plants

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American National Standard

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Foreword

(This foreword is not a part of American National Standard "Earthquake Instrumentation Criteria for Nuclear Power Plants," ANSI/ANS-2.2-2016.)

The purpose of this standard is to specify for water-cooled nuclear power plants the minimum requirements for earthquake instrumentation. Should an earthquake occur, the instrumentation provides information on the vibratory ground motion and resultant vibratory responses of representative Category I structures (defined in U.S. Nuclear Regulatory Commission Regulatory Guide 1.29, "Seismic Design Classification for Nuclear Power Plants") so that an evaluation can be made as to

(1) whether or not the design response spectra have been exceeded;

(2) whether or not the motion was damaging through determination of its standardized cumulative absolute velocity (CAV) as incorporated in ANSI/ANS-2.23-2016, "Nuclear Power Plant Response to an Earthquake";

(3) whether or not the calculated vibratory responses used in the design of the representative Category I structures and equipment have been exceeded at instrumented locations;

(4) the degree of applicability of the mathematical models used in the seismic analysis of the building and equipment.

In addition, instrumentation could be provided to furnish specific information that would increase knowledge and understanding of seismic design. The problem of determining what additional instrumentation is needed to perform this function should be the basis of research and development programs and is not addressed in this standard.

The seismic design of nuclear power facilities requires, in part,

(1) the determination of (a) site-specific earthquake ground motion response spectra, and (b) site-independent certified broadband smooth response spectra, referred to as certified seismic design response spectra (CSDRS);

(2) the construction of mathematical models for dynamic analysis from which the vibratory response of structures and equipment to the input vibratory ground motion can be calculated.

Seismic designs for nuclear power plants utilize advanced analytical and design techniques. Therefore, evidence that the earthquake ground motion response spectra, developed from actual instrumental measurements, did not exceed the design basis spectral values, or that the CAV from the free-field instrument showed that the motion was not damaging, in accordance with ANSI/ANS-2.23-2016, "Nuclear Power Plant Response to an Earthquake," would give reasonable assurance that plant structures and equipment were not damaged or made inoperable. In addition, the determination by actual instrument data of (a) the resultant vibratory responses of representative structures, (b) the input to supported equipment, and (c) the check of the applicability of mathematical models used in the dynamic analysis would give further assurance that plant structures or equipment was not damaged.

When an earthquake occurs, it is important to determine as soon as possible (within 4 hours) whether or not the free-field motion exceeded predetermined conditions in accordance with ANSI/ANS-2.23-2016. An acceptable instrumentation system would provide necessary data in a conveniently usable form for making this determination in a timely manner. Through the use of commercially available instruments, and by specifying their functional and operational requirements, an acceptable instrumentation system can be assembled, procured, installed, and operated. This standard provides the minimum requirements for an acceptable seismic instrumentation system.

The basic and most important instrument for measuring vibratory motion is the data acquisition unit (DAU), a subsystem of the seismic monitoring system (time-history accelerograph in previous versions of this standard), that acquires, stores, and transmits digital data from one or more sensors. A DAU consists of amplifiers, analog-to-digital converter, storage, telemetry, and timing source (for instance, global positioning system or network time protocol). From the resulting time-history records, the peak accelerations and duration can be determined, and the response spectra and CAV can be derived by computation.

This standard references documents and other standards that may have been, or become, superseded or withdrawn at the time the standard is applied. A statement has been included in the reference section that provides guidance on the use of such references.

This standard does not explicitly incorporate the concepts of generating risk-informed insights, performance-based requirements, or a graded approach to quality assurance. The user is advised that one or more of these techniques could enhance the application of this standard.

This standard was prepared by Working Group ANS-2.2 of the American Nuclear Society Standards Committee. This is a major revision to the ANSI/ANS-2.2-2002 standard. All comments received were reviewed and, where possible, were incorporated. Working Group ANS-2.2 had the following membership during its work on this standard:

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