

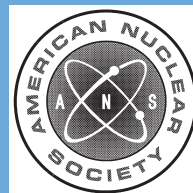
American Nuclear Society

WITHDRAWN

earthquake instrumentation criteria
for nuclear power plants

an American National Standard

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**American National Standard
Earthquake Instrumentation Criteria
for Nuclear Power Plants**

Secretariat
American Nuclear Society

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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-2.2-1988.)

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 and equipment (defined in U.S. Nuclear Regulatory Commission Regulatory Guide 1.29, "Seismic Design Classification") 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 calculated vibratory responses used in the design of the representative Category I structures and equipment have been exceeded at instrumented locations; and
- (3) 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 which 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 an input vibratory grounded motion for the site. Input vibratory ground motion could be described as "response spectra," or time-history earthquake records. Most nuclear plant owners have specified their design input vibratory ground motion by response spectra in the form of "design response spectra" in their application to the Nuclear Regulatory Commission (NRC).
- (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 response spectra did not exceed the design response spectra would give reasonable assurance that plant structures and equipment were not damaged. The determination by actual instrument data of the resultant vibratory responses of representative structures and equipment and the check of the applicability of mathematical models used in the dynamic analysis would give additional assurance that plant structures or equipment were not damaged.

Instrument locations should be related to the locations of the "input" and "output" vibratory motions used in the seismic design. Typical general locations are:

- (1) Input vibratory ground motion:
 - a. "Free-field"
 - b. Containment foundation.
- (2) Output vibratory response motion:
 - a. Containment structure or reactor building
 - b. Reactor equipment
 - c. Reactor piping
 - d. Other Category I structures, equipment and piping.

Specific locations should be selected by the nuclear plant designer to obtain the most pertinent information.

This standard was prepared by Working Group ANS-2.2 of Subcommittee ANS-2, Site Evaluation, of the American Nuclear Society Standards Committee.

This revision incorporates a few minor changes to the ANS-2.2-1978 standard. All comments received and reviewed and where possible, incorporated. All negative ballots have been retracted.

Working Group ANS-2.2 of the Standards Committee of the American Nuclear Society had the following membership:

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When an earthquake occurs, it is important to determine as soon as possible whether or not seismic design conditions were exceeded. An ideal instrumentation system would immediately provide in a usable and convenient form (for example, permanent visual record, remote indication) the information for making this determination. Using commercially available instruments, the necessary functions of this ideal instrumentation system can be provided. The providing of these functions is the basis for the minimum requirements specified in this standard.

The basic and most important instrument for measuring vibratory motion is the time-history accelerograph (T/A), which measures and records absolute acceleration as a function of time during an earthquake. This may be a self-contained instrument or it may consist of acceleration sensors, which detect absolute acceleration and transmit the data to a remote central recorder. From the resulting time-history records, the peak accelerations can be determined, and the response spectra can be derived by computation.

An almost equally important instrument in measuring structural response is the response spectrum recorder (R/S), which measures and records spectral accelerations at specified frequencies during an earthquake. This may be a passive instrument, or an active instrument and may transmit data to a remote terminal.

A seismic switch (S/S) can provide an immediate signal to remotely indicate if a specified acceleration has been exceeded. It consists of an acceleration sensor and a switch closure. Such an instrument can provide the basis for immediate administrative procedures or decisions following an earthquake.

A response spectrum switch (R/SS) can provide an immediate signal to remotely indicate if a specified spectral acceleration has been exceeded. Such an instrument can provide the basis for immediate administrative procedures or decisions following an earthquake.

A peak accelerograph (P/A) is a passive instrument requiring no power that can detect and record peak acceleration. Such a passive instrument can provide needed information after an earthquake, in the event a powered instrument fails to operate.

In summary, the following instrumentation functions can be provided:

- (1) Recording of the time-history of vibratory motion;
- (2) Recording of a point or points on a response spectrum;
- (3) Remote immediate indication that a specified acceleration has been exceeded;
- (4) Remote immediate indication that specified spectral acceleration(s) has been exceeded; and
- (5) Recording of peak acceleration by a non-powered, passive instrument.

At the time of its approval of this standard, Subcommittee ANS-2, Site Evaluation, had the following membership:

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