



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

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MEMORANDUM FOR: Raymond F. Fraley, Executive Director
Advisory Committee on Reactor Safeguards

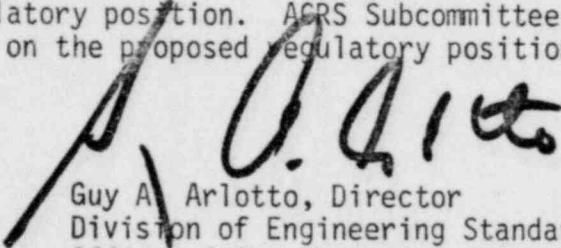
FROM: Guy A. Arlotto, Director
Division of Engineering Standards
Office of Standards Development

SUBJECT: PROPOSED REVISION 2 TO REGULATORY GUIDE 1.12,
"INSTRUMENTATION FOR EARTHQUAKES"

Enclosed for review by the ACRS Regulatory Activities Subcommittee are fifteen (15) copies of the Proposed Revision 2 to Regulatory Guide 1.12, "Instrumentation for Earthquakes" (Working Paper B, dated July 22, 1980), and the preliminary value/impact statement for the proposed guide.

Current Regulatory Guide 1.12 endorses ANSI N18.5-1974, "Earthquake Instrumentation Criteria for Nuclear Power Plants," with several exceptions regarding the number and location of seismic recording instruments. Working Group ANS 2.2 of the American Nuclear Society Standards Committee has revised N18.5. The revised standard reflects most of the exceptions taken in current R.G. 1.12. The proposed regulatory guide will endorse the new revised Standard ANSI/ANS-2.2-1978 to eliminate most of the exceptions.

Since the proposed revision to the guide is preliminary, additional staff effort, including review and resolution of public comments, will be necessary prior to implementation of a regulatory position. ACRS Subcommittee comments and recommendations are requested on the proposed regulatory position prior to issuance for a comment period.

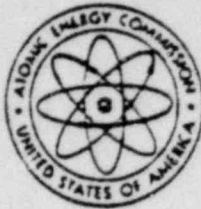

Guy A. Arlotto, Director
Division of Engineering Standards
Office of Standards Development

Enclosures:

- (1) Draft R.G. 1.12, Rev. 2, 7/22/80
- (2) Value/impact assessment for
Draft R.G. 1.12

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NUCLEAR REGULATORY COMMISSION
U.S. ATOMIC ENERGY COMMISSION

Revision 2
Working Paper B
JULY 22, 1980

REGULATORY GUIDE

DIRECTORATE OF REGULATORY STANDARDS
OFFICE OF STANDARDS DEVELOPMENT

REGULATORY GUIDE 1.12

INSTRUMENTATION FOR EARTHQUAKES

A. INTRODUCTION

Paragraph (c) of § 50.36, "Technical Specifications," of 10 CFR Part 50, "Licensing of Production and Utilization Facilities," provides that the technical specifications will include surveillance requirements to assure that the necessary quality of systems and components is maintained, that facility operation will be within safety limits, and that the limiting conditions of operation will be met. Appendix A, "Seismic and Geologic Siting Criteria for Nuclear Power Plants," to 10 CFR Part 100, "Reactor Site Criteria," requires, in Paragraph VI (a)(3), a suitable program for implementing this requirement with regard to seismic instrumentation needed to determine promptly the seismic response of nuclear power plant features important to safety to permit comparison of such response with that used as the design basis. Such a comparison is needed to decide whether the plant can continue to be operated safely. This guide describes seismic instrumentation acceptable to the ~~AEC Regulatory~~ staff as satisfying the above-stated requirements of Appendix A to 10 CFR Part 100. This guide does not, however, address the need for instrumentation that would automatically scram a nuclear power plant or specify the methods to be used in the analysis of recorded data. ~~The Advisory Committee on Reactor Safeguards has been consulted concerning this guide and has concurred in the regulatory position.~~

NRC

B. DISCUSSION

When an earthquake occurs, it may not be known immediately how severe the effects of the earthquake are on a given nuclear power plant. It is advisable to have triaxial time-history accelerographs¹ installed at

¹ This guide is a revision of Safety Guide 12.

American National ~~Standard~~ ^{ANSI/ANS-2.2-1978} ~~ANSI Standard~~ "Earthquake Instrumentation Criteria for Nuclear Power Plants", for definitions. This standard is available from the American Nuclear Society, 244 East Ogden Avenue, Hinsdale, Illinois 60521.

555 NORTH KENSINGTON AVENUE,
La Grange Park, Illinois 60525

USAEC REGULATORY GUIDES

Regulatory Guides are issued to describe and make available to the public methods acceptable to the AEC Regulatory staff of implementing specific parts of the Commission's regulations, to delineate techniques used by the staff in evaluating specific problems or potential accidents, or to provide guidance to applicants. Regulatory Guides are not substitutes for regulations and compliance with them is not required. Methods and actions different from those set out in the guides will be acceptable if they provide a basis for the findings requisite to the issuance or continuation of a permit or license by the Commission.

Published guides will be revised periodically, as appropriate, to accommodate changes and to reflect new information or experience.

appropriate locations to provide data on the seismic input to containment, data on the frequency, amplitude, and phase relationship of the seismic response of the containment structure, and data on the seismic input to other Seismic Category I structures, systems, and components. It is desirable that these strong-motion accelerographs be located so as to facilitate the engineering analysis of the recorded traces following an earthquake.

The acceleration value corresponding to zero period in the containment foundation design response spectra may be referred to as the "acceleration level" of the input design earthquake motion to the containment structure. This acceleration level is an important parameter because the magnitudes of the design response spectra themselves are affected to a large extent by this level, and the plant shutdown requirement as specified in Appendix A to 10 CFR Part 100 is also related to this level. It is therefore necessary to install a triaxial seismic switch at an appropriate location in the basement capable of providing an immediate signal to remotely indicate if the specified zero-period acceleration has been exceeded. This can provide the basis for immediate administrative procedures if needed.

Appendix A to 10 CFR Part 100 requires that all the structures, systems, or components of a nuclear power plant necessary for continued operation without undue risk to the health and safety of the public be designed to remain functional when subject to the Operating Basis Earthquake (OBE). Since the zero-period acceleration of the containment foundation design response spectra representing the OBE may not fully describe the seismic event, it is important to have a triaxial response-spectrum recorder installed at an appropriate location in the basement of the plant capable of providing immediate signals for remote indicating in the control room if any significant portion of the foundation design response spectra has been exceeded. This can provide additional basis for

Copies of published guides may be obtained by request indicating the divisions covered to the U.S. Atomic Energy Commission, Washington, D.C. 20545. Attention: Director of Regulatory Standards. Comments and suggestions for improvements in these guides are encouraged and should be sent to the Secretary of the Commission, U.S. Atomic Energy Commission, Washington, D.C. 20545. Attention: Chief, Public Proceedings Staff.

The guides are issued in the following ten broad divisions:

- | | |
|-----------------------------------|------------------------|
| 1. Power Reactors | 6. Products |
| 2. Research and Test Reactors | 7. Transportation |
| 3. Fuels and Materials Facilities | 8. Occupational Health |
| 4. Environmental and Siting | 9. Accident Review |
| 5. Materials and Plant Protection | 10. General |

immediate administrative procedures or decisions immediately following an earthquake.

The effects of the seismic motion at a given floor level in a structure can be represented by calculated floor response spectra. In many of the nuclear power plants, calculated floor response spectra are also used to design Seismic Category I systems and components supported on these levels. It is therefore important to install triaxial ~~response spectrum~~ recorders at the selected support (floor) locations to determine if the calculated floor response spectra have been exceeded. This information will be needed to determine (1) the conservatism in the modeling and design assumptions made for the structure and design input motion to the supported systems and components and (2) the advisability of continuing the operation of the plant without a safety analysis following an earthquake.

recording instruments

The magnitude of the response of the systems and components supported on the containment structure is required in order to verify if the actual response of these parts has exceeded the design basis. This can be monitored by installing triaxial peak accelerographs² over selected locations on these parts. In addition, peak response of these parts will be necessary to determine the conservatism in the modeling and design assumptions made for these systems and components.

The severity of response of a given Seismic Category I structure will depend to a large degree on the maximum acceleration of the Safe Shutdown Earthquake at the foundation of the containment structure. It is therefore reasonable to relate the amount of instrumentation desirable to the magnitude of the maximum expected foundation acceleration. For this purpose, Safe Shutdown Earthquakes are divided into two categories: (1) earthquakes with maximum foundation accelerations of less than 0.3 g, and (2) earthquakes with maximum foundation accelerations of 0.3 g or greater. The earthquakes in the first category may be termed as ranging from moderate to strong, and the earthquakes in the second category may be called severe. This guide prescribes appropriate instrumentation for monitoring these categories.

Working Group ANS-2.2 of Subcommittee ANS-2, Site Evaluation, of the American Nuclear Society Standards Committee, prepared ANSI/~~ANS-2.2-1978~~, "Earthquake Instrumentation Criteria for Nuclear Power Plants," which contains ~~most~~ of the criteria with respect to location and number of instruments, instrument characteristics, and instrumentation station installations specified in this guide.

ANS-2.2-1978

, alternate instruments and maintenance

C. REGULATORY POSITION

Earthquake instrumentation specified in ANSI/~~ANS-2.2-1978~~, "Earthquake Instrumentation Criteria for ~~ANS-2.2-1978~~"
² ANSI/~~ANS-2.2-1978~~ for definitions.

ANS-2.2-1978

II

3

Nuclear Power Plants," is acceptable to the Regulatory staff for satisfying the seismic instrumentation requirements indicated in Paragraph VI (a) (3) of Appendix A to 10 CFR Part 100 for assuring the safety of nuclear power plants, subject to the following:

1. The instrumentation called for in Section 4.1 of the Standard should be applied to nuclear power plants with a Safe Shutdown Earthquake maximum foundation acceleration of less than 0.3 g as supplemented by the following:

a. Instead of the locations specified in Section 4.1.2 of the Standard, one triaxial peak accelerograph should be provided at one location of each of the following:

- (1) A selected location on the reactor equipment.
- (2) A selected location on the reactor piping.
- (3) The most pertinent location on one of the following outside of the containment structure:
 - (a) Seismic Category I equipment.
 - (b) Seismic Category I piping.

b. One triaxial response-spectrum recorder³ capable of measuring both horizontal motions and the vertical motion and capable of providing signals for immediate control room indication should be provided at the containment foundation.

c. One triaxial response-spectrum recorder capable of measuring both horizontal motions and the vertical motion should be provided at one location of each of the following:

- (1) A selected location on the reactor equipment or piping supports.
- (2) The most pertinent location on one of the following outside of the containment structure:
 - (a) A seismic Category I equipment support or appropriate floor location.
 - (b) A Seismic Category I piping support or appropriate floor location.
- (3) At the foundation of an independent Seismic Category I structure where the response is different from that of the reactor containment structure.

2. Section 4.2 of the Standard should not be used.

3. The instrumentation specified in Section 4.3 of the Standard should be applied to nuclear power plants with a Safe Shutdown Earthquake maximum foundation acceleration of 0.3 g or greater as supplemented by Regulatory Positions 1 and 2 above, and the following:

a. Instead of the locations specified in Section 4.3.2 of the Standard, one triaxial time-history accelerograph should be provided at the most pertinent

³ An instrument having the capability when actuated of permanently recording peak responses as a function of frequency.

location on one of the independent Seismic Category I structures where the response is different from that of the reactor containment structure.

h. Instead of the locations specified in Section 4.3.3 of the Standard, one triaxial peak accelerograph should be provided at the most pertinent location on Seismic Category I equipment or piping in an independent Seismic Category I structure where the response is different from that of the reactor containment structure.

c. In addition to the locations specified in Regulatory Positions 1.b., 1.c.(1), and 1.c.(3) above, one triaxial response-spectrum recorder should be provided at one location on both items specified in Regulatory Positions 1.c.(2)(a) and 1.c.(2)(b) above.

d. Instead of the locations specified in Section 4.3.4 of the Standard, one triaxial seismic switch should

be provided at a selected location on reactor equipment supports or piping supports.

4. The response-spectrum recorders should have the following specifications:

a. Dynamic Range--50:1 zero to peak (such as 0.02 g to 1.0 g).

b. Frequency Range--minimum coverage from 1 Hz to 30.0/Hz.

c. Damping--not less than nominal 2% nor more than nominal 5% of critical damping, controlled to ± 0.15 of nominal. The actual amount of damping is to be consistent with the OBE-based design damping for the supported structure or equipment.

5. Instead of the dynamic range specified in Section 5.3.5 of the Standard, a range of 100:1 should be used.

D. IMPLEMENTATION

The purpose of this section is to provide information to applicants regarding the NRC Staff's plans for using this regulatory guide.

This guide reflects current NRC Staff practice. Therefore, except in those cases in which the applicant proposes an acceptable alternative method for complying with specified positions of the Commission's regulation, the method described herein is being and will continue to be used in the evaluation of submittals for construction permit applications and operating licenses reviews.

REGULATORY GUIDE 1.12 VALUE/IMPACT STATEMENTI. The Proposed ActionA. Description

Seismic instrumentation is required at nuclear power plants so that in the event of an earthquake, the seismic response of plant features important to safety can be determined promptly. This response is then compared with that used as the design basis in order to decide whether the plant can continue to be operated safely. Detailed guidance on the type and location of such instrumentation is currently provided in Regulatory Guide 1.12, "Instrumentation for Earthquakes," (Revision 1, April 1974) which endorses ANSI N 18.5 - 1974. The proposed action will update this guidance by endorsing the revised version of this standard which is titled "ANSI/ANS-2.2-1978."

B. Need for the Proposed Action

Regulatory Guide 1.12 currently endorses ANSI N18.5-1974, "Earthquake Instrumentation Criteria for Nuclear Power Plants," with several exceptions regarding the number and location of seismic recording instruments. Working Group ANS 2.2 of the American Nuclear Society Standards Committee has revised N18.5. The revision reflects most of the exceptions taken in Regulatory Guide 1.12. The proposed action will endorse the new revised standard ANSI/ANS-2-2-1978 to eliminate the exceptions.

C. Value/Impact of the Proposed Action1. NRC

The revision of R.G. 1.12 will have no impact on NRC Staff because proposed R.G. will endorse the Current Staff position.

2. There will be no impact on industry from this proposed revision to the R.G. because guide will be endorsing the Current Staff position.

3. There will be no increase in cost to the public because proposed guide will be endorsing the current position.

D. Decision on the Proposed Action

Regulatory Guide 1.12 should be updated to reflect the revision of ANSI N18.5 by endorsing revised standard ANSI/ANS-2.2-1978.