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September 29, 1987

September 1, 1987
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Rules and Procedures Branch
Division of Rules and Records
Office of Administration and Resource Management
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Gentlemen:

I personally, and as Chairman of the ASME Task Committee on Seismic Performance Qualification of Mechanical Equipment, strongly object to the extension of the Regulatory Guide 1.100 Revisions 1 on "Seismic Qualification of Electrical Equipment for Nuclear Power Plants," scope to include mechanical equipment primarily by reference to IEEE Std. 344-1987. The ASME Committee on Qualification of Mechanical Equipment in addition to its active development of 13 performance and operability standards for mechanical equipment has had under active development for the past two years a standard for seismic qualification of mechanical equipment. This standard, the table of contents of which is attached to this letter, is in the final stages of review and approval. I have attached the text of Appendix A of the draft mechanical standard which is a check list for the determination of "similarity" which is essential for the use of experience data in seismic qualification. No equivalent check list is contained in the IEEE 344-87 Specifications. The draft mechanical standard is currently awaiting the release of a NUREG/CR (scheduled for October 1, 1987) being prepared by Southwest Research Institute under the direction of the Idaho National Engineering Laboratory and sponsored by the NRC on "Similarity." The "Similarity" NUREG/CR will be used for the final editing of Appendix A of the draft mechanical standard.

A meeting of the Seismic Task Committee on the Seismic Performance Qualification of Mechanical Equipment Standard (membership list attached) is scheduled for 26 October 1987 to finalize the standard and in particular incorporate as appropriate the "Similarity" material contained in the NUREG/CR being prepared by Southwest Research Institute. A vote on the standard by the ASME Main Committee on Qualification of Mechanical Equipment is planned at its next meeting on 11 November 1987.

I strongly urge you to do the following:

1. Delay issuing Rev. 2 to Regulatory Guide 1.00 until the approval of the mechanical standard can be properly referenced. This should be approximately 6 months from November 1987

or alternatively

letter sent 10/9/87

2. Issue Rev. 2 to Regulatory Guide 1.100 with its original scope, that is applicable to electrical equipment only. A rev. 3 to Regulatory Guide 1.100 could then be issued covering mechanical equipment and properly referencing the ASME mechanical seismic qualification standard when available in approved form in approximately 6 months.

To do otherwise will seriously undermine a major standard development effort at its moment of completion and which, up to now, has had active NRC participation and support.

Sincerely,

John D. Stevenson
President

JDS:mm

cc: G. Arlotto, NRC
R. Bosnak, NRC
R. Miller, Duke Power
D. Kana, SWR

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

August 14, 1987

Regulatory Guide 1.100
Proposed Revision 2

REGULATORY GUIDE DISTRIBUTION LIST FOR DIVISION 1

Your attention is directed to the change in the title of the attached proposed Revision 2 to Regulatory Guide 1.100, "Seismic Qualification of Electric and Mechanical Equipment for Nuclear Power Plants." Revision 1 of this guide covered electric equipment only; this proposed revision also covers mechanical equipment. Specifically, this proposed regulatory guide covers two categories of equipment: (1) safety-related electric (Class 1E) equipment and safety-related mechanical equipment and (2) equipment whose failure could prevent the satisfactory accomplishment of safety functions.

This draft regulatory guide endorses IEEE Std 344-1987, "Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations," with two exceptions.

Section 8.3 and Section 9 of IEEE Std 344-1987 provide guidance on the use of experience data for seismic qualification. The NRC staff believes that this approach is consistent with the proposed resolution of Unresolved Safety Issue (USI) A-46 (NUREG-1030, "Seismic Qualification of Equipment in Operating Nuclear Power Plants," February 1987).

While comments and suggestions are encouraged in all areas, comments are specifically requested on the consistency of IEEE Std 344-1987 with the proposed resolution of USI A-46.

Written comments may be submitted to the Rules and Procedures Branch, Division of Rules and Records, Office of Administration and Resource Management, U.S. Nuclear Regulatory Commission, Washington, DC 20555. Comments may also be delivered to Room 4000, Maryland National Bank Building, 7735 Old Georgetown Road, Bethesda, Maryland, from 8:15 a.m. to 5:00 p.m. Copies of comments received may be examined at the NRC Public Document Room, 1717 H Street NW., Washington, DC. Comments will be most helpful if received by October 30, 1987.

Guy A. Arlotto, Director
Division of Engineering
Office of Nuclear Regulatory Research

U.S. NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REGULATORY RESEARCH

DRAFT REGULATORY GUIDE

August 1987
Division 1
Task EE 108-5

Contact: S. K. Aggarwal (301) 443-7840

PROPOSED REVISION 2 TO REGULATORY GUIDE 1.100

SEISMIC QUALIFICATION OF ELECTRIC AND MECHANICAL EQUIPMENT FOR NUCLEAR POWER PLANTS

A. INTRODUCTION

The Commission's regulations in 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," require that certain structures, systems, and components in a nuclear power plant be designed to withstand the effects of natural phenomena such as earthquakes, and that design control measures such as testing be used to check the adequacy of design. This general requirement is contained in Appendix A, "General Design Criteria for Nuclear Power Plants," to Part 50; in Criterion III, "Design Control," and Criterion XVII, "Quality Assurance Records," of Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to Part 50; and in Appendix A, "Seismic and Geologic Siting Criteria for Nuclear Power Plants," to Part 100, "Reactor Site Criteria."

In Appendix A to 10 CFR Part 100, Section VI, "Application to Engineering Design," requires that the nuclear power plant be designed so that, if the safe shutdown earthquake occurs, certain structures, systems, and components will remain functional. These safety-related structures, systems, and components are those necessary to ensure (1) the integrity of the reactor coolant pressure boundary, (2) the capability to shut down the reactor and maintain it in a safe condition, or (3) the capability to prevent or mitigate the consequences of accidents that could result in offsite exposures comparable to the Part 100 guidelines. In Appendix A to Part 100, Section VI(a)(2) requires that

This regulatory guide is being issued in draft form to involve the public in the early stages of the development of a regulatory position in this area. It has not received complete staff review and does not represent an official NRC staff position.

Public comments are being solicited on the draft guide (including any implementation schedule) and its associated regulatory analysis or value/impact statement. Comments should be accompanied by appropriate supporting data. Written comments may be submitted to the Rules and Procedures Branch, DRR, ARM, U.S. Nuclear Regulatory Commission, Washington, DC 20555. Comments may also be delivered to Room 4000, Maryland National Bank Building, 7735 Old Georgetown Road, Bethesda, Maryland from 8:15 a.m. to 4:00 p.m. Copies of comments received may be examined at the NRC Public Document Room, 1717 H Street NW., Washington, DC. Comments will be most helpful if received by October 30, 1987.

Requests for single copies of draft guides (which may be reproduced) or for placement on an automatic distribution list for single copies of future draft guides in specific divisions should be made in writing to the U.S. Nuclear Regulatory Commission, Washington, DC 20555. Attention: Director, Division of Information Support Services

structures, systems, and components of the nuclear power plant necessary for continued operation without undue risk to the health and safety of the public be designed to remain functional and within applicable stress and deformation limits when subjected to the effects of the vibratory motion of an operating basis earthquake in combination with normal operating loads. The engineering method used to ensure that the required safety functions are maintained during and after the vibratory ground motion associated with the safe shutdown earthquake or the operating basis earthquake must involve the use of either a suitable dynamic analysis or a suitable qualification test to demonstrate that structures, systems, and components can withstand the seismic and other concurrent loads.

This regulatory guide describes a method acceptable to the NRC staff for complying with NRC's regulations with respect to seismic qualification of electric and mechanical equipment.

Any information collection activities mentioned in this draft regulatory guide are contained as requirements in 10 CFR Parts 50 or 100, which provide the regulatory basis for this guide. The information collection requirements in 10 CFR Parts 50 and 100 have been cleared under OMB Clearance Nos. 3150-0011 and 3150-0093, respectively.

B. DISCUSSION

IEEE Std 344-1987, "Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations,"* was prepared by Working Group 2.5 (Seismic Qualification) of Subcommittee 2 (Equipment Qualification) of the Institute of Electrical and Electronics Engineers (IEEE) Nuclear Power Engineering Committee, and was subsequently approved by the IEEE Standards Board on June 11, 1987.

The IEEE Standard includes principles, procedures, and methods of seismic qualification that, when satisfied, will confirm the adequacy of the equipment design for the performance of safety functions before, during, and after the

*Copies may be obtained from the Institute of Electrical and Electronics Engineers, IEEE Service Center, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855.

time the safety-related equipment is subjected to high stresses resulting from design basis events. For this guide, the design basis events are the loadings imposed by seismic events: the operating basis earthquake (OBE) and the safe shutdown earthquake (SSE). It is also necessary to combine other dynamic or vibratory loads as part of seismic qualification. It is recognized that hydrodynamic loads have their primary energy content in a frequency range greater than that of seismic vibrations; however, they are a part of the in-plant equipment aging process, along with other nonseismic vibration loads, and therefore should be considered in seismic testing.

Revision 1 of this guide was issued in August 1977. Since then, several new technical issues have arisen, such as treatment of hydrodynamic loads, the limits of generic testing, the treatment of rattling, methods of qualifying line-mounted devices, and the use of actual seismic experience data bases to qualify identical or similar equipment. These issues are covered by IEEE Std 344-1987, which reflects the state-of-the-art technology. Further, the NRC has extended the application of this standard to the qualification of mechanical equipment.

This regulatory guide covers two categories of equipment: (1) safety-related electric (Class 1E) equipment and safety-related mechanical equipment, and (2) equipment whose failure can prevent the satisfactory accomplishment of safety functions. Examples of mechanical equipment and equipment supports within the scope of this guide are valves, valve operators, pumps, compressors, chillers, air handlers, fans, blowers, pipe supports, snubbers, restraints, hangers, fuel rod assemblies, and control rod drive mechanisms.

IEEE Std 344-1987 references other standards that contain valuable information. Those referenced standards not endorsed by a regulatory guide or incorporated into the regulations, if used, are to be used in a manner consistent with current regulations.

C. REGULATORY POSITION

The procedures described by IEEE Std 344-1987, "Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations," are acceptable to the NRC staff for satisfying the Commission's regulations pertaining to seismic qualification of electric and mechanical equipment subject to the following:

1. For mechanical equipment, thermal distortion effects on operability should be considered, and loads imposed by the attached piping should also be accounted for.

If dynamic testing of a pump or a valve assembly is impracticable, static testing of the assembly is acceptable provided that (1) the end loadings are applied and are equal to or greater than postulated event loads, (2) all dynamic amplification effects are accounted for, (3) the component is in the operating mode during and after the application of loads, and (4) an adequate analysis is made to show the validity of the static application of loads.

2. Section 9 of IEEE Std 344-1987 recognizes the use of experience data as a method for seismic qualification. This method of qualification should be appropriately justified so it can be evaluated by the NRC staff on a case-by-case basis.

D. IMPLEMENTATION

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

Except in those cases in which the applicant or licensee proposes an acceptable alternative method for complying with specified portions of the Commission's regulations, the methods described herein will be used in the evaluation of seismic qualification of electric and mechanical equipment for nuclear power plants as follows:

1. Plants for which the construction permit is issued after the issue date of the final guide,

2. Plants for which the operating license application is docketed for 6 months or more after the issue date of the final guide,

3. Plants for which the applicant or licensee voluntarily commits to the provisions of this guide.

DRAFT VALUE/IMPACT STATEMENT

BACKGROUND

IEEE Std 344-1975, "Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations," was approved by the IEEE in January 1975. In August 1977, the NRC staff issued Revision 1 to Regulatory Guide 1.100, which endorsed IEEE Std 344-1975, subject to four exceptions. Since then the staff has worked with the IEEE in developing IEEE Std 344-1987. As a result of these efforts, the exceptions to IEEE Std 344-1975 have been satisfactorily resolved.

IEEE Std 344-1987 also addresses several recent technical issues, for example, treatment of hydrodynamic loads, the limits of generic testing, the treatment of rattling, methods of qualifying line-mounted devices, and the use of actual seismic experience data bases to qualify identical or similar equipment. IEEE Std 344-1987 thus reflects the state-of-the-art technology.

Issuance of this Proposed Revision 2 is consistent with the NRC policy of evaluating the latest versions of national standards in terms of their suitability for endorsement by regulatory guides.

SUBSTANTIVE CHANGES

IEEE Std 344-1987 applies to seismic and dynamic qualification of Class 1E (safety-related electric) equipment. The nuclear industry has used this standard for seismic qualification of mechanical equipment as well. The NRC staff recognizes this fact and intends to extend the application of this standard to seismic qualification of mechanical equipment by this regulatory guide. Specifically, this regulatory guide covers two categories of equipment: (1) safety-related electric (Class 1E) equipment and safety-related mechanical equipment, and (2) equipment whose failure can prevent the satisfactory accomplishment of safety functions. Regulatory Position C.1 provides guidance for qualification of mechanical equipment that is consistent with current NRC practice.

Regulatory Position C.2 recognizes the use of experience data as a method of seismic qualification. This method should be appropriately justified and will be evaluated by the NRC staff on a case-by-case basis.

Regulatory Positions C.1 to C.4 in Revision 1 are not included in this Proposed Revision 2 because they have been incorporated in IEEE Std 344-1987 as follows:

Regulatory Position in Rev. 1 of this Guide	IEEE Std 344-1987 Section Number
C.1	6.3
C.2	7.6.2.1
C.3	7.6.2.5
C.4	10.3.2(6)

VALUE

This guide endorses the latest version of a national standard and reflects the current state-of-the-art technology. The guide should also enhance the licensing process.

IMPACT

Although the scope of this revision has been extended to include seismic qualification of mechanical equipment, the requirements are consistent with NRC current licensing practice. Thus, this regulatory guide does not impose any new requirements or costs on licensees or applicants.

*U.S. GOVERNMENT PRINTING OFFICE: 1987-181-862:60200

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Rev. 3 2/17/86
Rev. 4 4/20/86
Rev. 5 9/22/86

Appendix QME-QR-A

RECOMMENDED PRACTICES

FOR

SEISMIC PERFORMANCE QUALIFICATION OF MECHANICAL EQUIPMENT

USED IN NUCLEAR POWER PLANTS

WITH

PARTICULAR APPLICATION TO PUMPS AND VALVES

Sponsor

The ASME Committee on Qualification of
Mechanical Equipment Used in Nuclear
Power Plant, QME

Notice

This document is a draft which represents work being done by ASME technical committees aimed at generating an ASME Standard. It is furnished as informational material only.

The user is cautioned that this is not an approved document and cannot be presumed to reflect the position of the American Society of Mechanical Engineers.

Note: This document shall be reformated in accordance with current QME guidelines concurrent with review for technical content.

TABLE OF CONTENTS

APPENDIX A

Similarity Check List

A.1 Excitation Similarity

a) Original Excitation is Defined in Terms of:

☐ Response Spectra

☐ Acceleration Design Values

☐ Other

(b) Does the original excitation Envelope the New Required Excitation?

☐ Yes ☐ No

If answer is no, indicate the differences with reference to direction and frequency as applicable.

(c) Indicate durations and number of strong motion part of the original excitation considered as applicable for testing only.

SSE_____ Times_____Sec. ____

In order to have a valid qualification by similarity, excitation levels and time durations applicable to the original component should be equal to or higher than the required excitation levels and time duration for the new component. If there are segments of the original excitation that does not envelope the required excitation for new components, an assessement of the natural frequencies for the new component is necessary. If no natural frequency of the new component is found in the unenveloped segment, an affirmative answer can still be reached to the

question, "Does the original excitation envelop the new required excitation?", by discussing the differences with respect to excitation direction and frequencies as applicable.

A.2 SAFETY-RELATED DESIGN PARAMETERS:

List appropriate parameters for both the original and the new component in Table A.1.

Table A.1 list of Input Parmeters

1. Temperature
2. Design Pressure
3. Operating Pressure
4. Hydrostatic Pressure
5. Process Medium
6. Max. Leakage Rate
7. Torque
8. Thrust
9. Nozzle Loads
10. Other Parameters
    (List as Applicable)

A comparison of the design parameters for both the original and the new component should be made. If any one of the listed parameters for the new component exceeds the corresponding parameter for the original component by more than 10 percent an assessment of the effect of increment(s) shall be made in terms of quantities impacting the qualification status such as stresses, deformations, etc.[1].

---

[1] If any of the imput parameters of the new component is 10% higher than the original component, the increased stresses and deformations shall be within specified allowable limits.

A.3 PHYSICAL SIMILARITY

New Component is:

a. ☐ Identical to orginal component

Identity is demonstrated through make, model, and serial number comparison as applicable.

Provide References:

1.
2.
3.

b. ☐ Similar to original component

☐ Provide comparative data with appropriate references for the following:

1) Component Physical Dimensions
2) Component Weight, its Distribution and Center of Gravity
3) Bill of Materials
4) Cross Sectional and Length Data to Characterize Stiffness and load Transferring Capacity
5) Mounting with respect to:

-Mounting Description
-Type of Support
-Support Details
-Structural Members
. Size
. Location
. Material

-Welding Details

. Rod (material)

. Location

. Size & Length

. Type

-Bolting Details

. Bolts & Nuts Material, Grade

. Number and Size

. Geometry (Bolt circle or Pattern Info.)

. Washers

. Holes in Sole Plates (circular or oval)

. Pre-Torque Values

6. Nozzles

. Locations

. Sizes

7. Other interfaces with adjacent items such as cables, conduits, tubes, etc.

Provide comparison of items (1) through (7) of this section for both the original and new component. If there are any differences in any one of the items (or sub-items), the effect of the difference shall be evaluated in terms of the following:

1. Stiffness
2. Mass distribution
3. Boundary conditions
4. Natural frequencies

and determined to be within 15 percent of the original component values.

The different effect on the stresses, deformations and load capacities (such as stem or shaft buckling capacity, bearing load capacity, etc.) at critical locations shall also be evaluated and shown to be within the allowable criteria limits.

A.4 DYNAMIC RESPONSE

A. Original Component Dynamic Response

a. ☐ - Is determined by analysis and expressed in terms of:

☐ Response Spectra

☐ Time History

☐ Dynamic Coefficients

☐ Failure Modes and/or Failure Criteria

b. ☐ - Is determined by test in terms of

☐ Response Spectra

☐ Time History

☐ Transmissibility Plots

☐ Resonant Frequencies

A.5 OPERABILITY

A. New Component:

☐ - Is Safety-Related, Passive

☐ - Is Safety-Related, Active

a. Safety Function During Earthquake is:

b. Safety Function After Earthquake is:

c. Original Component Operability is verified

☐ By Experience

☐ By Tests

☐ By Analyses

☐ By Combined Analyses and Tests

☐ By Combined Analysis and Experience

☐ By Combined Test and Experience

☐ By Combined Analysis, Test and Experience

B. Can the operability verification results for original component be extended to the new component by similarity arguments?

☐ Yes ☐ No

List the documented evidence supporting the similarity arguments for operability verification of the new component:

a)

b)

c)

A.6 Qualification by Similarity is valid

☐ Yes ☐ No

Prepared by:

_____

Checked by:

_____

Approved by:

_____