



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

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MEMORANDUM FOR: Commissioner John F. Ahearne
FROM: William J. Dircks
Executive Director for Operations
SUBJECT: SECY-81-504 AND SECY-81-603
YOUR MEMORANDUM DATED NOVEMBER 17, 1981

The evolution of seismic qualification of electric equipment has been as follows:

Prior to 1971, no specific requirements for seismic qualification of electric equipment existed. Industry practice was such that seismic resistance was provided through inherent design conservatism, mathematical analysis, physical tests or engineering judgment. In 1971, IEEE 344-1971 was published. In 1972, the NRC staff informally issued a branch technical position that supplemented IEEE 344-1971 by requiring justification for single-axis and single-frequency testing in lieu of multi-axis and multi-frequency testing. In 1975, IEEE 344-1975 adopted this position. Section 3.10 of the SRP was issued November 24, 1975. Regulatory Guide 1.100, which endorsed IEEE 344-1975, was issued in August 1977.

The requirement of sequence testing came through Regulatory Guide 1.89 which endorses IEEE 323-1974, and is applicable to plants with CP applications for which the issue date of the SER is after July 1, 1974.

The finding of the SEP is that anchorages for certain equipment, for example battery racks and control cabinets needed upgrading as they were generally found deficient.

Pending development of specific requirements for seismic and dynamic qualification of electric equipment, the general requirements of GDC will continue to apply.

A detailed response to the issues raised by you in your memorandum dated November 17, 1981 is provided in Enclosure 1.

William J. Dircks
Executive Director for Operations

Enclosure: As stated

cc: See next page

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Enclosure 1

Responses to Commissioner Ahearne's Questions

(Memorandum dated November 17, 1981)

- Q. Regarding the seismic qualification of electric equipment, what precisely has been required for various vintage plants (IEEE-344-'71, -'75, BTP and/or SRPs)?
- A. Prior to 1971, there were no specific requirements for seismic qualification of electric equipment. However, seismic resistance of electric equipment for these plants was considered through inherent design conservatism, mathematical analysis, physical tests, or engineering judgment.

In 1972 a Branch Technical Position (BTP) was issued by the staff endorsing IEEE 344-1971, requiring justification where single-frequency and single-axis testing was used. In November 1975, Section 3.10 of SRP was published, which provided the following guidance:

Electric equipment for plants having CP dates prior to October 27, 1972 should meet the requirements of IEEE 344-1971, and electric equipment for plants having CP dates after October 27, 1972 should meet the requirements of IEEE 344-1975, with certain exceptions.

Current criteria for seismic qualification of electric equipment are embodied in the regulatory positions of Regulatory Guide 1.89 (proposed revision) and Regulatory Guide 1.100 which endorse the IEEE 323-1974 and IEEE 344-1975 respectively.

Thus there are four plant vintages:

- I Pre 1971 plants
- II Plants reviewed per BTP of 1972
- III Plants reviewed under SRP 3.10, 1975
- IV Plants reviewed under current requirements

There are 73 operating plants as of June 1981 and 49 plants expected to receive operating licenses through calendar year 1983. The distribution of plants for various vintages is as follows:

Operating Plants: 64 plants in vintage I and 9 plants in vintage II

Plants Under OL Review: 22 plants in vintage II, 17 plants in vintage III, and 10 plants in vintage IV

New hydrodynamic loads were discovered in 1976 for BWR plants. These loads are considered significant to shake equipment in the reactor building and cause acceleration response in the range of 60 to 100 Hz. (The frequency range generally considered for seismic loading is 0 to 33 Hz).

Appendix A to Part 50, which was issued in 1971, includes the general requirements for seismic and dynamic qualification. GDC 2, in part, states, "...designed to withstand the effects of..., earthquakes... without loss of capability to perform safety functions."

It should be noted that for the operating nuclear power plants, some considerations were given to the seismic resistance, and to the static acceleration coefficients in terms of the plant SSE value, if available, to determine the integrity of (a) structures, and (b) some large pieces of equipment. Large amplification due to dynamic coupling and the operability of electric devices during seismic motion were generally not considered.

Q. Have seismic tests ever been required as a part of the sequential test, as specified in IEEE 323-1974? If yes, for what vintage plants?

A. Regulatory Guide 1.89, which was published in November 1974, endorses IEEE 323-1974. This regulatory guide is being used by the staff in evaluating all CP applications for which the issue date of the SER is July 1, 1974 or after. Thus, the requirements of IEEE 323-1974 are applicable to newer plants of vintage IV. It could be concluded that Regulatory Guide 1.89 calls for sequential testing. This requirement was explicitly included in the latest revision of Section 3.10 of the SRP in July 1981.

Q. What seismic problems or deficiencies have we found in SEP plants?

The SEP seismic review of electric equipment was performed on a sampling basis where the general emphasis was on the structural integrity under seismic loading. Structural supports and anchorages of safety-related electric equipment, for example, battery racks and control cabinets, were generally found deficient. Buildings and large pieces of equipment, such as pumps for the five SEP power plants reviewed by the staff, were generally found adequate. As a result of this review, three actions have been or are being taken by the licensees: (1) the anchorage and structural supports of all safety-related electric equipment have been upgraded, (2) an SEP Owners' Group program has been initiated for the documentation of seismic qualification (functional capability of equipment and structural integrity of internal components of equipment; e.g., relays, switches, circuit breakers, etc.) of safety-related electric equipment, and (3) a program for seismic qualification of electric cable trays based upon testing by the SEP Owners' Group has been implemented. These two SEP Owners' Group programs are intended to confirm the adequacy of existing equipment designs.

The review of the adequacy of functional operability has been deferred pending resolution of the Unresolved Safety Issue (USI) A-46, "Seismic Qualification of Equipment in Operating Plants."

Q. What are the findings of the SQRT case-by-case audits?

A. SQRT audits from 1974 to 1980 consist of plant-specific audits and generic audits for major NSSSs and AEs. The purposes are: (1) to ensure that equipment tested under the old criteria has adequate margin to meet

current requirements, and (2) to provide the necessary clarifications to the industry regarding correct implementation of new criteria. Generic audits of Westinghouse equipment and specific audits of several plants were completed. However, audits of other NSSSs, all major AEs, and many plants have only been partially conducted because of the lack of resources.

Based on these audits, it was concluded that most of the equipment tested under IEEE 344-1971 is acceptable. However, nearly 20 percent of the equipment may be sensitive to either multi-frequency or multi-axis effect of seismic motions and need to be retested to meet the new qualification requirements.

For NTOLS, the general findings of SORT audits were as follows: (a) the applicants were unaware of modifications recommended by testing laboratories, (b) in some cases where applicants were aware of recommendations, the modifications were not in place at the plant, (c) mounting conditions were different from the way tests were conducted, (d) inadequate clearances, (e) tests did not simulate fatigue effects caused by many cycles of hydrodynamic loads, and (f) inadequate anchorages.

- Q. Are there any reevaluations being made of the technical bases in the basic staff guides covering seismic areas (e.g., SRP 3.10 or any Regulatory Guides)?
- A. Guidelines for the seismic qualification of equipment in operating power plants including electric equipment are being developed under A-46. The Task Action Plan (TAP) for A-46 is currently being circulated for final approval, and this plan schedules the completion of a NUREG report with technical resolution by December 1983. The objective of this Issue (A-46) is to develop guidelines to assess the capability of mechanical and electric equipment in operating nuclear power plants to perform their safety functions. The TAP includes three separate tasks: (1) survey the actual inservice seismic response of equipment in non-nuclear facilities to provide a data base of seismic experience for comparison with similar equipment in operating plants, (2) review methods used to qualify equipment, including determining method limitations, nonconservatisms, and anomalies, and (3) develop and verify methods for in situ qualification of equipment.

Regulatory Guide 1.29 (Seismic Design Classification) will be revised in late 1982 to reflect the current staff position on seismic categories of safety-related equipment.

Regulatory Guide 1.89 has been revised and is being issued for public comment. The guide will explicitly include requirements for the sequence testing of a single prototype. A final value impact statement will be developed after receipt of public comments.

- Q. Has a cost-benefit study been undertaken for expanding the review to include the seismic qualification of electric equipment?
- A. A cost-benefit study will be undertaken to evaluate the backfitting of seismic and dynamic qualification for power plants.

Q. Do we have a set of conditions that are characterized as "mild environments"? Regarding the qualification of electric equipment for mild environments, what kind of an incremental benefit can we expect and at what cost to both NRC and the regulated industry?

A. A definition of "mild environment" is included in Regulatory Guide 1.89. A mild environment is an environment that would at any time be no more severe than the environment that would occur during normal plant operations or during anticipated operational occurrences. Environmental testing is not required for the equipment located in mild environment. A well-supported surveillance program in conjunction with a good preventive maintenance program and a periodic testing program will be acceptable. Recent IEEE standards recommend preaging prior to seismic testing for equipment located in mild environment. This is an open issue at this time, and the staff will evaluate incremental benefit and its cost of implementation.