



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

MAR 3 1980

MEMORANDUM FOR: S. A. Varga, Acting Assistant Director
for Light Water Reactors
Division of Project Management

FROM: J. P. Knight, Assistant Director
for Engineering
Division of Systems Safety

SUBJECT: BOARD NOTIFICATION REGARDING NUREG/CR-0345 ENTITLED
"AN EVALUATION OF SEISMIC QUALIFICATION TESTS FOR NUCLEAR
POWER PLANT EQUIPMENT"

We have reviewed the attached subject report. The staff evaluation of this report is attached. Because the information in the report and the staff evaluation are relevant to all plants in licensing, we recommend that this information be provided to all Boards before which there are pending applications.

Since equipment qualification was a matter before the Diablo Canyon Board and since the Appeal Board is now considering the Intervenor's brief on the Diablo Canyon appeal and the Staff's and Applicant's responses, we request that the Diablo Canyon Appeal Board and Licensing Board be provided with this information as soon as possible.

A handwritten signature in black ink, appearing to read "J. P. Knight".

J. P. Knight, Assistant Director
for Engineering
Division of Systems Safety

cc: R. Mattson
D. Ross
D. Eisenhut
L. Shao
V. Noonan
R. Bosnak

8006040 432

I. PURPOSE OF THIS RESEARCH:

To meet seismic requirements safety related equipment is generally qualified by testing. The test input (shake table motion) is expected to adequately simulate the specific seismic environment and to consider its sensitivity to equipment response, which may vary greatly from case to case. Since the regulatory position must be general in nature, the selection of a test input for a specific application needs experience and engineering judgement. Because simpler test inputs have been used in many cases for equipment qualification before the existence of the current criteria, this research program was requested and intended to provide a basis for comparing the effectiveness of various test inputs.

II. ACHIEVEMENTS & COMMENTS:

Studies were conducted by subjecting one typical electrical cabinet to shake table tests using different wave forms. No internal electrical equipment of any kind was tested with the cabinet, and the effects of the test input on equipment operating function was not included in the investigation.

Primary findings and staff comments are as follows:

1. A numerically defined "Damage Severity Factor" (DSF) was developed and introduced as a way for comparing severity of various types of seismic qualification test inputs.

When the DSF is fully developed, it may have the potential to assess relative damage that can be inflicted by earthquake transients or test inputs to structural components. However, no immediate application of the DSF to equipment seismic qualification is recommended in its present form. The relationship between DSF and equipment operability requires further investigation.

2. The research results concluded that the single frequency sine dwell and sine beat tests are far more severe in general than the biaxial random tests for verifying structural integrity of passive equipment and supports.

We are aware that the single frequency sinusoidal test input at resonance is generally a very severe structural test, but this is not the case from the standpoint of verifying the operability of active equipment. Single frequency sinusoidal testing also does not necessarily yield valid results when testing to determine resonance. This fact was known to the staff through licensing reviews since 1972 when a revision of IEEE Standard 344, 1971 was initiated at the request of NRC. Nevertheless, these research results provide a useful independent conformation of the above facts.

3. It was found that there were some differences between modal data obtained from the same cabinet when mounted to a concrete floor and when mounted on the shake table.

It is a well known fact to dynamicists that modal data will be effected whenever the boundary conditions are changed and whenever dynamic coupling exists between the fixture and the test item. An MEB Branch Position developed in 1973 emphasized that items being tested should simulate service mounting and should avoid dynamic coupling with the fixture. This position was later adopted in the Standard Review Plan, Section 3.10 issued in 1974 and also incorporated in the revised IEEE Standard 344 in 1975. Equipment mounting has remained a concern of the SQRT audit program since its initiation in 1974 and continues to receive special attention in our review process. The research results provided further justification that our concerns are valid.

4. It was revealed that some deficiencies may exist in the use of response spectrum for seismic qualification testing. It was stated that the criterion requiring the response spectrum of testing input (TRS) to envelope the specific response spectrum required for the equipment qualification (RRS) may not ensure proper energy distribution through the range of frequencies tested and may actually induce an excessive zero period acceleration (ZPA), which, in turn, may cause an over test.

Although the development of explicit and generic guidance to achieve proper energy distribution and proper ZPA has not yet been completed, these shortcomings can be avoided if the wave form of the test input is carefully reviewed. The complex wave forms used by Westinghouse in their 1974 and 1975 generic testing programs were typical examples of carefully reviewed test input wave forms. The staff has constantly addressed such concerns in licensing reviews since 1974, when SQRT started systematic plant seismic audits, especially on those items of equipment tested at an earlier date. The research results have provided further evidence of our concerns. In order to improve the regulatory process, further efforts in this area have been recommended and have been incorporated into a request for contract proposal to be issued by the Office of Nuclear Regulatory Research in the near future. The IEEE Standards Committee responsible for developing equipment seismic qualification guidance was also informed of the research results for possible refinement of their current criteria.

III. CONCLUSIONS:

In summary, the research results provide a useful and independent confirmation of certain staff concerns which have existed for several years. These concerns are either already explicitly stated in the existing regulatory position, or have been addressed in past licensing reviews. These research results do not impact the regulatory process at the present time but future efforts by RES or the IEEE Standards Committee refining their current criteria may have impact.