GE Nuclear Energy

General Electric Company
175 Curtner Avenue, San Jose, CA 95125

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Docket No. STN 52-001

Chet Poslusny, Senior Project Manager
Standardization Project Directorate
Associate Directorate for Advanced Reactors
and License Renewal
Office of the Nuclear Reactor Regulation

Subject: Submittal Supporting Accelerated ABWR Review Schedule - **Seismic Qualification**

Dear Chet:

Enclosed are SSAR markups which improve/clarify Section 3.10 on seismic qualification.

Please provide a copy of this transmittal to Dave Terao and Jim Brammer.

Sincerely,

Jack Fox

Jack Fox
Advanced Reactor Programs

cc: Bernie Genetti (GE)
Norman Fletcher (DOE)

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3.10 SEISMIC QUALIFICATION OF SEISMIC CATEGORY I INSTRUMENTATION AND ELECTRICAL EQUIPMENT (INCLUDING OTHER DYNAMIC LOADS)

This section is supposed to address only seismic qualification of electrical components and equipment in accordance with NRC Regulatory Guide 1.70 Revision 3. However, recognizing that dynamic loads due to suppression pool dynamics associated with a loss-of-coolant accident (LOCA) and safety/relief valve (SRV) discharge can have a significant vibratory effect on the reactor building, and, hence, on the design of structures, systems, and equipment in the reactor building, GE has elected to address equipment qualification for both seismic and other reactor building vibration (RBV) dynamic loads in this section. The format utilized is consistent with R.G. 1.70, Revision 3; thus, reference to the operating basis earthquake (OBE) and the safe shutdown earthquake (SSE) in this section include the combined seismic and other RBV dynamic loads. The non-seismic RBV dynamic loads are described in Table 3.9-2.

The mechanical components and equipment and the electrical components that are integral to the mechanical equipment are dynamically qualified as described in Section 3.9.

Principal Seismic Category I structures, systems and components are identified in Table 3.2-1. Most of these items are safety-related as explained in Subsection 3.2.1. The safety-related functions are defined in Section 3.2, and include the functions essential to emergency reactor shutdown, containment isolation, reactor core cooling, reactor protection, containment and reactor heat removal, and emergency power supply, or otherwise are essential in preventing significant release of radioactive material to the environment.

3.10.1 Seismic Qualification Criteria (Including Other Dynamic Loads)

3.10.1.1 Selection of Qualification Method

Dynamic qualification of Seismic Category I instrumentation and electrical equipment is accomplished by test, analysis, a combination of test and analysis, or by experience data. INSERT 3.10.1.1(B)

In general, analysis is used to supplement test data although simple components may lead themselves to dynamic analysis in lieu of full scale testing. The deciding factors for choosing between tests or analysis include:

(1) magnitude and frequency of seismic and other RBV dynamic loadings;

(2) environmental conditions (Subsection 3.11.1) associated with the dynamic loadings;

(3) nature of the safety-related function(s);

(4) size and complexity of the equipment;

(5) dynamic characteristics of expected failure modes (structural or functional); and

(6) partial test data upon which to base the analysis.

(7) INSERT 3.10.1.1(A)

The selection of qualification methods to be used is largely a matter of engineering judgement; however, tests, and\or analyses of assemblies are preferable to tests or analyses on separate components (e.g., a motor and a pump, including the coupling and other appurtenances should be tested or analyzed as an assembly).

Qualification by experience is drawn from previous dynamic qualification or from other documented experience such as exposure to natural seismic disturbance. Qualification by experience is based on dynamic similarity of the equipment.

3.10.1.2 Input Motion

The input motion for the qualification of equipment and supports is defined by response spectra. The required response spectra (RRS) are generated from the buildings dynamic analysis, as described in Section 3.7. They are grouped by buildings and by elevations. This RRS definition incorporates the contribution and other RBV dynamic loads as specified by the load combination Table 3.9-2. The response spectra curves for the SSE and OBE are presented in Appendix 3G. When one type of equipment is locat-

scribed in Section 4.4 of of GE's Environmental Qualification Program, which is referenced in Subsection 3.11.2. The program conforms to the requirements of IEEE 323 as modified and endorsed by the Regulatory Guide 1.89, and meets the criteria contained in IEEE 344 as modified and endorsed by Regulatory Guide 1.100.

3.10.2 Methods and Procedures for Qualifying Electrical Equipment and Instrumentation

The following subsections describe the methods and procedures incorporated in the above mentioned dynamic qualification program. Described here are the general methods and procedures to qualify by test or analysis Seismic Category I instrumentation and electrical equipment for operability during and after an SSE including other RBV dynamic loads and to ensure structural and functional integrity of the equipment after an OBE including other RBV dynamic loads.

3.10.2.1 Qualification by Testing

The testing methodology for Seismic Category I instrumentation and electrical equipment includes the hardware interface requirements and the test methods. INSERT 3.10.2.1

3.10.2.1.1 Interface Requirements

Intervening structure or components (such as interconnecting cables, bus ducts, conduits, etc.) that serve as interfaces between the equipment to be qualified and that supplied by others are not qualified as part of this program. However, the effects of interfacing are taken into consideration. When applicable, accelerations and frequency content at locations of interfaces with interconnecting cables, bus ducts, conduits, etc., are determined and documented in the test report. This information is specified in the form of interface criteria.

To minimize the effects of interfaces on the equipment, standard configurations using bottom cable entry are utilized whenever possible. Where non-rigid interfaces are located at the equipment support top, equipment qualification is based on the top entry requirements. A report including equipment support outline drawings is furnished specifying the equipment maximum displacement during an SSE including other RBV dynamic loads. Embedment loads and mounting requirements for the equipment supports are also specified in this manner.

3.10.2.1.2 Test Methods

The test method is multi-axial, random single- and/or multi-frequency excitation to envelope generic RRS levels in accordance with Sections 6.6.3 and 6.6.6 of IEEE 344. Past testing has demonstrated that Seismic Category I instrumen- tation and electrical equipment have critical damping ratios equal to or less than 5%. Hence, RRS at 5% or less critical damping ratio are developed as input to the equipment base.

Multi-axial testing applies input motions to the vertical and one or both horizontal axes simultaneously. Independent random inputs are preferred and, when used, the test is performed in two steps with equipment rotated 90 degrees in the horizontal plane in the second step.

When independent random tests are not available, four tests are preformed:

(1) with the inputs in phase;

(2) with one input 180 degrees out of phase;

(3) with the equipment rotated 90 degrees horizontally and the inputs in phase; and

(4) with the same orientation as in the step (3) but with one input 180 degrees out of phase.

3.10.2.1.2.1 Selection of Test Specimen

Representative samples of equipment and supports are selected for use as test specimens. Variations in the configuration of the equipment are analyzed with supporting test data. For example, these variations may include mass distributions that differ from one cabinet to another. From test or analysis, it is determined which mass distribution results in the maximum acceleration and/or frequency content, and this worst-case configuration is used as the test specimen. The test report includes a justification that this configuration envelops all other equipment configurations.

INSERT 3.10.1.1 (A)

Dynamic coupling between equipment and related systems, if any, such as connected piping and other mechanical components should be considered.

INSERT 3.10.2.1

The methodology for qualifying relays shall be such that testing is performed in both the open and closed positions.

INSERT 3.10.1.1 (B)

Qualification by analysis alone, without testing is acceptable only if the necessary functional operability of the equipment is assured by its structural integrity alone. When complete testing is impractical, a combination of test and analysis is acceptable.

TABLE 1.8-21 (Continued)

INDUSTRIAL CODES AND STANDARDS
APPLICABLE TO ABWR

Code or Standard Number	Year	Title
IEEE (Con't)		
485	1983	Recommended Practice for Sizing Large Lead Storage Batteries for NPGS
501	1978	Seismic Testing of Relays
944	1986	Recommended Practice for the Application and Testing of Uninterruptable Power Supplies for Power Generating Station
ISA		
S7.3	1981	Quality Standard for Instrument Air
NCIG		
1		Visual Weld Acceptance Criteria for Structural Welding of Nuclear Power Plants, Revision 2
NEMA		
ICS 1	1983	General Standards for Industrial Control
MG 1	1987	Motors and Generators