

CHET



GE Nuclear Energy

ABWR

Date 4/29/92

Fax No.

To

Butch Burton ^{8D1}

This page plus 35 page(s)

From

Jack Fox

Mail Code

175 Curtner Avenue
San Jose, CA 95125

Phone (408) 925- 4824

FAX (408) 925-1193
or (408) 925-1687

Subject ABWR SSAR Section 3.11

Message Butch-

Enclosed is section 3.11 modified
by Bernie Genett, to reflect
your meeting last month.
I believe Bernie has captured
the essence of what you
were looking for.

(CONTAINS PROPRIETARY INFORMATION)

Jack Fox

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3.11 ENVIRONMENTAL QUALIFICATION OF SAFETY-RELATED MECHANICAL AND ELECTRICAL EQUIPMENT

This section defines the environmental conditions with respect to limiting design conditions for all the safety-related mechanical and electrical equipment, and documents the qualification methods and procedures employed to demonstrate the capability of this equipment to perform safety-related functions when exposed to the environmental conditions in their respective locations. The safety-related equipment within the scope of this section are defined in Subsection 3.11.1. Dynamic qualification is addressed in Sections 3.9 and 3.10 for Seismic Category I mechanical and electrical equipment, respectively.

Limiting design conditions include the following:

- (1) Normal Operating Conditions - planned, purposeful, unrestricted reactor operating modes including startup, power range, hot standby (condenser available), shutdown, and refueling modes;
- (2) Abnormal Operating Conditions - any deviation from normal conditions anticipated to occur often enough that the design should include a capability to withstand the conditions without operational impairment;
- (3) Test Conditions - planned testing including pre-operational tests;
- (4) Accident Conditions - a single event not reasonably expected during the course of plant operation that has been hypothesized for analysis purposes or postulated from unlikely but possible situations or that has the potential to cause a release of radioactive material (a reactor coolant pressure boundary rupture may qualify as an accident; a fuel cladding defect does not); and
- (5) Post-Accident Conditions - during the length of time the equipment must perform its safety-related function and must remain in a safe mode after the safety-related function is performed.

Amendment 11

3.11.1 Equipment Identification and Environmental Conditions

Safety-related electrical equipment within the scope of this section includes all three categories of 10CFR50.49(b) (Reference 1). Safety-related mechanical equipment (e.g., pumps, motor-operated valves, safety-relief valves, and check valves) are as defined and identified in Section 3.2. *INSERT "A"*

INSERT "B"

A list of all safety-related electrical and mechanical equipment that is located in a harsh environment area will be included in the Environmental Qualification Document (EQD) to be prepared as mentioned in Subsection 3.11.6.

Environmental conditions for the zones where safety-related equipment is located are calculated for normal, abnormal, test, accident and post-accident conditions and are documented in Appendix 3I, Equipment Qualification Environmental Design Criteria (EQEDC).

Environmental conditions are tabulated by zones *INSERT* each zone defining a specific area in the plant. Typical equipment in the noted zones is shown in the figures in Section 6.2, 12.3 and Appendix 9A. *INSERT*

Environmental parameters include temperature, pressure, relative humidity, and neutron dose rate and integrated dose. Radiation dose for gamma and beta data for both normal and accident conditions will be provided by applicant referencing the ABWR design in accordance with the interface requirements in Subsection 12.2.3.1. The radiation requirements are site specific documentation owing to the need to model specific equipment which is applicant determined, the HVAC detailed modeling, and the evolving considerations in the area of accident source terms are expected to generate significantly differing radiation requirements. Where applicable, these parameters are given in terms of time-based profiles.

The magnitude and 60-year frequency of occurrence of significant deviations from normal plant environments in the zones have insignificant effects on equipment total thermal normal aging or accident aging. Abnormal conditions are overshadowed by the normal or accident conditions in the Appendix 3I tables.

3.11-1

Insert 3.11.1

- A. Electrical and mechanical equipment safety classification are further defined on the system design drawings.
- B. Safety-related equipment located in a ~~harsh environment~~ must perform its proper safety function during normal, abnormal, test, and design basis accident and ^{post-accident} environments as applicable.
- C. contained in the referenced building arrangements.
- D. referenced system P&ID and IED design drawings.
- F. Occurrences of anticipated abnormal operating conditions are similar to test conditions and their significant environments are comparable.

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Margin is defined as the difference between the most severe specified service conditions of the plant and the conditions used for qualification. Margins shall be included in the qualification parameters to account for normal variations in commercial production of equipment and reasonable errors in defining satisfactory performance. The environmental ~~parameters~~ shown in the Appendix 3I tables do not include margins.

conditions

Some mechanical and electrical equipment may be required to perform an intended safety function between minutes of the occurrence of the event but less than 10 hours into the event. Such equipment shall be shown to remain functional in the accident environment for period of at least 1 hour in excess of the time assumed in the accident analysis unless a time margin of less than one hour can be justified. Such justification will include for each piece of equipment: (1) consideration of a spectrum of breaks; (2) the potential need for the equipment later in the event or during recovery operations; (3) a determination that failure of the equipment after performance of its safety function will not be detrimental to plant safety or mislead the operator; and (5) determination that the margin applied to the minimum operability time, when combined with other test margins, will account for the uncertainties associated with the use of analytical techniques in the derivation of environmental parameters, the number of units tested, production tolerances, and test equipment inaccuracies.

The environmental conditions shown in the Appendix 3I tables are upper-bound envelopes used to establish the environmental design and qualification bases of safety-related equipment. The upper bound envelopes indicate that the zone data reflects the worse case expected environment produced by a compendium of accident condition. Estimated chemical environmental conditions are also reported in Appendix 3I.

3.11.2 Qualification Tests and Analyses

Safety-related electrical equipment that is located in a harsh environment is qualified by test or other methods as described in IEEE 323

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and permitted by 10CFR50.49(f) (Reference 1). Equipment type test is the preferred method of qualification.

Safety-related mechanical equipment that is located in a harsh environment is qualified by analysis of materials data which are generally based on test and operating experience.

The qualification methodology is described in detail in the NRC approved licensing Topical Report on GE's environmental qualification program (Reference 2). This report also addresses compliance with the applicable portions of the General Design Criteria of 10CFR50, Appendix A, and the Quality Assurance Criteria of 10CFR50, Appendix B. Additionally, the report describes conformance to NUREG-0588 (Reference 3), and Regulatory Guides and IEEE Standards referenced in Section 3.11 of NUREG-0800 (Standard Review Plan).

Mild environment equipment is that equipment which, during or after a design basis event (DBE, as defined in Reference 2), does not experience an environment that is significantly more severe than that existing during normal and abnormal events. Additionally, equipment that experiences the environment of a DBE can be treated as if it were in a mild environment if the equipment falls into either of the following categories:

- (1) The equipment accomplishes its safety function prior to experiencing the environment of the DBE and the equipment will not fail in a manner detrimental to plant safety, or
- (2) The equipment is not needed to mitigate the DBE and the equipment will not fail in a manner detrimental to plant safety.

The vendors of mild environment equipment are required to submit a certificate of compliance certifying that the equipment has been qualified for the requirements specified to assure its required safety-related function in its applicable environment. This equipment is qualified for dynamic loads as addressed in Sections 3.9 and 3.10. Further, a surveillance and maintenance program will be developed to ensure equipment operability during its designed life.

3.11.3 Qualification Test Results

The results of qualification tests for safety-related equipment will be documented, maintained, and reported as mentioned in Subsection 3.11.6.

3.11.4 Loss of Heating, Ventilating, and Air Conditioning

To ensure that loss of heating, ventilating, and air conditioning (HVAC) system does not adversely affect the operability of safety-related controls and electrical equipment in buildings and areas served by safety-related HVAC systems, the HVAC systems serving these areas meet the single-failure criterion. Section 9.4 describes the safety-related HVAC systems including the detailed safety evaluations. The loss of ventilation calculations are based on maximum heat loads and consider operation of all operable equipment regardless of safety classification.

3.11.5 Estimated Chemical and Radiation Environment

3.11.5.1 Chemical Environment

Equipment located in the containment drywell and wetwell is potentially subject to water spray modes of the RHR system. In addition, equipment in the lower portions of the containment is potentially subject to submergence. The chemical composition and resulting pH to which safety-related equipment is exposed during normal operation and design basis accident conditions is reported in Appendix 3I.

Sampling stations are provided for periodic analysis of reactor water, refueling and fuel storage pool water, and suppression pool water to assure compliance with operational limits of the plant technical specifications.

3.11.5.2 Radiation Environment

Safety-related systems and components are designed to perform their safety-related function when exposed to the normal operational radiation levels and accident radiation levels.