December 1. 1993

Docket No. 52-002

MEMORANDUM FOR: Richard W. Borchardt, Director
Standardization Project Directorate
Associate Directorate for Advanced Reactors
and License Renewal

FROM: Conrad E. McCracken, Chief
Plant Systems Branch
Division of Systems Safety and Analysis

SUBJECT: CE-SYSTEM 80+ FSER INPUT FOR SECTION 3.11 OF CHAPTER 3 OF THE STANDARD SAFETY ANALYSIS REPORT REGARDING EQUIPMENT QUALIFICATION (TAC NO. M83129)

Plant Name: System 80+ Standard Plant
Applicant: ABB Combustion Engineering
Review Status: Complete

Enclosed is the Plant Systems Branch (SPLB) input to the final Safety Evaluation Report (FSER) for Section 3.11 of Chapter 3 of CE-System 80+ Standard Safety Analysis Report (CESSAR) regarding equipment qualification. This SER input is a revision of the DSER based on our review of the information subsequently submitted by CE to address the unresolved open issues and the updated information from the amended CESSAR (up to Amendment S). Based on this review, the staff concludes that the information provided in this section of the CESSAR for the System 80+ standard design is acceptable.

Original signed by

Conrad E. McCracken, Chief
Plant Systems Branch
Division of Systems Safety and Analysis

Enclosure:
As stated

cc w/enclosure:
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SPLB:DST	SPLB:DST	SPLB:DST
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3.11 Environmental Qualification of Mechanical and Electrical Equipment

3.11.1 Introduction

Equipment that is used to perform a necessary safety function must be demonstrated to be capable of maintaining functional operability under all service conditions postulated to occur during its installed life for the time it is required to operate. This requirement, which is embodied in GDC 1 and 4 of Appendix A to 10 CFR Part 50 and Criteria III, XI, and XVII of Appendix B to 10 CFR Part 50, is applicable to equipment located inside, as well as outside, the containment. More detailed requirements and guidance related to the methods and procedures for demonstrating this capability for electrical equipment are given in 10 CFR 50.49, "Environmental Qualification of Electric Equipment Important to Safety for Nuclear Power Plants;" NUREG-0588, "Interim Staff Position on Environmental Qualification of Safety-Related Electrical Equipment " which supplements IEEE Standard 323 and various regulatory guides and industry standards; and RG 1.89, Revision 1.

3.11.2 Background

The staff issued NUREG-0588 in December 1979 to promote a more orderly and systematic implementation of equipment qualification programs by industry and to provide guidance to the staff for its use in ongoing licensing reviews. The positions in the NUREG-0588, provide guidance on (1) how to establish environmental qualification service conditions, (2) how to select methods that are considered appropriate for qualifying equipment in different areas of the plant, and (3) other areas such as margin, aging, and documentation. A final rule on environmental qualification of electrical equipment important to safety for nuclear power plants became effective on February 22, 1992. This rule, 10 CFR 50.49, specifies the requirements to be met for demonstrating the environmental qualification of electrical equipment important to safety located in a harsh environment. RG 1.89, Revision 1 (June 1984), identifies the guidelines that have to be met for complying with the rule. In conformance with 10 CFR 50.49, electrical equipment for PWRs referencing the System 80+ standard design must be qualified according to the criteria specified in Category I of NUREG-0588 and RG 1.89.

The qualification requirements for mechanical equipment are principally contained in Appendices A and B to 10 CFR Part 50. The qualification methods defined in NUREG-0588 can also be applied to mechanical equipment.

To document the degree to which the environmental qualification program for the System 80+ standard design complies with the environmental qualification requirements and criteria, the applicant presented CESSAR Section 3.11, "Environmental Design of Mechanical and Electrical Equipment," and CESSAR Appendix 3.11A, "Typical Environmental Conditions and Test Profiles for Structures and Components," and responded on February 12, 1992 (LD-92-017), to a staff request for additional information of October 10. 1991.

3.11.3 Staff Evaluation

The staff limited its evaluation of the environmental qualification program for the System 80+ standard design to a review of applicant submittals on its approach for selecting and identifying equipment required to be environmentally qualified for the System 80+ standard design, qualification methods proposed, and completeness of information in the tables in CESSAR Appendices 3.11A and 3.11B, "Typical Environmental Conditions and Test Profiles for Structures and Components," and "Identification, Location and Typical Environmental Conditions of Equipment," respectively. The bases for the staff's evaluation are SRP Section 3.11, Revision 2; NUREG-0588, Category 1; RG 1.89, Revision 1; and 10 CFR 50.49. For applicants referencing the CESSAR, the staff will review specific details of the environmental qualification programs for their plants using the evaluation bases mentioned above.

3.11.3.1 Completeness of Qualification of Electrical Equipment Important to Safety

The following three categories of electrical equipment important to safety that must be qualified in accordance with the provisions of the rule are identified in 10 CFR 50.49(b)(1), (b)(2), and (b)(3).

- (b)(1) safety-related electrical equipment (relied on to remain functional during and following design-basis events)

- (b)(2) non-safety-related electrical equipment whose failure under the postulated environmental conditions could prevent satisfactory performance of the safety functions by the safety-related equipment

- (b)(3) certain post-accident monitoring equipment (Categories 1 and 2 post-accident monitoring equipment as specified in RG 1.97, Revision 2, "Instrumentation for Light-Water-Cooled Nuclear Power Plants to Assess Plant and Environs Conditions During and Following an Accident")

In CESSAR Appendix 3.11B, the applicant listed the equipment required to mitigate a design-basis accident or to attain a safe shutdown. The applicant states that specific equipment for each system is discussed in the appropriate section of the CESSAR as reference by Appendix 3.11B. The staff reviewed Appendix 3.11B and found the applicant's approach for identifying and selecting electrical equipment required to be environmentally qualified acceptable. The staff will review specific details provided by applicants referencing the System 80+ standard design to demonstrate their compliance with 10 CFR 50.49(b)(1), (b)(2), and (b)(3) with respect to identification of electrical equipment important to safety required to be environmentally qualified. The details must include a list of systems and their components that are included in the plant environmental qualification program and design features for preventing the potential adverse consequences identified in IE Information Notice 79-22, "Qualification of Control Systems."

3.11.3.2 Qualification Methods

3.11.3.2.1 Electrical Equipment in a Harsh Environment

Detailed procedures for qualifying safety-related electrical equipment located in a harsh environment are defined in NUREG-0588 and RG 1.89. The criteria in these documents are also applicable to other equipment important to safety defined in 10 CFR 50.49.

The methodology used by the applicant to qualify nuclear steam supply system safety-related electrical equipment is outlined in the applicant's Topical Report CENPD-255-A, Revision 3, dated October 1985, entitled "Qualification of Class 1E Electrical Equipment." This topical report is a generic document that has been reviewed and approved by the NRC staff. The NRC staff's approval of CENPD-255-A, Revision 3, incorporated Amendment 9 of CESSAR-F. The staff's review of CESSAR-DC included a review of the basis for incorporating Amendment 9 of CESSAR-F into the review of CENPD-255-A, Revision 3. ABB-CE has stated that the referencing of CENPD-255-A, Revision 3 is independent of references to Amendment 9 of CESSAR-F. Consequently, the NRC staff has concluded that it is acceptable for CESSAR-DC to reference CENPD-255-A Revision 3, without reliance upon Amendment 9 of CESSAR-F, and that where CENPD-255-A and CESSAR-DC differ, CESSAR-DC takes precedence. Applicants referencing CENPD-255-A, Revision 3, must provide actual, plant-specific values that are in compliance with the requirements of 10 CFR 50.49. In addition, each applicant must verify the completeness of the equipment lists through use of the appropriate interface criteria and the validity of the environmental classification for each equipment item. On the basis of the staff review and approval of CENPD-255-A, Revision 3, the staff finds the methodology acceptable.

In Amendment I to CESSAR Section 3.11.2, the applicant proposed an alternate test profile which allowed for the substitution of testing twice at the specified service condition as a substitute for testing once at a profile that includes margins. In the DSER, the staff stated that this approach is non-conservative; not consistent with IEEE Std. 323-1974, NUREG-0588, or RG 1.89; and does not meet the intent of nor is it in compliance with 10 CFR 50.49. Consequently, this was identified as DSER Open Item 3.11.3.2.1-1. In Section 3.11.2 of Amendment N to CESSAR it is stated that " Environmental qualification of electrical equipment located in harsh environments within Combustion Engineering's scope of supply will be in accordance with the methodologies outlined in CENPD-255-A, Rev. 3..... Environmental qualification of electrical equipment outside of Combustion Engineering's scope of supply will be in accordance with IEEE 323-1974 and Regulatory Guide 1.89, Rev. 1." CENPD-255-A, Rev. 3 and IEEE Std. 323-1974 do not include an alternate test profile which allows for the substitution of testing twice at the specified service condition as a substitute for testing once at a profile which includes margins. Therefore the staff finds this acceptable to resolve Open Item 3.11.3.2.1-1.

To date the NRC staff has not endorsed IEEE Std. 323-1983; therefore, references to this standard in its entirety, or in part, are not acceptable. Consequently, in Amendment I to CESSAR Section 3.11.2.1 where IEEE Std. 323-

1983 is referenced in regard to the definition of a mild environment, the staff considered this DSER Open Item 3.11.3.2.1-2. In Section 3.11.2, which includes subsection 3.11.2.1 of CESSAR Amendment N, IEEE Std. 323-1983 is no longer referenced in relation to environmental qualification of electric equipment important to safety for nuclear power plants. The staff finds this acceptable to resolve DSER Open Item 3.11.3.2.1-2. An acceptable definition for a mild environment can be found in 10 CFR 50.49, paragraph (c).

In addition, for current-generation operating reactors, the staff's definition of what constitutes a mild radiation environment for electronic components such as semi-conductors, or any electronic component containing organic materials, is different from what it is for other equipment. The staff position is that a mild radiation environment for electronic equipment is a total integrated dose of less than 10^3 R. For other equipment it is less than 10^4 R. With the expected significant increase in the quantity and variety of electronic components in newer generation plants, the staff has increasing concerns about the efforts being made and the ability of these components to be environmentally qualified. In the DSER, the staff stated that the applicant should address the staff's concerns relative to their position on the environmental qualification of electronic components. This was identified as DSER Open Item 3.11.3.2.1-3. In CESSAR Amendment Q, Section 3.11.2.2, it is stated that equipment which is exposed to radiation equal to or above 10^4 Rads (equal to or above 10^3 Rads for electronic equipment) will be irradiated to its anticipated Total Integrated Dose (TID) prior to type testing unless determined by analysis that radiation does not affect its ability to perform its required function. The staff finds this acceptable to resolve Open Item 3.11.3.2.1-3.

Topical Report CENPD-255-A, Revision 3, was written by the applicant and reviewed and approved by the NRC staff for equipment within the applicant's scope of supply. However, in Amendment I to CESSAR Section 3.11.2 and in the applicant's submittal of February 12, 1992 (LD-92-017), the applicant indicated that the acceptance of this report should be extended to include other equipment suppliers. The staff does not agree with this position; therefore, this was identified as DSER Open Item 3.11.3.2.1-4. In Amendment N to CESSAR Section 3.11.2, it is stated that environmental qualification of electrical equipment outside of Combustion Engineering's scope of supply will be in accordance with IEEE 323-1974 and Regulatory Guide 1.89, Rev. 1. The staff finds this acceptable to resolve Open Item 3.11.3.2.1-4

3.11.3.2.2 Safety-Related Mechanical Equipment in a Harsh Environment

Although no detailed requirements exist for mechanical equipment, GDC 1 and 4 and Appendix B to 10 CFR Part 50 (Criteria III, "Design Control," and XVII, "Quality Assurance Records") contain the following requirements related to equipment qualification:

- components should be designed to be compatible with the postulated environmental conditions, including those associated with LOCA

- measures should be established for the selection and review for the suitability of application of materials, parts, and equipment

that are essential to safety-related functions

- design control measures should be established for verifying the adequacy of design

- equipment qualification records should be maintained and should include the results of tests and materials analyses

For mechanical equipment, the staff will concentrate its review on materials that are sensitive to environmental effects, for example, seals, gaskets, lubricants, fluids for hydraulic systems, and diaphragms. A review and evaluation should be performed that include the following:

- identification of safety-related mechanical equipment located in harsh environment areas, including required operating time

- identification of non-metallic subcomponents of this equipment

- identification of the environmental conditions for which this equipment must be qualified (The environments defined in the electrical equipment program are also applicable to mechanical equipment.)

- identification of non-metallic material capabilities

- evaluation of environmental effects

In LD-92-017, the applicant proposed a revision to CESSAR Sections 3.11.2.1 and 3.11.3.2 to provide additional clarifying information and committed the environmental qualification of mechanical equipment to CENPD-255-A, Revision 3. This proposed change will resolve most of the staff concerns with this section. Therefore, in the DSER this was identified as a confirmatory item until the staff verified that the applicant had made the proposed changes to CESSAR Sections 3.11.2.1 and 3.11.3.2. This was DSER Confirmatory Item 3.11.3.2.2-1. CESSAR sections 3.11.2.1 and 3.11.3.2 have been updated in Amendments N and Q respectively to eliminate reference to IEEE Std. 323-1983 for a mild environment and to add reference to CENPD-255-A, Rev. 3 for environmental qualification of mechanical equipment. The staff finds this acceptable to resolve Confirmatory Item 3.11.3.2.2-1.

In the DSER, the remaining concern in this section is the applicant's definition of a mild environment which is taken from IEEE Std. 323-1983. As stated in Section 3.11.3.2.1 of the DSER, a definition of a mild environment that is acceptable to the staff can be found in 10 CFR 50.49(c). The applicant's use of IEEE Std. 323-1983 was previously identified as open item in the DSER. Resolution of Open Item 3.11.3.2.1-2 above resolves this concern.

3.11.3.3 Conclusions

On the basis of its review of the CESSAR, other applicant submittals, and previous review and acceptance of CENPD-255-A, Revision 3, the staff concludes

that the program proposed by the applicant for environmentally qualifying electrical equipment important to safety and safety-related mechanical equipment is acceptable.

For applicants referencing the System 80+ standard design, the staff will evaluate the specific details of their plant-specific environmental qualification program, including maintenance and surveillance, for applicable equipment located in potentially harsh environmental zones (COL Action Item 3.11.3.3-1).