Department of Energy
Washington, D.C. 20545

Docket No. 50-537
HQ:S:82:031

MAY 17 1982

Mr. Paul S. Check, Director
CRBR Program Office
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Check:

RESPONSES TO REQUEST FOR ADDITIONAL INFORMATION - EQUIPMENT QUALIFICATION

Reference: 1) Letter, P. S. Check to J. R. Longenecker, "CRBRP Request for Additional Information," dated March 9, 1982

2) Letter, P. S. Check to J. R. Longenecker, "CRBRP Request for Additional Information," dated March 11, 1982

This letter formally responds to your request for additional information contained in the referenced letters.

Enclosed are responses to questions CS 270.3, CS 270.10, CS 270.11, and CS 270.13 in the area of equipment qualification. These responses will also be incorporated into the PSAR Amendment 69, scheduled for May 28.

Sincerely,

John R. Longenecker

John R. Longenecker, Manager
Licensing & Environmental
Coordination
Office of Nuclear Energy

Enclosure

cc: Service List
Standard Distribution
Licensing Distribution

D001
S1/1

Question CS270.3

NUREG-0800, Standard Review Plan Section 3.11 requires environmental qualification of mechanical as well as electrical equipment. Explain in detail how you intend to comply with the requirements for the environmental qualification of mechanical equipment.

Proposed Response to NRC Question CS270.3

As required by CRBRP Design Criterion 5, safety-related mechanical equipment is designed for the external environmental conditions associated with normal operation, operational occurrences and postulated accidents. These external environments and the internal environments form the basis for the Design Code Requirements (ASME, etc.). Furthermore, the safety-related mechanical equipment must meet the applicable requirements of the Active Pump and Valve Operability Program (Section 3.9) and the Seismic Design Criteria (Section 3.10).

In addition, sodium aerosols have been recognized to be a unique environment for CRBRP equipment. Safety-related mechanical equipment will be required to perform its safety function within its specification requirements in the applicable severe or non-severe sodium aerosol environments. Sodium aerosol environments within cells where sodium aerosols originate or within cells that directly ingest significant quantities of sodium aerosols are specified as "severe sodium aerosol environments." Extremely low sodium aerosol environments in air filled cells, other than those in which the aerosols originate, are classified as "non-severe sodium aerosol environments." For safety-related mechanical equipment exposed to severe sodium aerosol environments, testing of prototypic equipment is the preferred method of performance verification. Analysis will be performed only when extensive experience or testing exists to support the verification. For safety-related mechanical equipment exposed to non-severe sodium aerosol environments, analysis and/or past operating experience is the preferred method of performance verification.

These elements of safety-related mechanical equipment design are utilized to ensure that this equipment will perform its safety function in the presence of external accident environments. The external environments determined to be applicable for each safety-related mechanical component (sodium aerosol, pressure, temperature, radiation, and/or humidity) are design requirements contained in the Equipment Specifications for those components.

Question CS270.10

The equipment qualification program at CRBR involves several parties, the Department of Energy, Project Management Corporation, and various vendors. When the plant is fully licensed and operational, it will be turned over to the plant operator. It is essential for the operator of the plant to maintain all relevant documentation on equipment qualification in an auditable manner at a central location. Regarding equipment qualification the details of the interactions of the organizations and locations of the central file should be provided by amending appropriate sections of the PSAR.

Response:

CRBRP will maintain all relevant documentation on equipment qualification in an auditable manner at a central location. The documentation requirements for Class 1E equipment qualification are described in Reference B as specified in PSAR Section 3.11.2, "Qualification Tests and Analyses." The overall system for collection, storage, and maintenance of this documentation is described in PSAR Chapter 17, Appendix A, paragraph 17.1, "Quality Assurance Records: Owner Implementation," and paragraph 17.2, "Quality Assurance Records: Requirements of Other Participants." Briefly stated, this quality records management system specifies that the environmental qualification data packages are to be declared as lifetime quality records by each responsible participant and are to be transmitted to the Project Office for collection, storage, and maintenance by the owner at the Owners Level III Quality Records Center, Oak Ridge, Tennessee. Pursuant to the CRBRP Project implementation of the records storage requirements of ANSI N45.2.9, a duplicate file of these records is to be maintained for security purposes at the regional federal records center established for the CRBRP Project.

Question CS270.11

Recognizing that margins to be used in developing the required seismic and dynamic loadings are to be in accordance with the requirements of IEEE Standard 344-1975, provide an amendment that addresses (a) how the input loading specified in the purchase specification will be verified against the final design values, and (b) what method will be used to establish the total margin consisting of an input envelope over a number of similar equipment, differences between the initial input and final design input, and the test input versus the required input.

Response:

(a) The input loading specified in the purchase specification is in itself a controlled design data. Verification against the final design values is assured by the established Design Control procedures. These procedures are part of the Project QA Program, which is described in detail in the CRBRP PSAR Chapter 17.

(b) Where an input envelope over a number of similar equipment is used, the adequacy of margin is established by assuring the minimum value case satisfies the requirement. As in (a) above, such an input envelope will be in itself a controlled design data. Verifications of the initial input against the final design input and of the test input versus the required input are assured by a combination of established procedures including: Design Control Procedures, Test Control Procedures, and Procurement Document Control Procedures under the Project QA Program as described in PSAR Chapter 17.

Question CS270.13

Some equipment experiences high temperatures. Material behavior under the effects of high temperature during normal operation can go from the linear to the non-linear region. Thus, normal operating loads superimposed with seismic and dynamic loads are likely to produce non-linear responses in equipment. Discuss in detail in the amendment the non-linear analysis procedures to be used for equipment qualification. In the case of seismic analysis to account for the non-linear effects indicate how the nonuniqueness of seismic time history will be considered. Indicate what method or criteria will be used, including reduction of allowable stresses beyond those that are established for pressure boundary integrity, to account for the effects of material non-linearity at high temperatures and creep to ensure equipment operability.

Response

PSAR Section 3.7 and Appendix 3.7-A describes the requirements, load combinations and analysis methods for seismic analysis. The non-linear material response and analysis methodology utilized is described in RDT F9-4T and RDT F9-5T (if this standard is applied to the specific component). For illustrative purposes, a detailed response is provided for the permanent reactor internals.

Permanent reactor internals are designed to the appropriate ASME criteria (ASME - III, including CC N-47) with additional restrictions to assure component operability. The operability requirements are particularly critical for components related to reactor shutdown, such as the control rods and interfacing equipment. In general, these restrictions include an upgrade of the seismic events to more stringent requirements such as evaluating the OBE as ASME Normal (Service Condition A) and the SSE as ASME Emergency (Service Condition C), as well as detailed studies to evaluate the acceptable control rod insertion time. Normally, the OBE would be evaluated to Upset (Service Condition B) and SSE to Faulted (Service Condition D) limits.

In general, seismic and thermal stresses are not critical at the same locations due to the different nature of the loading conditions. Seismic events are most significant for thin sections when primary stresses and stability are critical. Thermal stresses are generally most significant at thick sections where the thermal inertia of the component produces large thermal stresses. A typical situation where the thermal and seismic stresses are both important would be the intersection of thin and thick sections. The seismic stresses in this section may be significant by themselves while the thermal stresses may also be significant due to the difference in thermal response of the two sections at the discontinuity. In these situations, the following general procedures apply.

(1) One OBE event is combined with the worst upset event at the most critical time in the upset event. Four OBE events are combined with the worst normal operating condition.

(2) The SSE event is combined with most adverse normal operating condition.

(3) In these situations, there is generally one stress component (or effective stress/strain is used) that is highly predominate relative

to the other components. The thermal and seismic events are conservatively combined to maximize these critical stress components.

(4) The requirements of RDT F9-5T regarding bilinear stress strain curves and 10th cycle kinematic hardening are imposed in the analysis.

The effects of this load combination may be stated for three separate cases. In all cases, the total increased creep and fatigue damage due to this loading combination is generally relatively small due to the limited number of events considered.

Case 1: Structure does not yield

The loading combination produces larger primary plus secondary and fatigue stress ranges than either event acting alone, but does not result in a residual stress. Thus the fatigue damage is increased, but the creep damage is not affected by the load combination.

Case 2: Structure yields only during loading

The loading combination produces larger primary plus secondary and fatigue stress ranges than either event acting alone, and results in a residual stress that may produce creep damage in the structure. The residual stress and resultant creep damage increment is dependent on the maximum strain produced by the loading combination.

Case 3: Structures yield during loading and unloading

This loading combination produces a larger primary plus secondary and fatigue stress and strain range than either event alone and results in a residual stress that contributes to creep damage at elevated steady state temperatures. This residual stress is somewhat dependent upon the total strain in the event combination because of the bilinearized stress strain curve (and resultant variations in yield stress and plastic modulus) approach specified by RDT F9-5T.