Department of Energy
Washington, D.C. 20585

May 7, 1982

Docket No. 50-537
HQ:S:82:026

Mr. Paul S. Check, Director
CRBRP 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: Letter, P. S. Check to J. R. Longenecker, "CRBRP Request for Additional Information," dated March 9, 1982

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

Enclosed are responses to questions CS 270.1, CS 270.2, and CS 270.4 through CS 270.9 in the area of equipment qualification. These responses will also be incorporated into the PSAR in Amendment 69, scheduled for May 21.

Sincerely,

D Gleason for

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

Enclosure

cc: Service List
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Question QCS 270.1 (3.11)

The NRC staff position of environmental qualification of electrical equipment is discussed in NUREG-0588. Discuss your compliance with these requirements. If you intend to use WARD-D-0165, "CRBRP Requirements for Environmental Qualification of Class 1E Equipment", identify any differences between IEEE 323,1974 and the NUREG-0588 Category I requirements and discuss how the CRBR design complies with the NUREG-0588, Category I requirements.

Response

The CRBRP program for environmental qualification of safety-related electrical equipment, WARD-D-0165, is consistent with the objectives and requirements delineated in NUREG-0588, Rev. 1 "Interim Staff Position on Environmental Qualification of Safety-Related Electrical Equipment", except as noted below.

Differences in CRBRP reactor technology and plant configurations exist and, as a result, some specific LWR requirements delineated in NUREG-0588 are not applied to CRBRP. These differences are: the use of liquid metal sodium for the reactor coolant; a low pressure coolant system with no mechanism for a highly pressurized containment; the absence of steam, containment spray, and the mechanism for water flooding within the containment; environmental separation of the upper containment from the lower containment; and placement of redundant heat transport loops in separate cells resulting in independent loop environmental conditions (environments in one loop do not propagate to the cells of another loop).

Paragraph 2.4 of the NUREG-0588, Category 1 requirements, discuss "Other Qualification Methods". In this regard, CRBRP requirements permit type testing, analysis, prior operating experience and/or a combination of these techniques for equipment qualification. An evaluation of the adequacy of the proposed method would be done before using analysis or operating experience in lieu of testing. Also an evaluation would be done to determine the necessary extent of any partial type tests required to be provided in support of these methods.

In addition to the design differences stated above, CRBRP does not apply two NRC staff positions stated in NUREG-0588. The first exception deals with the radiation source term used for qualifying Class 1E equipment located within the containment. NUREG-0588 specifies the worst radiation environment as an instantaneous release from the fuel to the atmosphere of 100 percent of the noble gases, 50 percent of the iodines, and 1 percent of the remaining fission products. CRBRP uses the normally expected radiation environment over the equipment qualified life plus that associated with the most severe design basis accident during or following which the equipment must remain functional. The worst case radiation DBA is the In-Containment Primary Sodium Storage Tank failure during maintenance. The second exception concerns the application of time margin to safety-related equipment which performs its safety function

within a short time period into the event (i.e., less than 10 hours). In NUREG-0588 a minimum qualification time margin of 1 hour is specified. CRBRP requires that equipment be qualified for the environment in which it must perform its safety function for the time duration specified for the safety response plus time margin per IEEE 323-1974. Failure of any equipment after its qualification time (whether longer or shorter than 1 hour) will not result in unsafe plant conditions.

Question CS 270.2 (3.11.1)

Confirm that Section 3.2 contains all safety-related systems (including display instrumentation which is required by the plant emergency procedures) requiring environmental qualification.

Response

Section 3.2 of the PSAR contains a generic list of all CRBRP safety-related electrical equipment. This list does not differentiate between the various instrumentation and control devices, e.g., Temperature Sensors (RTD's or thermocouples), Temperature Controllers, Temperature Indicators (display), etc. A comprehensive list of CRBRP Class 1E equipment, including display instrumentation, is provided in Tables 3-1 and 3-2 of WARD-D-0165, "CRBRP Requirements for Environmental Qualification of Class 1E Equipment," (Ref. 13, PSAR Section 1.6).

Question QCS 270.4 (3.11)

Discuss how you intend to account for the uncertainties caused by the production errors and errors associated with defining satisfactory performance when only a small number of units are tested. This margin should be in addition to the margin applied during the derivation of the specified plant parameters and margin applied to account for the instrument error during testing.

Response

CRBRP conservatively calculates the most severe specified service conditions that include accident environments that result from a review of all design basis events. The events that produce the most severe environmental transient are used. Often this would require multiple design basis accidents occurring to generate the most severe environmental conditions (temperature, pressure, radiation, humidity, etc.). These conservatisms assure margins between the service conditions specified and the actual conditions which could realistically be expected in a design basis event. Quantifiable margin is then applied to the conservatively calculated most severe service condition design parameters as per IEEE 323, Section 6.3.1.5.

In defining the type testing, the margin applied to the test profile envelops the specified design condition profile. In addition to applying margin to the environmental parameters, margin is added to the test duration. Further margin is applied in type testing by adding a margin transient (Section 4.2.2, step #7 of WARD-D-0165 "CRBRP Requirements for Environmental Qualification of Class IE Equipment").

Through application of these margins, CRBRP accounts for uncertainties associated with reasonable error in defining satisfactory performance when a small number of units is tested, normal variations in the commercial production of equipment, and accuracies of data resulting from type test measurements.

When conducting a type test for an item being qualified, an acceptance test is performed to assure that production problems do not exist. Also the equipment specification requirements assure that the delivered plant equipment design and manufacture is verified by inspection, testing (such as factory tests, burn-in tests, system tests, etc.), design control measures, and quality assurance methods.

Question QCS 270.5 (3.11)

Since equipment may be exposed to a sodium aerosol environment and this condition is unique to CRBRP, describe in detail how you plan to qualify the equipment for the sodium aerosol environment. Provide the results of the testing performed to date. How do you assure the operability of diesel generators in the sodium aerosol environment?

Response

CRBRP requires that Class 1E equipment which is required to perform its safety function during or after exposure to a sodium aerosol environment, must be qualified for the sodium aerosol environment. Two specific aerosol environments are identified. Sodium aerosol environments within cells where sodium aerosols originate or within cells that directly ingest significant quantities of sodium aerosols are specified "severe sodium aerosol environments". Extremely low sodium aerosol environments in air filled cells, other than those in which the aerosols originate, are classified as a "non-severe sodium aerosol environment". Equipment in the low sodium aerosol environment is located in general plant areas outside containment. This equipment does not experience any significant changes in its service conditions due to a design basis event which has occurred in another plant location.

Class 1E equipment required to function within non-severe or severe sodium aerosol environments is required to be qualified by using either analysis, type testing, prior operating experience, or a combination of the previous qualification methods. The qualification procedure must comply with IEEE 323-1974 and IEEE 344-1975 as endorsed by RG 1.89 and RG 1.100 respectively, with application of pertinent NUREG 0588 guidance as discussed in Response CS 270.1.

For equipment required to function within severe sodium aerosol environments; the equipment is aged to its end of life condition, subjected to the seismic/vibration condition, and then exposed to the worst case Design Basis Event transients (temperature, pressure, radiation, humidity, sodium aerosols). The equipment being type tested is required to be either identical to the plant hardware or all differences existing must be identified and justification provided that the differences do not affect the qualification results. Prior to subjecting equipment to this type test, equipment specification acceptance testing must be completed. The type tests shall be performed in the numerical order to meet the requirements of IEEE 323-1974, paragraph 6.3.2 as well as the requirements specified in WARD-D-0165, Section 4.2.2.

Where equipment is required to function within non-severe sodium aerosol environments; the equipment will be placed in its end of life state where required, subjected to off normal temperature, humidity and sodium aerosol environments, and then exposed to the seismic/vibration environment. The CRBRP aging program for equipment located in non-severe environments permits equipment and components to be excluded from the stimulated aging requirement

based on documented demonstration of no significant degradation of pertinent properties during its projected installed service life provided scheduled maintenance, surveillance and inspection is properly performed.

The qualification test sequences depicted above are the most severe test sequences. Equipment located in severe environments is exposed to the most severe Design Basis Event transients last, since exposing the test item to the most severe environment after exposure to the lesser environmental parameters results in the most severe test. For equipment located in non-severe environments, the most severe condition that can challenge operation of the equipment is the seismic event; therefore, the seismic parameters are inserted last. It should be pointed out that the abnormal temperature condition and the low sodium aerosol environment represent design requirements for which the equipment can be designed to prevent failures. Even though equipment located in non-severe environments will be designed to operate for the off normal temperature and aerosol environments, CRBRP requires that the equipment be qualified for these environments per Section 4.1 of WARD-D-0165.

At present, no qualification testing has been completed for equipment located in non-severe or severe sodium aerosol environments.

Each of three Class IE Diesel Generators and the auxiliary equipment for each diesel generator are located in a separate diesel generator room which will not be exposed to sodium aerosols. Each room is served by 100% recirculating cooling system and therefore the ingestion of sodium aerosol into the diesel room is excluded.

The combustion air to the diesel engines will be filtered by high efficiency (HEPA) filters with a filtration efficiency higher than the 99.97%. It is expected that the trace amounts of aerosol passing through the HEPA filters will not affect the operation of the diesel engines.

Question QCS 270.6 (3.11)

WARD-D-0165, Section 4.2.2, item 9, discusses failures during testing. In case of the failure during the test, if a redesign or replacement has been pursued as a solution, the complete assembly must be tested again to assure qualification. Discuss your commitment to this requirement.

Response

WARD-D-0165 endorses IEEE 323-1974, Section 6.8, which contains specific instructions regarding modification to equipment which fails during testing. Modifications involving a redesign or a replacement to the equipment or to the equipment specification should not be made after the start of the type test. CRBRP requires a test failure evaluation on a case by case basis to determine whether or not a requalification in whole or in part is required. Modifications, with additional confirmation testing, are pursued as a solution to a test failure only if full justification is provided to document that the change has no bearing on the validity of the test.

Question QCS 270.7 (3.11)

WARD-D-0165, Section 4.2.2, page 5, third paragraph: revise IEEE 383-1972 to IEEE 382-1972.

Response

The typographical error has been corrected and forwarded to the NRC as part of Rev. 6 to WARD-D-0165.

Question QCS 270.8 (3.11)

WARD-D-0165, Page 4.11, Figure 4.3 and the Table on page 4-13 discuss the aging method similar to the 10°C rule. It is the NRC staff position that the 10°C rule is not an acceptable aging method unless justified by providing the verification based on Arrhenius methodology. Discuss how you comply with this requirement.

Response

The CRBRP equipment qualification program is designed to conform to IEEE 323-1974 as clarified by the forward issued by Nuclear Power Engineering Committee (NPEC) on July 24, 1975, as IEEE 325A-1975. This statement includes to "utilize known technology in any aging program".

CRBRP recognizes the limitations of aging techniques and the existence and development of various aging theories. CRBRP evaluates the aging methods to be utilized by the equipment vendor. It is not acceptable for the 10°C rule to be applied without documented assurance that this technique fulfills the objectives of aging. Further CRBRP anticipates that due to the empirical nature of the 10°C rule, use of the Arrhenius model may be the most suitable method. This will be evaluated on a case by case basis. The CRBRP aging program establishes in WARD-D-0165, Section 4.2.2.1 guidance to ensure that equipment suppliers are required to address the aging objectives of the qualification program.

Question QCS 270.9 (3.11)

WARD-D-0165, Section 2.2 defines the mild (non-severe) environment. The definition used by the staff for the mild environment is defined as "an environment that would at no time be more severe then the environment that would occur during normal plant operation or during anticipated operational occurrences". Discuss your compliance with the staff's definition for the mild environment.

Response

The CRBRP non-severe environment does include the same environmental parameters that are included in the NRC definition of a mild environment. This applies to the parameters that occur on both LWR's and CRBRP, such as temperature, humidity and seismic. The values for those parameters that are included in mild (LWR) and non-severe (CRBRP) environments are those that result from normal plant operation, anticipated operational occurrences, or safe shutdown and operating base earthquakes. For the CRBRP design, an additional parameter, sodium aerosols, may be present. Due to the design of CRBRP, specifically the environmentally separated cells into which the plant is divided, the aerosols that may be present as a result of an accident are classified as (1) those that are present in the cell in which the accident occurs, or (2) those that may be present in other cells as a result of a short ingestion period prior to isolation being completed. The aerosols present in the cell in which an accident occurs are classified as severe environmental parameters. The aerosols present in cells other than the accident cell are classified as non-severe since Class IE equipment located in these areas are not expected to experience an environment any more severe than the environment resulting during normal plant operation or during anticipated operational occurrences.

The aerosols associated with the non-severe environment are specified for CRBRP as a concentration in air of 15 mg/m^3 and a deposited surface concentration of 0.1 g/m^2.

The environmental parameters associated with a non-severe environment can be accommodated by the equipment design. These non-severe environmental parameters are addressed in the equipment design specifications. CRBRP further requires that the equipment be qualified to these parameters. A specific discussion of the qualification procedures appears in Section 4.2.1 of WARD-D-0165, Rev. 6.

To: J. W. Longenecker (DOE/HDQR)
From: Don Robinson (CRBRP/PO)
Attn: Rob Woolay

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PSAR RESPONSE APPROVAL FORM

Date: ____________

Response to NRC Question(s) 270.1

Reference Letter Number ________

The above NRC Question Response(s) have been reviewed and dispositioned as follows:

☐ Approved Without Changes:
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Comments:

Approval:

K. L. P[illegible] 5/4/82
date

Concurrence:

J. P. [illegible] 5/3/82 | D. L. DeMott 5/3/82 | R. [illegible] 5/3/82
AE date | LRM date | PO Concurring Divisions date

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PSAR RESPONSE APPROVAL FORM

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Response to NRC Question(s) 270.2

Reference Letter Number _____

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date

Concurrence:

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Response to NRC Question(s) 270.4

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date

Concurrence:

J.P. Roeller 5/3/82	D.L. DeMott 5/3/82	[signature] 5/[illegible]
AE date	LRM date	PO Concurring Divisions date

Distribution: PO Public Safety Division (Action)

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PO Lead Division

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PSAR RESPONSE APPROVAL FORM

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Response to NRC Question(s) 270.5

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Comments:

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K. G. Pl... 5/4/82
date

Concurrence:

J. P. Pinter 5/3/82
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PO Lead Division

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PSAR RESPONSE APPROVAL FORM

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Response to NRC Question(s) 270.6

Reference Letter Number _____

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Kirk Peterson 5/14/82
date

Concurrence:

J. P. Burke 5/13/82 — date
LRM — date
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PO Lead Division

PSAR RESPONSE APPROVAL FORM

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Response to NRC Question(s) 270.7

Reference Letter Number ______________

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Comments:

Approval:

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date

Concurrence:

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Distribution: PO Public Safety Division (Action)

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PSAR RESPONSE APPROVAL FORM

Date: ________________

Response to NRC Question(s) 270.8

Reference Letter Number ____________

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Comments:

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Concurrence:

[signature] 5/3/82	[signature] 5/3/82	[signature] 5/4/82
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PO Lead Division

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PSAR RESPONSE APPROVAL FORM

Date: _____

Response to NRC Question(s) 270.9

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Approval:

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date

Concurrence:

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AE Date

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LRM date

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