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April 7, 1988
Fort St. Vrain
Unit No. 1
P-88121

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555

Attention: Mr. Jose A. Calvo
Director, Project Directorate IV

Docket No. 50-267

SUBJECT: Proposed Plan for CRDM Temperature Requalification

REFERENCES: (See Attached)

Dear Mr. Calvo:

The purpose of this letter is to provide the NRC with Public Service Company of Colorado's (PSC) proposed plan for requalification of the Control Rod Drive Mechanisms (CRDM) for elevated temperatures.

BACKGROUND

Following review of PSC's previous submittal (Reference 1) for temperature requalification of the CRDM assembly, the NRC recommended (Reference 2) that PSC revise the entire study related to requalification of the CRDM's for elevated temperatures due to inadequacies in the test methodology. Following receipt of this NRC guidance, PSC requested a meeting with NRC representatives to present PSC's revised temperature requalification plan. This meeting was conducted on December 4, 1987, and the results of the meeting are reported in Reference 3.

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The following items were identified during this meeting (and documented in Reference 3) for consideration in PSC's temperature requalification plan for the CRDM's:

(1) Evaluate the projected maximum CRDM service temperature.

(2) Evaluate the CRDM system for acceptability at this projected service temperature.

(3) Perform an integrated systems test of an entire CRDM assembly.

(4) Evaluate the role of the preventive maintenance program in assuring system performance.

ITEM 1: MAXIMUM TEMPERATURE DETERMINATION:

Evaluation of the maximum projected CRDM service temperature is not yet completed, pending analysis of recently completed core testing which reflects CRDM temperature information. Test procedure RT-500 was completed March 13, 1988, and test results are being correlated with previous temperature data and the temperature prediction computer model. The RT-500 testing consisted of: (1) closing orifice valves to increase core resistance to simulate higher core differential pressures expected during this cycle; (2) increasing reactor power from 60 percent to 78 percent (in 3 percent step increases); and (3) monitoring for core fluctuations. This configuration represents worst case conditions for causing excessive temperatures in the CRDM cavity. Preliminary review of data indicates that only 2 of 37 regions exceeded 215 degrees F, with a maximum CRDM temperature attained of 248 degrees F.

The maximum daily motor temperature achieved to date in 1988 during normal operation was 245.4 degrees F (Reference 4). Further information related to the maximum CRDM temperatures experienced during operation in January and February in 1988 can be found in References 4 and 5 (Monthly Report of CRD Maximum Daily Temperatures).

It is PSC's intent to complete the evaluation of the maximum service temperature within the next 30 days and to submit the results with the CRD Rod Position Indication report due to the NRC on April 29, 1988. It is also PSC's intent to incorporate this temperature analysis into the proposed CRDM temperature requalification plan and continue to track CRDM temperature in accordance with Technical Specification surveillance requirements.

ITEM 2: CRDM SYSTEM EVALUATION

Attachment 1 provides the details of the proposed temperature requalification plan. It is requested that you review the attached requalification plan, as it is PSC's intent to proceed with this plan to document the CRDM qualification basis for elevated temperatures. Within this requalification process, PSC will incorporate the regulatory guidance identified in Reference 3, to the extent applicable, recognizing that portions of the CRDM are non-safety related and will be treated as such.

ITEM 3: PERFORMANCE OF INTEGRATED SYSTEMS TEST

Determination of the need for an integrated system test will be made as part of the overall plan (Attachment 1) for temperature requalification of the CRDM's. The possibility exists that use of the analyses associated with the requalification plan (identified in the attachment) may provide suitable basis for not performing additional type tests of the entire CRDM mechanism. The need for the type test will be determined during the requa tion program.

ITEM 4: ROLE OF PREVENTIVE MAINTENANCE

Evaluation of preventive maintenance will be factored into the overall requalification plan. Maintenance and inspection requirements will be reviewed to determine if revision is necessary based on the results of analysis and type testing performed. Additionally, maintenance and inspection requirements will be reviewed to determine if frequency of these requirements should be adjusted based on any evidence of accelerated wear or aging of CRDM components found during maintenance inspections.

SCHEDULE

PSC is currently conducting discussions with outside contractors to accomplish all activities associated with the requalification plan. It is expected that component analysis will start within two months and will be complete within one year. PSC intends to provide the NRC with a status update regarding progress on requalification of the CRDM's in about six months and will provide the NRC with the results of the CRDM temperature requalification activities when complete.

If you have any questions on this subject, please contact Mr. M. H. Holmes at (303) 480-6960.

Very truly yours,

D.W. Warembourg

D.W. Warembourg, Manager
Nuclear Engineering Division

DWW/CRB:dvd

Attachment

cc: Regional Administrator, Region IV
ATTN: Mr. T. F. Westerman, Chief
Projects Section B

Mr. Robert Farrell
Senior Resident Inspector
Fort St. Vrain

REFERENCES

(1) PSC letter, Warembourg to Berkow, dated May 16, 1986 (P-86374)

(2) NRC letter, Heitner to Williams, dated December 24, 1986 (G-86664)

(3) NRC Memorandum, Heitner to Calvo (NRC), dated December 16, 1987 (G-87445)

(4) PSC letter, Williams to Calvo, dated February 2, 1988 (P-88054)

(5) PSC letter, Williams to Calvo, dated March 21, 1988 (P-88106)

ATTACHMENT 1
CRDM TEMPERATURE REQUALIFICATION PLAN

1. METHOD OF QUALIFICATION:

The following requalification plan has been developed for temperature requalification of the CRDMs. The plan consists of the following phases: (1) evaluate temperature profiles obtained from operational data and computer codes for CRDM assemblies to establish the temperature to be used for qualification basis; (2) evaluate age-related qualifications of the CRDMs using standard materials aging analysis techniques; (3) perform a failure-modes-and-effects analysis, if necessary, to determine the consequences of component failure for those components determined to have insufficient life at elevated temperatures; and (4) if necessary, perform a type test of a complete CRDM assembly.

The following documents will be reviewed, as applicable, to determine the basis for the CRDM temperature requalification plan:

1) Standard Review Plan 3.11 "Environmental Qualification of Mechanical and Electrical Equipment", (Rev. 2, July 1981).

2) Standard Review Plan 4.5.1 "Control Rod Drive Structural Materials", (Rev. 2, July 1981).

3) Standard Review Plan 4.6 "Functional Design of Control Rod Drive System", (Rev. 1, July 1981).

4) NRC Regulatory Guide 1.97 "Instrumentation for Light-Water-Cooled Nuclear Power Plants to Assess Plant and Environs Conditions During and Following an Accident", (Rev. 3, May 1983).

5) Generic Letter 83-28 "Required Actions Based on Generic Implications of Salem ATWS Events".

6) 10 CFR 50.62 "Requirements for reduction of risk from ATWS events for light-water-cooled nuclear power plants".

7) NRC letter, Denton to Walker, dated October 16, 1984 (G-84392) Subj: Preliminary Report Related to the Restart and Continued Operation of FSV.

2. REFERENCES:

Identify all relevant correspondence, analyses, and reports (including historical data) related to the CRDMs.

- Drawings
- Specifications
- Procedures (SOP's, AOPs, EPs, SSC, etc.)
- Baseline Calculations
- Special Definitions

3. EQUIPMENT DESCRIPTION:

a. Identify all components and subcomponents by manufacturer and model number.

b. Identify all materials used in each of the components (degradable vs. non-degradable) for purposes of thermal aging analysis.

4. PERFORMANCE REQUIREMENTS:

a. Define the safety functions that the CRD's are required to perform.

b. Provide a complete system description, including both normal and abnormal operation.

c. Identify the functional and operational requirements for the CRDMs to ensure that they are used as the basis for temperature requalification of the CRDM assembly.

d. Identify applicable design requirements; identify such items as codes, standards, design margins, separation/segregation, and performance characteristics.

e. Identify other special considerations, such as:

- Technical Specifications
- Setpoints
- Others (interfaces, qualifications, failures modes, limitations precautions)
- FSAR commitments/analyses
- Operations and Maintenance

f. Perform a review of the normal and post-accident operating requirements for the CRDMs, based on review of the FSAR operations and accident analysis, Technical Specification operability requirements, and surveillance requirements.

5. SERVICE CONDITIONS:

   a. This section evaluates FSV temperature conditions in the CRDOA regions.

   b. Predicted maximum temperature and temperature history will provide basis for aging qualification to be performed under "Qualification by Analysis."

   c. Analyze and document available data on the maximum expected motor temperature for which the CRDMs should be qualified. Develop and document (1) recent motor temperatures while operating at power, (2) the computer code used to estimate maximum temperatures, and (3) assumptions used in this code which will require monitoring/review when additional operating data is available. This procedure is to provide the basis for the qualification temperature to be used in the determination of qualified life.

6. SYNERGISTIC EFFECTS TO BE EVALUATED:

   a. Identify temperature related synergistic effects of concern and determine the method to be used to evaluate each.

   b. Evaluation should include but not be limited to the following:

   - Moisture Ingress
   - Lubricant Embedded in the Brake
   - Heat Effects
   - Differential Thermal Expansion
   - Integrated operation of the CRD mechanism
   - Tolerance accumulation
   - Wear-induced Misalignment
   - Lubricant Redeposition
   - Motor Temperature Rise

   c. Due to the concern over CRD operation at higher temperatures than previously evaluated, the effects of elevated temperature on the various synergistic effects should be evaluated to determine if previous analyses are sensitive to higher temperatures; results of these sensitivity determinations should be documented with the individual analyses.

7. QUALIFICATION BY ANALYSIS:

   a. Define the specific qualification limitations to be evaluated by analysis.

b. Qualified life will be established through use of material analysis; due to location of the CRDMs in a mild environment, use of this methodology is acceptable.

c. Specific qualification criteria to be evaluated by analysis include the following:

1) Thermal Aging Analysis - evaluate the effects of operation at elevated temperature to determine allowable motor temperature rise and expected component life.

2) Radiation Aging Analysis

3) Humidity and/or Moisture Ingress

4) Synergistic effects - provide analysis of those synergistic effects which can be evaluated by use of analysis.

d. Failure Modes and Effects Analysis (FMEA):

As a result of thermal aging analysis, it may be determined that certain CRDM components have insufficient qualified life for the remaining lifetime of the CRDM based on their service time at elevated temperatures. A FMEA will be performed for these CRDM components to determine if their failure will adversely affect the ability of the CRDM to perform its design safety function. Based on the results of the FMEA, a determination will be made to type test the components, increase maintenance and surveillance activities associated with the components, or increase the frequency of replacement.

8. QUALIFICATION BY TYPE TESTING:

a. Define the specific qualification objectives to be evaluated by type testing (i.e., synergistic effects, integrated operation of the mechanism, moisture ingress, rod position indication, etc.).

b. Type testing is intended to resolve non-aging, synergistic concerns identified by the NRC in their submittals to PSC.

c. One key objective is to measure actual motor temperature rise/maximum motor temperature at the elevated ambient temperature to compare with analytical calculations.

d. Previous type tests should be reviewed for applicable data and results incorporated into this section.