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50-267

April 27, 1983
Fort St Vrain
Unit No. 1
P-83160

Mr. John T. Collins
Regional Administrator
Nuclear Regulatory Commission, Region IV
611 Ryan Plaza Drive, Suite 1000
Arlington, TX 76011

DOCKET NO. 50-267

SUBJECT: Fort St. Vrain Prestressed Concrete Reactor Vessel (PCRV) Liner Hot Spots

REFERENCE: P. Wagner (NRC) letter to O.R. Lee (PSC) dated 12/28/82 (G-83035)

Dear Mr. Collins:

This letter follows a conversation with Mr. P. Wagner, of your staff, in response to the referenced letter.

The referenced letter provided a copy of Los Alamos National Laboratory's (LANL's) interim report on their independent review of PCRV Liner Hot Spots, the seven localized areas of the Fort St. Vrain PCRV where actual operating temperatures were found to exceed original FSAR design values. The report proposes to categorize each of the hot spots according to a universal and, as yet, undefined acceptability criterion based on "relative degrees of severity." Further, it proposes to define, in general terms, the required remedial actions for each hot spot area based on an assumed degree of severity.

Public Service Company of Colorado does not concur with this approach. The development of a new universal acceptability criterion

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for the spectrum of "relative degrees of severity" is unnecessary. An acknowledged acceptability criterion, in the form of the ASME Code, already exists. Further, the actual hot spots have been well characterized and are few in number.

It is more meaningful and practical to evaluate each hot spot area by its effect on the adequacy of the structure as a whole. The acceptability criterion for the hot spots should be that the actual stresses in the concrete when subjected to elevated temperatures meet the ASME Code allowables under the appropriate load category. The satisfaction of this criterion would mean that no corrective action is necessary. Only if this criterion cannot be met would further justification or corrective action be appropriate. This is the approach that PSC has been using, with NRC's concurrence, since these hot spots were discovered during startup testing.

Further comments by the PSC and GA Technologies staffs are contained in the attachment to this letter.

PSC appreciates having the opportunity to review and comment on this work before it is finalized. We encourage NRC to continue this sort of cooperative interchange.

If you have any questions regarding our comments please contact Jack Levin at (303) 571-7387.

Very truly yours,

Lawrence Brey

H. L. Brey, Manager
Nuclear Engineering Division

HLB/JPL:pa

Attachment

Attachment to P-83160

Public Service Company of Colorado

and

GA Technologies

Comments on

Interim Report by

Los Alamos National Laboratory

on

PCRV Liner Hot Spots

The stated objectives of the PCRV Liner Hot Spot study are to:

1. Review the temperature data for the Fort St. Vrain (FSV) Prestressed Concrete Reactor Vessel (PCRV) Liner Cooling System hot spot areas.

2. Determine the hot spot temperature distribution at the PCRV liner/concrete interface for each area.

3. Evaluate the severity and consequences of the hot spots on reactor safety and performance.

4. Suggest improvements for reducing hot spot temperature distributions.

The hot spot areas reviewed are the same seven hot spots reviewed in "PCRV Liner Hot Spot Evaluation" (P-78037, dated March 8, 1978).

The following are comments relative to the four stated objectives of the LANL study:

1. Review of temperature data

   - The data in the LANL Study is in agreement with PSC's data.

   - In LANL's Table E.1, data from thermocouple TE-1170-20 is presented. This data should not be used since the value recorded is not valid (it stays at about 15°F irrespective of core power level). All the other thermocouple data in Table E.1 are valid.

   - Our copy of the LANL Study does not contain Table B.1 which is stated as containing thermocouple and operating data.

2. Determine a hot spot temperature distribution

   - No comment: Table 1, attached, shows that the temperatures predicted by LANL are "comparable" to GA results.

3. Evaluate the severity and consequences of the hot spots on reactor safety and performance

   - LANL made no attempt to evaluate the structural acceptability of each hot spot area analytically. Instead they propose a hot spot acceptability criterion based on relative degrees of severity. Their recommended degree of severity and their calculated extent of severity for each of the seven hot spots is given in Table 1.

The classification of severity of hot spots by a specific volume of concrete exceeding a certain temperature appears arbitrary since it is not based on the stress allowables. In addition, the volume of concrete affected by all hot spots identified in the FSV PCRV is considered very small relative to the volume of the concrete of the structural sections involved. The maximum depth of penetration of high temperatures at the hot spots is less than 3 inches as indicated in Table 1. The ASME Code allowables for concrete temperatures are intended to ensure that the range of material properties considered in design/analysis is maintained. Therefore, it is more meaningful and practical to evaluate the acceptability of a hot spot by its effect on the adequacy of the structure as a whole taking into consideration any material degradation, concrete creep and stress relaxation, that may be caused by elevated temperatures. The acceptability criterion for the hot spots should be that the actual stresses in the concrete when subjected to elevated temperatures meet the ASME Code allowables under the appropriate load category. The satisfaction of this criterion would mean that no corrective action is necessary. Only if this criterion cannot be met would a hot spot area be classified as having the "third and maximum degree of severity".

- In Appendix A, the conclusion that the core barrel/core support floor is degree #3 severity is inconsistent with the findings that only "extremely limited areas of concrete" are affected which "do not affect the overall temperature distribution in the CSF" and that localized elevated temperatures "decrease rapidly to below 250°F within 1 inch of the concrete penetration."

- In Appendix B, the conclusion that the loop divider baffle is degree #3 severity is inconsistent with the statement that "previewing the structural analysis furnished by GAC indicates that, under the given thermal conditions, the structure and supporting welds can withstand these temperatures." The third level of severity was defined as encompassing those hot spot areas for which structural analysis failed to show compliance with ASME design codes. Since this is not the case, degree #3 severity is not appropriate.

- In Appendix C, the Helium Purification Train Crossover pipe is classified as degree #2 severity but LANL's Table 1 lists it as degree #3 severity.

- In Appendix D, the conclusion states that the core outlet thermocouple penetrations "would most likely be of degree #2 severity" because of correctability, but then classifies this hot spot as degree #3 severity. These statements are inconsistent with the proposed acceptability criterion, i.e.; classification as degree #3 severity would depend on the results of structural analysis.

4. Suggest improvements for reducing hot spot temperature distribution

   - No comment.

5. The following are minor editorial comments:

   - Ref. 31 incorrectly gives the document number as VEC:625.75. It should be VEC-652:75.

   - Table A.1 is not labeled. In Table A.1 the date (4/18/81), the pressure (688 psi) and the core helium flow (3.1 x 10 lb/h) for data taken at 80% power are missing. Also in Table A.1 at 80% power T-in and T-out are correctly given as 688°F and 1376°F in one location but incorrectly given as 704°F and 1374°F in another location.

   - Figure B.1 incorrectly shows the loop divider baffle going through the access penetration.

   - In Figure C.2 the effective pitch of the spiral cooling tubes on the HTFA is correctly given as 6.8 inch. However, in the Background section of Appendix C it is incorrectly given as 7.5 inch.

   - Relative to the core outlet thermocouple penetrations the local maximum concrete temperature is quoted at different values in different locations in the text: 345°F in Table 1, 343°F in Results section of Appendix D, and "approaches 350°F" in the Summary to Appendix D.

   - In the second paragraph of the Analysis section of Appendix E, Figure E.3 is incorrectly called out.

   - Relative to the steam generator penetration, the local maximum concrete temperature is quoted at different values in the different locations in the text: 273°F in Table 1 and 275°F in Appendix F.

   - Relative to the loop divider baffle, the local maximum concrete temperature is quoted at different values in

different locations in the text: 350°F in Table 1, 375°F in Summary section of Appendix B, and "approaching 400°F" in the Results section of Appendix B.

- In the Results section of Appendix B, Figure B.5 is incorrectly called out. It should have stated Figure B.4.

6. References

(1) "Evaluating the Severity and Consequences of the PCRV Liner Hot Spots at The Fort St. Vrain Nuclear Generating Station," interim LANL report transmitted to PSC by letter from P. Wagner of NRC dated 12/28/82 (G-83035)

TABLE 1
PCRV LINER HOT SPOT RESULTS

	Apparent Cause	Predicted Maximum Local Concrete Temp.(1) 100% Power, °F LANL	GA	Depth of Penetration, in.	Volume ft³	Severity Degree	Recommendations(5)
Core Support Floor	Bypass flow under core barrel support pad	Between Tubes 350	326	< 0.5	< 0.4	3	Further investigation
		At T/C Location 210	200-215				
Loop Divider Baffle	Discontinuity in thermal barrier producing thermal short to liner	375(4)	375	< 3.0	< 1.2	3	Further investigation
Helium Purification	Insufficient cooling at intersection of HTFA penetration & crossover pipe	330	300	1.0	0.06	2(2)	OK(2)
Thermocouple Penetration	Discontinuity in thermal barrier producing thermal short to liner	345	346	2.5	0.5/ pene.	3	Further investigation
Refueling Penetration	Flow pattern impinging on penetration liner	290	291	1.6	< 0.03	1	OK

TABLE 1 (cont)
PCRV LINER HOT SPOT RESULTS

	Apparent Cause	Predicted Maximum Local Concrete Temp.(1) 100% Power, °F LANL	GA	Depth of Penetration, in.	Volume ft^3	Severity Degree	Recommendations
Steam Generator	Insufficient cooling at intersection of penetration & bottom head	275	~265(3)	2.2x5.6	< 0.2	2	OK
Peripheral Seal	Discontinuity in thermal barrier producing thermal short to liner	220	205	0.25	< 0.1	1	OK

(1) All tubes operational.
(2) Per Appendix C of LANL report they "conclude that this hot spot has a negligible effect on the overall PCRV temperature distribution, and poses no degradation on safety or plant operation". This hot spot is classified as a degree #2 severity. Table 1 of Ref. 1 shows degree 3, however, this is not consistent with Appendix C and is considered a type error in Ref. 1.
(3) The 265°F temperature is based mainly on measured results. These measured results exceeded the values predicted by GA.
(4) The 375°F is per Appendix B. Table 1 of Ref. 1 shows 350°F. This discrepancy in Ref. 1 needs to be resolved.
(5) Section 1.5 of Ref. 1 states that "Because the volume of concrete affected by the elevated temperature is small .... the changes in concrete properties are considered tolerable". This statement does not seem consistent with the severity 3 classification called out for some hot spots.