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August 28, 1989

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

Subject: McGuire Nuclear Station, Units 1 and 2
Docket Nos. 50-369 and 50-370
Catawba Nuclear Station, Units 1 and 2
Docket Nos. 50-413 and 50-414
NRC Bulletin 88-08
Thermal Stress in Piping Connected to The Reactor Coolant System

Gentlemen:

Dr. K. N. Jabbour's letter dated June 29, 1989 transmitted a request for additional information regarding NRC Bulletin 88-08, Thermal Stress in Piping Connected to the Reactor Coolant System. This request for additional information was based on my September 9 and December 28, 1988 and April 3, 1989 letters to the Document Control Desk. The purpose of this submittal is to provide responses to your request and to further clarify our efforts in regard to the requirements of Bulletin 88-08.

Question No. 1 from your June 29, 1989 letter requested the review and basis for the conclusion that the Reactor Coolant Systems at McGuire and Catawba are not subject to the thermal stress described in NRC Bulletin 88-08. The results of our review of piping systems connected to the Reactor Coolant System were transmitted to the NRC per my September 9, 1988 letter to the Document Control Desk in response to Item 1 of Bulletin 88-08. This letter conservatively identified 1-1/2 inch safety injection piping for inspection. This piping is not as likely to be subjected to thermal stresses as Farley's 6 inch diameter piping because: 1) Smaller piping has a higher probability of mixing due to its smaller flow area; 2) Smaller diameters enhance the effects of heat conduction around the circumference of the pipe wall; and 3) Thinner walls lessen the effect of the through-wall thermal gradient.

A bounding analysis was performed to determine whether an event of the type described in the bulletin could possibly result in the failure of the 1-1/2 inch safety injection lines. The bounding analysis conservatively indicated that operation is acceptable for at least 11 years. The design differences between McGuire, Catawba, and Farley coupled with the results of the bounding analysis and safety injection line inspections provide assurance that at the present time McGuire and Catawba Nuclear Stations are not susceptible to the type of failure described in the Bulletin. Results of the safety injection line inspections performed at McGuire Unit 1 and Catawba Units 1 and 2 were transmitted to the NRC per my December 28, 1988 and April 3, 1989 submittals. Attachment I provides further information regarding the design differences between McGuire, Catawba, and Farley's safety injection piping.

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However, the bounding analysis only provides assurance of piping integrity until the McGuire Unit 1 end-of-cycle 8, McGuire unit 2 end-of-cycle 7, Catawba Unit 1 end-of-cycle 6, and Catawba Unit 2 end-of-cycle 5 refueling outages. In order to reduce the conservatism used in the bounding analysis and to further verify that the safety injection lines are not susceptible to the type of failure described in the bulletin, we have instrumented the McGuire Unit 2 safety injection lines during the end-of-cycle 5 refueling outage. Details of the instrumentation and data collection program were transmitted to the NRC per my August 18, 1989 letter to the Document Control Desk. Data will be collected during heatup, power operation, cooldown, and selected plant transients until the next refueling outage. The end-of-cycle 6 refueling outage is tentatively scheduled to start on September 14, 1990.

The temperature data collected will be evaluated to reduce the conservatism used in the bounding analysis. A reanalysis may be performed if necessary. The results of the bounding analysis and temperature data evaluation will be reviewed to identify any necessary action. The results of this program will be communicated to the NRC within 4 months from the start of the end-of-cycle 6 refueling outage. This program meets the requirements of NRC Bulletin 88-08 Item 3 for McGuire and Catawba Nuclear Stations.

Question No. 2 from your June 29, 1989 letter requested details of the conservative bounding analysis for thermal stresses referenced in my December 28, 1988 and April 3, 1989 submittals. Attachment I contains a detailed summary of the assumptions and calculations performed.

Very truly yours,

Hal B. Tucker

Hal B. Tucker

Attachment

JGT/4/RAI88-08

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CATAWBA AND MCGUIRE NUCLEAR STATIONS, UNITS 1 AND 2

REQUEST FOR ADDITIONAL INFORMATION

RESPONSE

1. Provide the review and the basis for the conclusion that the reactor coolant systems for Catawba Units 1 and 2 and McGuire Unit 1 are not subject to the thermal stress described in NRC Bulletin No. 88-08.

   McGuire and Catawba are dissimilar to Farley in that Bulletin 88-08 shows that the ECCS piping at the junction with the Reactor Coolant Loop piping is 6" diameter piping at Farley. At McGuire and Catawba, this piping is 1-1/2" diameter. The Farley piping serves both the Safety Injection (SI) and Residual Heat Removal (RHR) functions. At McGuire and Catawba, these functions are served by separate pipe lines, and the Safety Injection pipe needs to be only 1-1/2" in diameter. Since thermal stratification may not occur as readily in small diameter piping due to the limited diameter distance available for thermal layers to form, the McGuire and Catawba piping is likely to be less susceptible to stratification. However, since thermal cycling may not necessarily depend on stratification, the McGuire and Catawba piping is conservatively identified for inspection.

2. Provide in detail the "highly conservative thermal analysis" which indicates that no further surveillance is required until the end of cycle 6 refueling outage (May 22, 1992) for Catawba Unit 1, the end of cycle 5 (November 22, 1992) for Catawba Unit 2, and the end of cycle 8 (December 7, 1992) for McGuire Unit 1.

   A detailed summary of the analysis performed to determine whether an event of the type described in NRC Bulletin 88-08 could possibly result in the failure of the 1-1/2 inch safety injection lines is enclosed. The TRANS2A computer code was used to approximate the heat transfer coefficients in Step 1 and to determine the stresses described in Step 2 of the enclosed calculation summary. The SUPERPIPE computer code was used to determine the uniform and linear portions for temperature distributions in Step 4. The TRANS2A and SUPERPIPE computer codes have been verified by IMPELL. The design calculation package is available for inspection should you require additional information.

STATION: MCGUIRE AND CATAWBA

TITLE: PIPING ANALYSIS INVESTIGATION FOR NRC BULLETIN 88-08

CALCULATION NO: DPC-1206.02-54-0002 (Revision 0, 4-17-89)

PURPOSE:

Determine if a NRCB 88-08 type event could possibly produce unacceptable stresses for systems identified as susceptible to a NRCB 88-08 event.

DESIGN METHOD:

- Qualitative:

  Identify and discuss piping variables affecting the significance of cyclic thermal stratification stresses. Compare variables for Farley & Tihange to Duke plants.

- Quantitative:

  Perform fatigue evaluation according to ASME Code Section III, 1986 Edition, as follows:

  1) Approximate the heat transfer coefficient that caused temperature oscillations reported for Farley in NRCB 88-08.

  2) Apply similar heat transfer coefficient to Duke piping and calculate code stresses associated with quantities ΔT_1 and ΔT_2

  3) Assume a 200 °F top-of-pipe-to-bottom-of-pipe temperature difference based on Farley Data in Bulletin 88-08. Assume the 200 °F temperature difference is stepped at 3 o'clock pipe position. (i.e. top half of pipe 200 °F warmer than bottom half)

  4) Determine uniform, linear and non-linear temperature portions of Step (3) temperature distribution.

  5) Determine stresses for each step (4) quantity.

  6) Combine stresses for Step (2) and (5).

  7) Assume the number of applied cycles from Farley data as, 1 million cycles/7 years of operation = 143,000 cycles/year.

  8) Determine the number of years until number of allowed cycles for Step (6) stresses equal number of Step (7) applied cycles.

RESULTS:

o Qualitative:

PARAMETER	FARLEY & TIHANGE	MCGUIRE	CATAWBA
Nominal Pipe Size & Schedule	6"ϕ sch.160	1 1/2"ϕ sch.160	1 1/2"ϕ sch.160
Outside Diameter Do	6.625"	1.900"	1.900"
Pipe Thickness t	.718"	.281"	.281"
Inside Diameter d	5.189"	1.338"	1.338"

Note: 1) Smaller piping has a higher probability of mixing due to its smaller flow area.

2) Smaller diameters enhance the effect of heat conduction around circumference of the pipe wall; lessening the effect of the 12 o'clock-to-6 o'clock temperature gradient.

3) Thinner walls lessen the effect of the through-wall thermal gradient.

Conclude that the Duke piping is not as sensitive to cyclic thermal stratification stresses as the Farley and Tihange piping.

o Quanitative:

Number of years until allowed number of cycles equal applied number of cycles:

McGuire and Catawba - > 11 years

The 11 year figure is considered a lower bound number in light of the assumptions made in Steps (1), (2), (3), and (7) above. The number provides a basis for continued operation but point to the need for defined data to reduce the conservatism in the current analysis.