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SUBJECT: Forwards results of insps during Unit 1 EOC-11 refueling outage,per Bulletin 88-008.

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TITLE: Bulletin Response 88-08 - Thermal Stress in Piping to RCS.

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DUKE POWER

March 10, 1989

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

Subject: Oconee Nuclear Station
Docket Nos. 50-269, 270, 287
Thermal Stresses in Piping Connected to
Reactor Cooling System

Gentlemen:

My letter of October 6, 1988 provided a response to Item 1 of the NRC Bulletin 88-08 concerning thermal stresses in piping connected to reactor cooling system (RCS). My response identified two portions of the high pressure injection (HPI) lines located between valves HP-152/HP-153 and the RCS which may be subject to the kind of thermal stresses described in Bulletin 88-08. Furthermore, I indicated that inspection of these pipings as required by Action Item 2 of the bulletin will be completed by the end of upcoming refueling outages for Oconee Unit 1, 2, and 3. The purpose of this letter is to transmit to you the results of our inspections during the Unit 1 EOC-11 refueling outage as a partial response to Item 2 of the bulletin and to further clarify our activities in regards to the requirements of Item 3.

Our review of portions of the HPI line between HP-152/HP-153 and the RCS identified six piping welds for an augmented inspection. These welds, which are the only geometric discontinuities, and their heat-affected zones were determined to be the highest stress locations. Each identified weld on the HPI lines for Unit 1 received a full volumetric ultrasonic inspection of the weld and base material extending out one inch. The examination of all six welds was completed during the Unit 1 EOC-11 refueling outage, and no reportable conditions were found. Similar inspections for Units 2 and 3 will be performed during the upcoming refueling outages EOC-10 and EOC-11, respectively. The results of inspections for Units 2 and 3 will be submitted within thirty days of completion of EOC-10 and EOC-11 refueling outages for Units 2 and 3, respectively.

In regards to Item 3 of the bulletin, I proposed in my letter of October 6, 1988 a phased approach program to address this item. This program has been defined and includes the following components:

1. A bounding analysis of the pipings which may be susceptible to thermal stresses as a result of thermal stratification. The piping of concern was identified within my October 6, 1988 letter.

2. Instrumentation of both Unit 1 HPI emergency injection lines to detect stratified temperature conditions. These lines were identified as the only lines which may be susceptible to the type of events described in NRC Bulletin 88-08.

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3. Collect and evaluate the data from the Unit 1 instrumented HPI pipings. The data collected will include heatup, cooldown and steady-state operation.

4. Determine and implement the most effective means of providing the long term assurance of piping integrity for all Oconee Units pursuant to Item 3 of the bulletin.

A bounding analysis to determine whether an event of the type described in the bulletin could possibly produce unacceptable stresses for pipings identified as being susceptible to thermal stresses has been completed. A summary of this analysis is provided in Attachment 1. The bounding analysis did not show complete code compliance for a 40 year fatigue life. However, coupled with the results of the Unit 1 inspection the bounding analysis provides assurance of near term piping integrity for the current fuel cycle plus at least two additional cycles which correspond to EOC-14, EOC-13, and EOC-14 for Units 1, 2 and 3 respectively.

Instrumentation of the two Unit 1 emergency injection lines was completed during the Unit 1 EOC-11 refueling outage. These lines which were identified as susceptible to thermal stresses have been instrumented three inches downstream of valves HP-152 and HP-153. At each location three thermocouples are positioned in a vertical plane around the outside wall of the pipe. Attachment 1 provides a figure showing the piping configuration. Collection of temperature data began during the Unit 1 heatup and will continue periodically during the normal operation, as well as through the cooldown for the next refueling outage.

The temperature data collected will be reviewed to reduce the conservatism used in the bounding analysis. A reanalysis, if required, may be performed. The results of the bounding analysis or the reanalysis, as well as the temperature data collected will be evaluated to identify any necessary corrective action and/or surveillance programs to assure the piping integrity for the life of the plant. We intend to complete this effort by December 1, 1989. However, this schedule is based on the assumption that sufficient data are obtained for all modes of operation including cooldown. Therefore, in the absense of a Unit 1 cooldown condition before December 1, 1989 to collect cooldown data, this schedule may be slipped until all data becomes available during the next Unit 1 refueling outage.

I will submit a letter within 30 days following the completion of this effort confirming that Action Item 3 for all Oconee Units has been completed. This letter which is currently scheduled for submittal by December 31, 1989 will provide a summary of the results of our efforts and any actions taken to assure the long term piping integrity.

I declare under penalty of perjury that the statements set forth therein are true and correct to the best of my knowledge.

Very truly yours,

Hal B. Tucker

Hal B. Tucker

MAH30.D2/lcs

Attachment

xc: P. H. Skinner
NRC Resident Inspector
Oconee Nuclear Station

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Duke Power Company

Oconee Nuclear Station

Attachment 1

Bounding Analysis Summary

TITLE: PIPING ANALYSIS INVESTIGATION FOR NRC BULLETIN 88-08

CALCULATION NO: DPC-1206.02-54-0002

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 Oconee Nuclear Station.

- Quantitative:

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

  4) Determine uniform, linear and non-linear temperature portions for 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	OCONEE
Nominal Pipe Size	6" sch.160	2 1/2" sch.160
Outside Diameter Do	6.625"	2.875"
Pipe Thickness t	.718"	.375"
Inside Diameter d	5.189"	2.125"

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 Oconee 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 for Oconee Nuclear Station is > 17 years.

The 17 year figure is considered a lower bound number in light of the assumptions made in Steps (1), (2), (3) and (7) above. This number provides a basis for continued operation but points to the need for defined data to reduce the conservatism in the current analysis.

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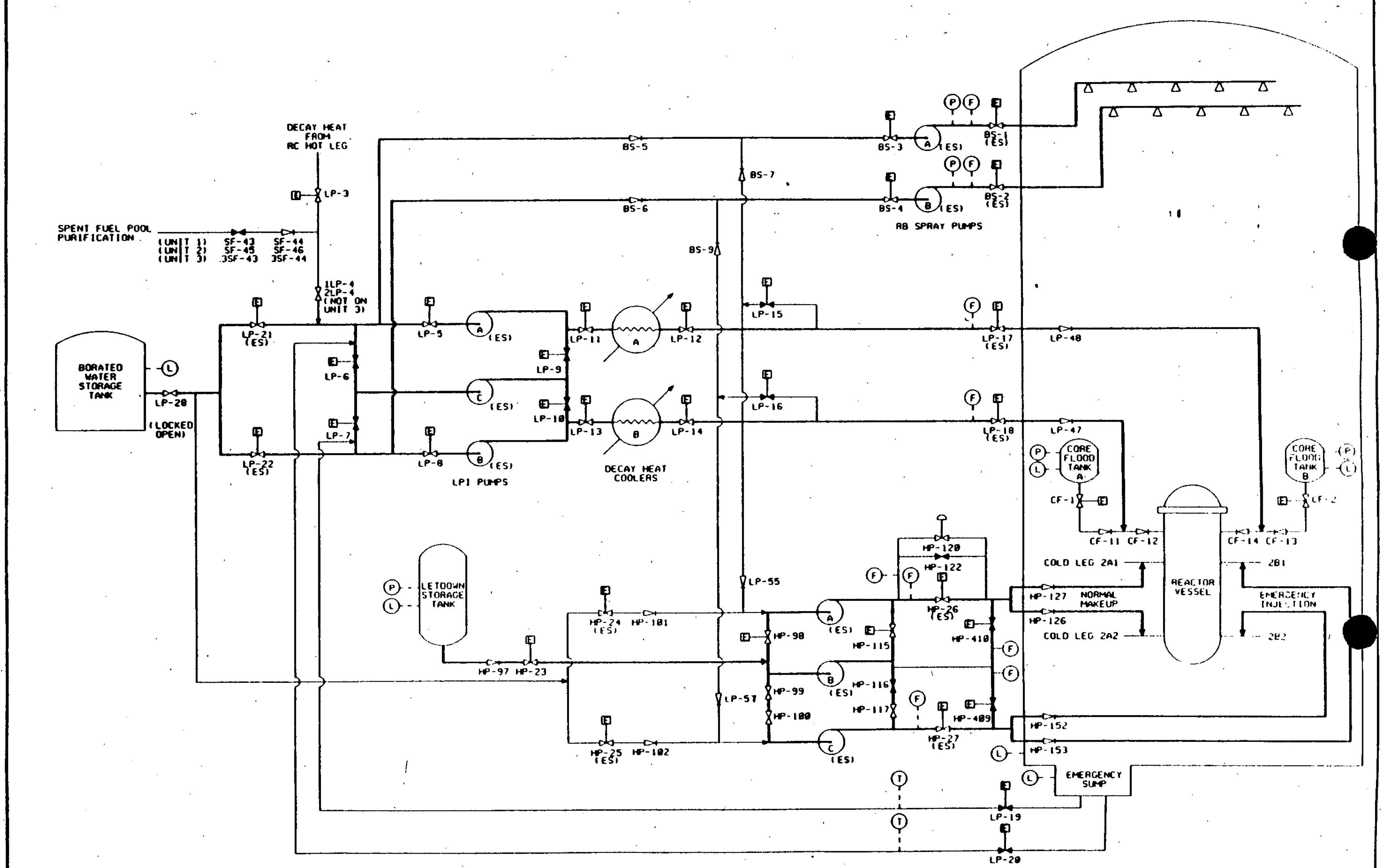

TYPICAL FOR UNITS 1, 2, 3

LEGEND

- SHUTOFF VALVE
- FLOW CONTROL VALVE
- CHECK VALVE (ALL TYPES)
- RELIEF VALVE
- NORMALLY OPEN
- NORMALLY CLOSED
- NORMALLY THROTTLED
- F-FLOW
- L-LEVEL
- P-PRESSURE
- T-TEMPERATURE
- E-ELECTRIC
- H-HYDRAULIC
- P-PISTON
- S-SOLENOID
- PNEUMATIC
- (ES)-RECEIVES ENGINEERED SAFEGUARD SIGNAL

THIS DRAWING IS A SUMMARY FLOW DIAGRAM. FOR COMPLETE SYSTEM DESIGN INFORMATION REFER TO FLOW DIAGRAMS LISTED BELOW

OFD-101A-1.2, -2.2, -3.2	LETDOWN STORAGE TANK
-1.3, -2.3, -3.3	HPI PUMPS
-1.4, -2.4, -3.4	HPI TO RC SYSTEM
OFD-102A-1.1, -2.1, -3.1	BWST & EMERGENCY SUMP
-1.2, -2.2, -3.2	CPI PUMPS & COOLERS
-1.3, -2.3, -3.3	CORE FLOOD TANKS
OFD-103A-1.1, -2.1, -3.1	RB SPRAY SYSTEM
OFD-104A-1.2, -2.2, -3.2	SPENT FUEL POOL PURIF.

NO.	REVISIONS	DRN	DATE	CHKD	DATE	APPR	DATE	INSPECTED		
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DUKE POWER COMPANY
OCONEE NUCLEAR STATION

SUMMARY FLOW DIAGRAM OF EMERGENCY CORE COOLING AND RB SPRAY SYSTEMS

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