NSP

NORTHERN STATES POWER COMPANY

MINNEAPOLIS, MINNESOTA 55401

July 30, 1976

Mr D L Ziemann, Chief
Operating Reactors Branch #2
Division of Operating Reactors
U S Nuclear Regulatory Commission
Washington, DC 20555

Dear Mr Ziemann:

MONTICELLO NUCLEAR GENERATING PLANT
Docket No. 50-263 License No. DPR-22

Supplement to June 7, 1976 Letter Concerning LPCI Design

Our June 7, 1976 letter stated that Monticello was not vulnerable to the potential LPCI deficiency identified in your May 20, 1976 letter. We have been requested verbally by members of your staff to supply the following additional information in support of our conclusion.

The analysis was done for the base case of two pumps in a single LPCI loop pumping into the postulated broken recirculation loop assuming throttle valves to be wide open. Runout flow was found by plotting the system dynamic head-flow curve on the pump characteristic curve and noting the flow at the point of intersection of the two curves. Knowing runout flow, the NPSH available was calculated. Available NPSH (atmospheric head + elevation head - friction head loss in suction piping - vapor pressure head + dynamic head) exceeds the required NPSH (found from characteristic pump curve). It is therefore concluded that no cavitation will occur.

LPCI consists of two systems, each having two pumps. A single suction line supplies the two pumps in each system from a common torus ring header. The discharge lines from the two systems are cross tied so that either system can discharge into either recirculation loop.

The case of two pumps discharging into a broken recirculation loop is more severe than the other two cases postulated in your letter for BWR-3 plants with Loop Selection Logic Systems. (This is identified as Case I in the attached Figure 1.) For the case of four LPCI pumps injecting into a broken recirculation loop (Case II) the system dynamic head is greater, causing runout flow to be less, resulting in a larger available NPSH. (The total flow of the four pumps in Case II is the same as that of Case I, resulting in the same loss in the suction screens and ring header.) For the case of three pumps providing flow to the unbroken loop (Case III) the pumps must be looked at individually. For the LPCI system having two operable

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pumps, the flow is less than in Case I and therefore the available NPSH is greater. For the LPCI loop having only one operable pump, the flow will be much less than the total flow from the two pumps in Case I which discharge to the broken loop. Since almost all of the friction head loss in the suction piping occurs in piping common to the two pumps of the LPCI system, the NPSH available to the single operational pump in Case III will be greater than that of Case I.

Figure 2 shows the runout flow for the Case I system head to be 4500 gpm per pump. This is based on a water temperature of 145°F (Figure 5.2.16, FSAR). At this flow the NPSH required is 26.6 feet of water absolute and BHP required is 555 which is less than BHP requirement at pump rated conditions. At this flow the friction head loss in the suction line is 10.47 feet of water (based on loss through suction strainer, 20" torus ring header, 20" pump suction line and 14" suction line). Flow through the suction strainer and torus ring header was based on operation of two core spray pumps at rated capacity, two LPCI pumps at rated capacity and two LPCI pumps at the runout flow.

The available NPSH is 28.68 feet of water: 33.60 feet (atmospheric pressure) + 11.63 feet (elevation difference between torus level and pump center line) -10.47 feet (friction head loss) - 7.75 feet (vapor pressure of water at 145°F) + 1.67 feet (dynamic head).

Rigorous analysis was completed for "B" LPCI loop. Comparison of system isometrics shows no significant difference in configuration of "A" and "B" loop. It is safe to conclude that results of "B" loop analysis are typical of "A" loop.

In accordance with Safety Guide 1, the calculation of available NPSH does not take credit for containment pressurization. It is believed that in a real situation the margin of available NPSH over required NPSH would be substantially increased due to containment pressurization. It should also be stated that pump cavitation is not equivalent to pump damage and failure, as this request for information seems to imply. In fact, in certain applications pumps operate continuously in a state of cavitation.

On the basis of the characteristic pump brake horsepower and motor current at runout flow, and the available NPSH at runout flow, we conclude that the Monticello LPCI pumps are not subject to cavitation or motor overload in the runout condition.

Yours very truly,

L. O. Mayer

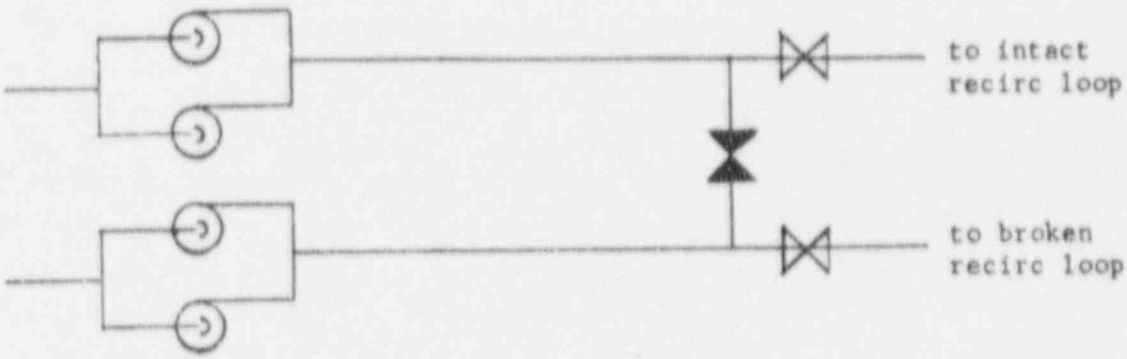
L O Mayer, PE
Manager of Nuclear Support Services

LOM/MHV/ak

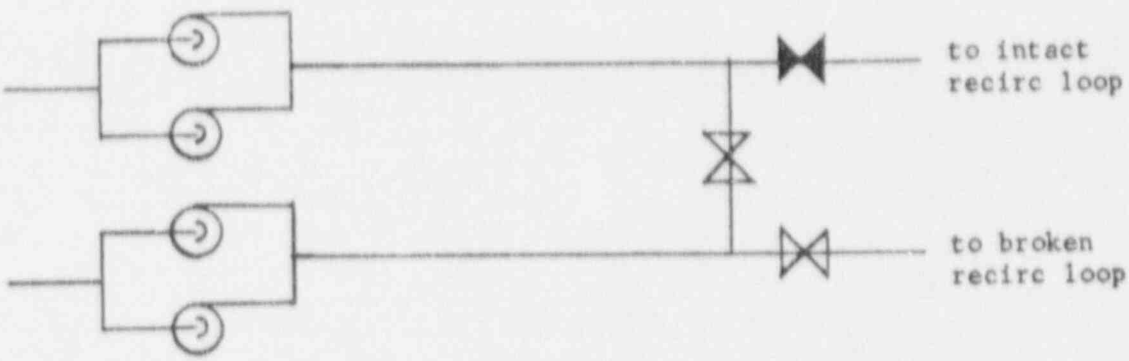
cc: J G Keppler
G Charnoff
MPCA
Attn: J W Ferman

Attachments

Case I. Two Pumps into Broken Loop



Case II. Four Pumps into Broken Loop



Case III. Three Pumps into Intact Loop

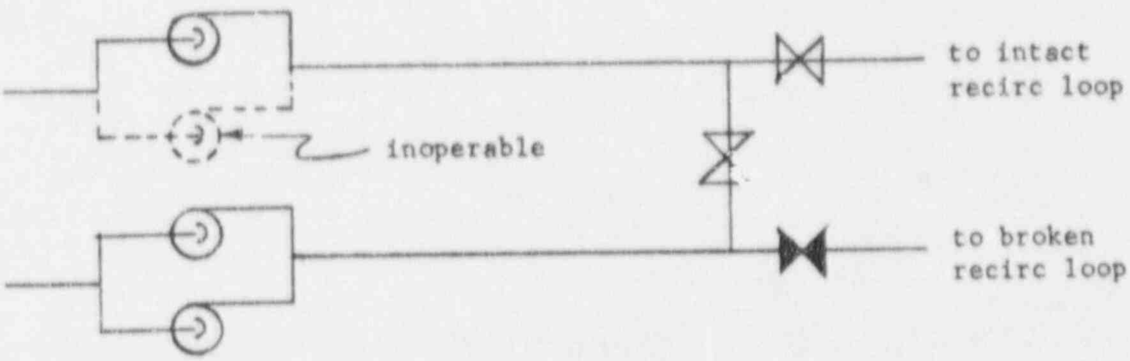
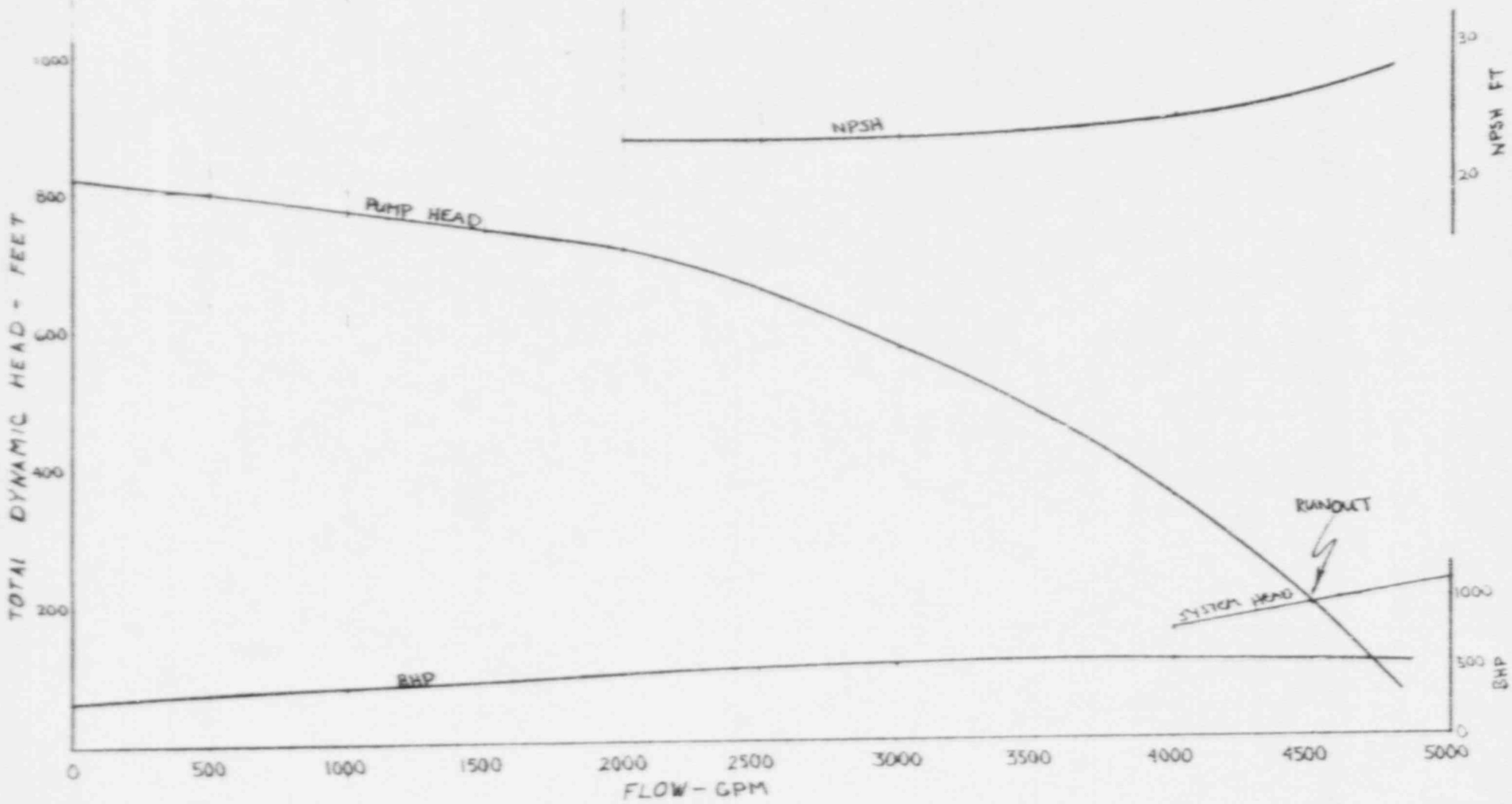


Figure 1. Postulated Failure Configurations

FIGURE 2

TYPICAL LPCI PUMP CURVE



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DESCRIPTION

LTR REFERENCE THEIR 6-7-76 LTR......LTR TRANS THE FOLLOWING.........

PLANT NAME: Monticello

ENCLOSURE

SUPPLEMENT TO JUNE 7, 1976 LTR CONCERNING LPCI DESIGN

ACKNOWLEDGED

DO NOT REMOVE

FOR ACTION/INFORMATION — ENVIRO 8-2-76 RKB

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