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United States Nuclear Regulatory Commission
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Washington, D. C. 20555

Subject: Response to NRC Bulletin No. 88-04: Potential Safety-Related Pump Loss

Gentlemen:

On May 12, 1988, Toledo Edison (TE) received NRC Bulletin No. 88-04 entitled "Potential Safety-Related Pump Loss", (Log No. 1-1P03). This Bulletin requests that licensees provide a written response, within 60 days of receipt, that summarizes the investigation of the concerns discussed in the bulletin. However, upon learning that vendor information could not be received in time to permit TE to meet the original due date, Mr. A. W. DeAgazio, the NRC/NRR Davis-Besse Project Manager, agreed to extend the due date.

NRC Bulletin 88-04 identifies two miniflow design concerns that each licensee is required to investigate and take corrective actions for, if applicable. The first concern involves the potential for one or more safety-related pumps (in systems that have a common miniflow configuration) to become "dead-headed" as a result of pump-to-pump interaction during miniflow operation. The second concern is whether current miniflow line capacities for safety-related pumps are adequate for single pump operation.

TE identified seven systems that contain pumps that could be affected by the concerns addressed in the bulletin. These systems are: Auxiliary Feedwater (AFW), Motor Driven Feedwater (MDFW), Service Water (SW), Containment Spray (CS), Component Cooling Water (CCW), Decay Heat/Low Pressure Injection (DH/LPI), and High Pressure Injection (HPI). Each of these systems was evaluated for the two concerns presented in the bulletin. The attachment contains a summary of the evaluation process, as well as details concerning the calculations, tests, and reviews conducted.

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Toledo Edison has concluded that Davis-Besse does not have any safety-related systems in which a pump or pumps will become dead-headed as a result of pump-to-pump interactions during miniflow operation. Verification of the adequacy of minimum flow bypass lines has been confirmed for all but the DH/LPI and HPI systems. TE is currently developing a test plan to verify the adequacy of miniflow for these two systems. Testing will be completed as soon as practicable following restart from the current refueling outage. A final report will be submitted by December 15, 1988.

Very truly yours,

CFM/tlt

Attachment

cc: A. B. Davis, Regional Administrator
A. W. DeAgazio, Project Manager
DB-1 NRC Resident Inspector

RESPONSE TO NRC BULLETIN 88-04

FOR

DAVIS-BESSE NUCLEAR POWER STATION

UNIT NO. 1

This letter is submitted in conformance with the Atomic Energy Act of 1954 Section 182a, in response to NRC Bulletin 88-04: "Potential Safety-Related Pump Loss."

By: _____
D. C. Shelton, Vice President, Nuclear

Sworn and subscribed before me this 8th day of September, 1988.

_____
Notary Public, State of Ohio

JUDITH HIRSCH
Notary Public State Of Ohio
My Commission Expires June 30, 1992

RESPONSE TO NRC BULLETIN NO. 88-04

NRC Item 1

Promptly determine whether or not your facility has any safety-related system with a pump and piping system configuration that does not preclude pump-to-pump interaction during miniflow operation and could therefore result in dead-heading of one or more of the pumps.

TE Response

Seven systems were identified that contain pumps that could be affected by the concerns identified in the bulletin. These systems are: Auxiliary Feedwater (AFW), Motor Driven Feedwater (MDFW), Service Water (SW), Containment Spray (CS), Component Cooling Water (CCW), Decay Heat/Low Pressure Injection (DH/LPI), and High Pressure Injection (HPI). The potential for pump-to-pump interaction during miniflow operation exists for the AFW, MDFW, and SW systems.

NRC Item 2

If the situation described in Item 1 exists, evaluate the system for flow division taking into consideration (a) the actual line and component resistance for the as-built configuration of the identified system; (b) the head versus flow characteristics of the installed pumps, including actual test data for "strong" and "weak" pump flows; (c) the effect of test instrument error and reading error; and (d) the worst case allowances for deviation of pump test parameters as allowed by the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) Section XI, Paragraph IWP-3100.

TE Response

TE evaluated the three systems identified above by performing calculations, based on certified pump performance curves, to determine the approximate flowrates through the systems for various pump combinations and conditions. The results of these calculations were then compared against the pump vendor's confirmed minimum flowrates. A summary of the results of this effort is provided in Tables 1, 2, and 3.

A review of these tables shows that there is no case in which the calculated flowrate is less than the flowrate considered adequate by the applicable pump vendor. Therefore, TE concludes that "dead-heading" of one or more pumps as a result of pump-to-pump interaction is not a concern at Davis-Besse (DB-1).

NRC Item 3

Evaluate the adequacy of the minimum flow bypass lines for safety-related centrifugal pumps with respect to damage resulting from operation and testing in the minimum flow mode. This evaluation should include consideration of the effects of cumulative operating hours in the minimum flow mode over the lifetime of the plant and during the postulated accident scenario involving the largest time spent in this mode. The evaluation should be based on best

current estimates of potential pump damage from operation of the specific pump models involved, derived from pertinent test data and field experience on pump damage. The evaluation should also include verification from the pump suppliers that current miniflow rates (or any proposed modifications to miniflow systems) are sufficient to ensure that there will be no pump damage from low flow operation. If the test data do not justify the existing capacity of the bypass lines (e.g., if the data does not come from flows comparable to the current capacity) or if the pump supplier does not verify the adequacy of the current miniflow capacity, the licensee should provide a plan to obtain additional test data and/or modify the miniflow capacity as needed.

TE Response

The adequacy of miniflow rates was evaluated by requesting current miniflow rate information from each pump vendor and comparing that information against the lowest normal, emergency, and test flowrate for each of the seven systems. Table 4 presents the vendor confirmed miniflow rate and the lowest normal flowrate for each of the seven systems. The CCW Pump vendor (Goulds Pumps) recommended a miniflow rate that was greater than the lowest flowrate for a normal mode of operation. The system lineup that results in the lowest flowrate for a CCW pump (i.e., 1350 gpm) consists of the Emergency Diesel Generator Cooling Water Heat Exchanger, the Containment Gas Analyzer, the DH/LPI Pump Bearing Housing Cooler, and the HPI Pump Bearing Oil Cooler. This lineup only occurs on the train dedicated to the essential header during: 1) a Loss of Offsite Power, 2) an SFAS Level 2 actuation without an SFAS Level 3 actuation, or 3) testing of the Emergency Diesel Generator.

While Goulds Pumps recommended 3000 gpm as the minimum recirculation flow for the CCW pumps, they qualified this recommendation by stating that lower flowrates would be acceptable for "intermittent operation", provided there was no excessive pump vibration at that flowrate. As part of DB-1's Inservice Test (IST) Program, vibration measurements are conducted quarterly on all pumps, including the three CCW pumps, but not at low flow conditions. Therefore, a test of CCW Pump No. 3 was conducted in which the flow was reduced in steps and vibration measurements for the pump were taken at the intermediate and the lowest flowrate. (Note: CCW Pump No. 1 and 2 were not available for testing due to the outage; they will be tested later.) A comparison of CCW Pump No. 3 vibration measurements with those taken quarterly indicates that there is no appreciable increase in pump vibration at the low flowrate. After the test, the vendor was again contacted, given the test results, and asked to clarify the term "intermittent operation". The vendor stated that operation for up to four hours per month at 1350 gpm would be acceptable. To ensure that the four-hour limit is not exceeded, TE plans to revise the CCW System Operating and Alarm Procedure prior to restart from the current refueling outage.

In addition to the test conducted on CCW Pump No. 3, a review of maintenance records for all three CCW pumps was conducted. This review indicates that during the more than 100,000 hours that these pumps have operated at various

flowrates (the number of hours at miniflow condition is not known), there has been no history of bearing or seal failures that could be attributed to vibration problems caused by impeller recirculation.

The vendor for the DH/LPI and HPI pumps (Hayward Tyler) stated that, while they had no definitive data that would raise doubts over Davis-Besse's current miniflows, they were unable to confirm that these flows were adequate to ensure that the DH/LPI and HPI pumps would not experience degradation as a result of impeller recirculation. The vendor recommended that a pump test to verify endurance be conducted under actual miniflow conditions or, alternatively, (for those pumps known to have operated at miniflow conditions), that service history data be examined.

TE examined performance test data for a seven year period for the pumps in both systems and did not identify any abnormal pump performance or degradation that could be attributed to operation at minimum flowrates. This finding is not conclusive, however, as the pumps in DH/LPI and HPI systems have experienced very little run time at miniflow conditions. Therefore, TE is currently evaluating the vendor's recommendation and developing a test plan designed to obtain vibration measurements after stabilizing DH/LPI and HPI pump operation at minimum flowrates.

Upon development of the test plan, details concerning the plan will be discussed with the NRC. Testing will be conducted as soon as practicable following restart from the current refueling outage. TE will submit a final report on this subject by December 15, 1988.

TABLE 1

SUMMARY OF THE EVALUATION OF PUMP-TO-PUMP INTERACTIONS FOR THE AFW PUMPS

CALCULATIONS		CALCULATED gpm (Pump/No.)
Case 1:	Weak Pump @ rated speed (3600 rpm)	242 (AF/1-1)
Case 2:	Strong and weak pumps in parallel @ rated speed	239 (AF/1-2) 236 (AF/1-1)
Case 3:	Weak pump @ rated speed (degraded 12%) in parallel with strong pump @ 4500 rpm	225 (AF/1-1)
Case 4:	Weak pump @ rated speed (degraded 12%) and in parallel with MDFW pump (strongest)	225 (AF/1-1)
Case 5:	Weak pump @ 1100 rpm	72 (AF/1-1)[a]
Case 6:	Weak pump @ 1100 rpm (degraded 12%) and in parallel with MDFW pump	64 (AF/1-1)[a]

Vendor Confirmed Miniflow Rates (AF)
225 gpm @ 3600 rpm
64 gpm @ 1100 rpm

a. Operation of an AFW pump at 1100 rpm is not required by normal, transient, or emergency procedures.

TABLE 2

SUMMARY OF THE EVALUATION OF PUMP-TO-PUMP INTERACTIONS FOR THE MDFW PUMP

CALCULATIONS		CALCULATED gpm
Case 1:	MDFW pump (degraded 12%) recirculating to the Condensate Storage Tank (CST)	216
Case 2:	MDFW Pump (degraded 12%) recirculating to the Dearator Storage Tank(DST)	>216 Note: The flow path to the DST is less restrictive.
Case 3:	MDFW Pump (degraded 12%) in parallel with the strong AF pump operating @4500 rpm	213 (MDFW)

Vendor Confirmed Miniflow Rate
180 gpm

TABLE 3

SUMMARY OF THE EVALUATION OF PUMP-TO-PUMP INTERACTIONS FOR THE SW PUMPS

CALCULATIONS		CALCULATED gpm (Pump/No.)
Case 1:	Weak Pump	1202 (SW/1-2)
Case 2:	Weak Pump (degraded 12%)	1129 (SW/1-2)
Case 3:	Weak Pump in parallel with strong pump	1145 (SW/1-2) 1168 (SW/1-1)
Case 4:	Weak Pump (degraded 12%) in parallel with strong pump	1070 (SW/1-2) 1173 (SW/1-1)

Vendor Confirmed Miniflow Rate (SW)
1000 gpm

TABLE 4

VENDOR CONFIRMED MINIFLOW RATE VERSUS THE LOWEST FLOWRATE BY SYSTEM

SYSTEMS	VENDOR CONFIRMED MINIFLOW RATE (gpm)	LOWEST DB-1 FLOWRATE (gpm)[a.]
AFW	225 (@3600 rpm) 64 (@1100 rpm)	225 64[b.]
MDFW	180	213
SW	1000	1070
CS	750	1275
CCW	3000 (1350 for four hours/month)	1350
DH/LPI	85[c.]	96
HPI	35[c.]	53

a. The lowest flowrate is the lowest rate for any mode of operation (i.e., normal, emergency, or testing) including parallel operation of pumps.

b. Operation of an AFW pump at 1100 rpm is not required by normal, transient, or emergency procedures.

c. This is the miniflow rate recommended by the original pump vendor; this number was not confirmed by the new pump vendor.