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50-364

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

Gentlemen:

Joseph M. Farley Nuclear Plant - Units 1 and 2
Miniflow Evaluation - NRC Bulletin No. 88-04

NRC Bulletin No. 88-04, "Potential Safety Related Pump Loss," required Alabama Power Company to investigate and correct, if applicable, two miniflow design concerns.

The Bulletin required that each safety-related system be evaluated for pump-to-pump interaction during miniflow operation. If pump-to-pump interaction was possible, the system was required to be evaluated from a flow division standpoint. The Bulletin further required an evaluation to address the adequacy of the minimum flow bypass lines for safety-related centrifugal pumps with respect to damage resulting from operation and testing.

The Bulletin reporting requirements include submittal of a short term (60 day) report which (a) summarizes the problems and the systems affected, (b) identifies the short-term and long-term modifications to plant operating procedures or hardware that have been or are being implemented to ensure safe plant operations, (c) identifies an appropriate schedule for long-term resolution of this and/or other significant problems that are identified as a result of this bulletin, and (d) provides justification for continued operation particularly with regard to General Design Criterion 35 of Appendix A to Title 10 of the Code of Federal Regulations (10 CFR 50), "Emergency Core Cooling" and 10 CFR 50.46, "Acceptance Criteria for Emergency Core Cooling System for Light Water Nuclear Power Reactors." Additionally, a long-term resolution report is required to be submitted within 30 days of the completion of the long-term resolution actions.

It is the opinion of Alabama Power Company that the pumps within the scope of this Bulletin have operated in a satisfactory manner and will continue to operate in a satisfactory manner until the issues identified in NRC Bulletin 88-04 are resolved. Bulletin scoped pumps included in the Technical Specifications are tested on a periodic basis where degradation in pump performance would be identified and addressed.

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Based on previous surveillance testing, no pump degradation has been identified which could be attributed to the mechanisms discussed by the Bulletin.

Westinghouse notified utilities of a potential generic concern regarding ECCS pumps utilizing a common miniflow path. On receipt of Westinghouse letters dated October 26, 1987 and November 30, 1987, Alabama Power Company commenced an evaluation of the miniflow design on the Residual Heat Removal (RHR) pumps and the Charging (HHSI) pumps. The evaluation concluded, with Westinghouse concurrence, that pump-to-pump interaction was precluded for the RHR pumps and HHSI pumps, and that the miniflow lines were adequately sized. It is recognized that long-term miniflow operation is an issue that requires additional evaluation; however, no immediate modifications are required at this time.

Attachment 1 identifies systems with safety-related centrifugal pumps, provides a brief description of the miniflow design, and identifies any problems with pump-to-pump interaction or inadequate miniflow. Procedure modifications, along with areas continuing to be investigated are also indicated. Attachment 2 provides a long-term resolution schedule and Attachment 3 provides a justification for continued operation concerning the Emergency Core Cooling System.

If there are any questions, please advise.

Respectfully submitted,

ALABAMA POWER COMPANY

W. G. Hairston, III

WGH,III/REM:dst-V8.36

Attachments

cc: Mr. L. B. Long
Dr. J. N. Grace
Mr. E. A. Reeves
Mr. W. H. Bradford

SWORN TO AND SUBSCRIBED BEFORE ME

THIS 8th DAY OF July, 1988

Notary Public

My Commission Expires: 9-11-88

ATTACHMENT 1

SYSTEM DESCRIPTION AND EVALUATION

System:	High Head Safety Injection/Charging
Pumps:	3 Charging pumps (HHSI) per unit
Miniflow Description:	A miniflow line from each HHSI pump discharges into a common miniflow header.
Pump-to-Pump Interaction:	Pump-to-pump interaction is precluded by the use of a 60 GPM minimum flow orifice in the miniflow line from each HHSI line.
Adequacy of Miniflow:	The HHSI pump miniflow lines have a greater capacity than originally required by the pump vendor. The system designer, in conjunction with the pump vendor, is evaluating the adequacy of the miniflow line for long-term operation.

System:	Low Head Safety Injection/Residual Heat Removal (RHR)
Pumps:	2 RHR pumps per unit
Miniflow Description:	Each RHR pump has an independent miniflow line.
Pump-to-Pump Interaction:	Pump-to-pump interaction is precluded by use of independent miniflow lines.
Adequacy of Miniflow:	The RHR pump miniflow lines have a greater capacity than originally required by the pump vendor. The system designer, in conjunction with the pump vendor, is evaluating the adequacy of the miniflow lines for long-term operation.

System: Containment Spray (CS)

Pumps: 2 CS pumps per unit

Miniflow Description: Each CS pump has a recirculation line which joins to form a common return header to the Refueling Water Storage Tank (RWST). Normally locked closed valves are provided in the recirculation lines and in the common header for isolation. This piping arrangement is utilized as a means to test the spray pumps without spraying into containment.

Pump-to-Pump Interaction: During plant surveillance testing, one test configuration is a CS pump operating on recirculation while another test configuration for Unit 1 is full flow to the refueling cavity. Surveillance procedures do not provide for operating pumps in parallel and it is not our practice to operate these pumps in parallel. However, a precaution against parallel operation does not exist but will be added to the surveillance procedures. The only time that both pumps are running is following a Phase B signal. During this time, there is no interaction between the two pumps discharging piping. Each pump injects into independent discharge headers which injects into containment. Therefore, pump-to-pump interaction is precluded.

Adequacy of Miniflow: The system designer, in conjunction with the pump vendor, is evaluating Item 3 of the Bulletin for CS pump operation on the recirculation line for the surveillance testing.

System: Auxiliary Feedwater (AFW)

Pumps: 2 motor driven AFW pumps per unit
1 turbine driven AFW pump per unit

Miniflow Description: A continuously open miniflow line from each AFW pump discharges into a common miniflow header.

Pump-to-Pump Interaction: Pump-to-pump interaction is precluded by the use of a high resistance minimum flow orifice and check valve in the miniflow line from each AFW pump. The miniflow orifice was supplied by the pump vendor and installed following the vendor's guidance.

Adequacy of Miniflow: The use of the vendor supplied miniflow orifice, installed following the vendor's guidance, has resulted in a miniflow capacity which meets original requirements. The pump vendor, in conjunction with the system designer, is evaluating the adequacy of the miniflow line for long-term operation.

System: Component Cooling Water (CCW)

Pumps: 3 CCW pumps per unit

Miniflow Description: A separate recirculation line from the CCW pump discharge to the CCW pump suction is provided for each pump. The recirculation line contains a minimum flow orifice provided by the pump manufacturer. A check valve is located in the discharge line downstream of the recirculation line connection for each pump.

Pump-to-Pump Interaction: Pump-to-pump interaction is precluded by providing a separate recirculation line for each pump.

Adequacy of Miniflow: Since the minimum flow orifice was provided by the pump vendor, the recirculation line meets the original pump vendor requirements. However, the system designer, in conjunction with the pump vendor, is evaluating Item 3 of the Bulletin for CCW pump operation on the recirculation line during surveillance testing. Currently, the Unit 1 CCW pumps are not operated on recirculation. Unit 2 CCW pumps are operated on recirculation for surveillance testing only.

System: Service Water (SW)

Pumps: 5 SW pumps per unit

Miniflow Description: The 5 SW pumps are divided as illustrated in Figure 1. SW pumps A and B are A train pumps. SW pumps D and E are B train pumps. SW pump C is a swing pump which may be aligned to the A or B train. A common miniflow is provided for pumps A and B. A common miniflow is provided for pumps D and E. Pump C is provided with its own miniflow line. The control valves for

all of the miniflow lines are set to open at 130 psig. Additionally, the SW system contains a 24 inch dilution bypass line which ultimately discharges to the river. The dilution bypass line control valve opens at 100 psig.

Pump-to-Pump Interaction: The SW system is not designed to preclude pump-to-pump interaction while on miniflow. Pumps A and B or pumps D and E, in conjunction with pump C, could discharge to a common miniflow line. However, with the large dilution bypass line control valve set to open at 100 psig, it would be unlikely that the SW pump miniflow line would open at 130 psig. Additionally, plant operators are procedurally directed to start and secure SW pumps in order to maintain SW header pressure between 70 to 100 psig. With the dilution bypass and the procedural guidance that is available to operators, pump-to-pump interaction in the SW header is precluded.

Adequacy of Miniflow: The pump vendor has stated that "we do not recommend the minimum continuous throttled flow to be less than thirty-five percent (35%) of the pump capacity at Best Efficiency Point (BEP). This calculates to approximately 3150 GPM..." The SW pump miniflow lines are sized to handle 3150 GPM/pump. Additionally, the dilution bypass line, which opens before the SW pump miniflow line, provides additional protection for SW pumps during operation. The system designer is evaluating the adequacy of the miniflow line for long-term operation.

System: Diesel Generator (DG) Fuel Oil (FO)

Pumps: 5 manual FO transfer pumps
5 automatic FO transfer pumps

Miniflow Description: The DG FO system has no miniflow lines. The FO transfer pumps take a suction on the FO storage tanks and discharge to the day tanks or other FO storage tanks.

Pump-to-Pump Interaction: If the FO transfer pumps are operated in parallel, possible dead-heading of a pump could occur. Procedures do not provide for operating pumps in parallel and it is not our practice to operate these pumps in parallel. However, a precaution against parallel operation does not exist but will be added to the operating procedure. Therefore, pump-to-pump interaction is precluded.

System: Boric Acid Transfer System

Pumps: 2 Boric Acid Transfer Pumps per unit

As a result of normal operating practice, the Boric Acid Pumps operate much of the time on miniflow. This operating configuration has not resulted in pump degradation. However, these pumps will be evaluated in accordance with Bulletin 88-04 by the system designer and pump vendor.

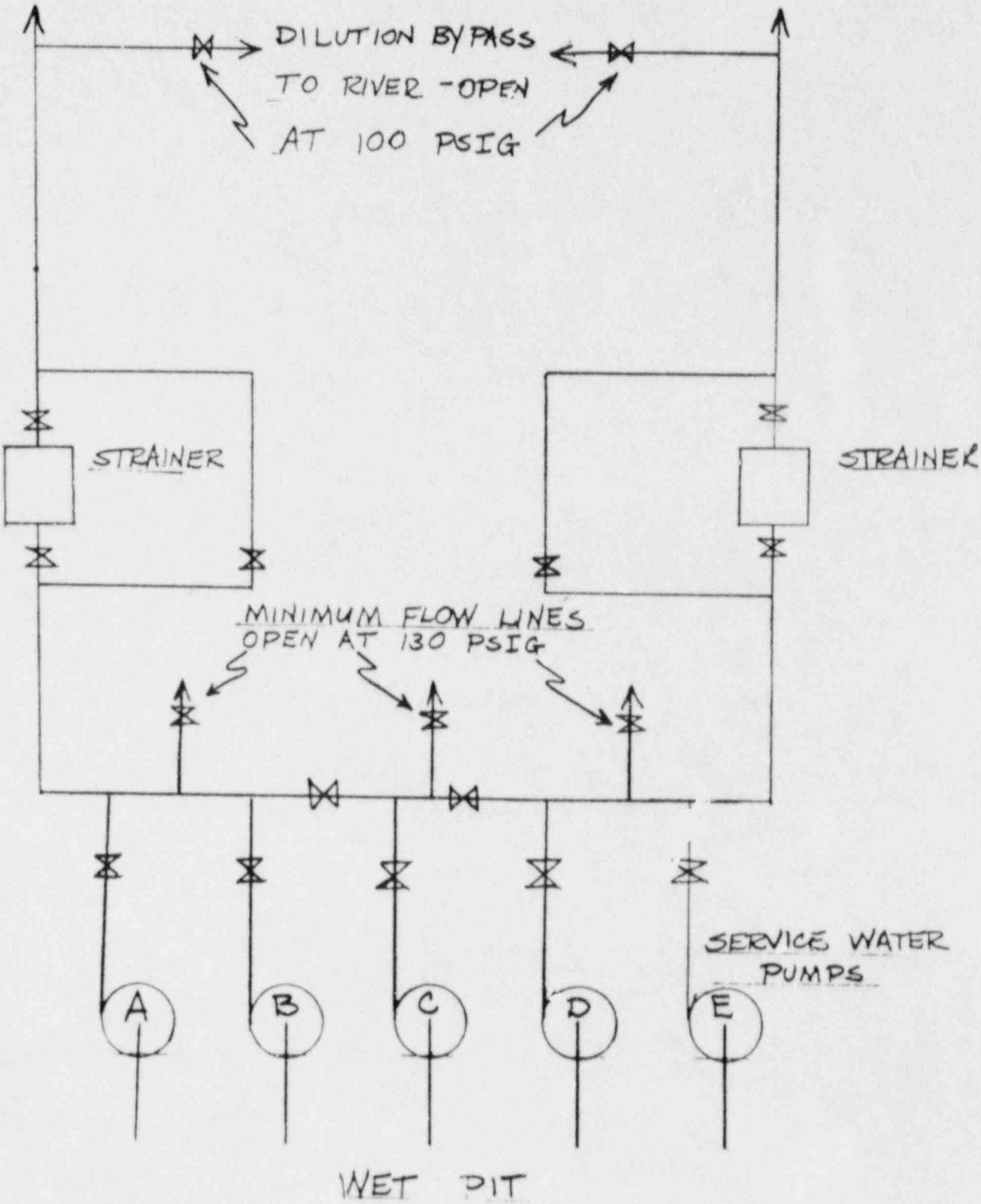
System: Spent Fuel Pool Cooling

Pumps: 2 Spent Fuel Pit Pumps per unit

The Spent Fuel Pit system does not include a miniflow provision for these pumps. Normal operation of the Spent Fuel Pool Cooling system is to throttle flow across the pump to 54 psid. This operational philosophy results in system flow rates significantly above those required for miniflow operation. Since these pumps are not operated at flows that would require miniflow, no additional action is required.

FIGURE 1

SERVICE WATER



ATTACHMENT 2

LONG-TERM RESOLUTION SCHEDULE

Alabama Power Company's goal is to identify long-term minimum pump flow requirements for safety-related centrifugal pumps by October 1, 1988. However, because of the required system designer/pump vendor interface and the increased workload placed on pump vendors by this bulletin, a delay is possible.

Alabama Power Company anticipates that it will take approximately 2 months to determine the required corrective action to resolve areas of concern identified by the system designer/pump vendor. A schedule to complete long-term actions will be provided to the NRC within 60 days of completion of the evaluation required to identify any required corrective actions. By November 30, 1988, Alabama Power Company will either provide the schedule for long-term actions or provide a status of the evaluation efforts.

ATTACHMENT 3

JUSTIFICATION FOR CONTINUED OPERATION (JCO) CONCERNING THE EMERGENCY CORE COOLING SYSTEM

Background

NRC Bulletin 88-04 Item 4(d) requested justification for continued operation particularly with regard to General Design Criterion 35 of Appendix A to 10CFR50 and to 10CFR50.46 for the Emergency Core Cooling System.

By letters ALA-87-827 dated October 26, 1987 and ALA-87-891 dated November 30, 1987, Westinghouse identified potential concerns with the RHR and HHSI miniflow designs. The primary concerns were that: 1) if multiple pumps operated on a common miniflow header, a strong pump could possibly dead-head a weaker pump, or 2) whether the installed miniflow capacity was adequate for operation of a single pump.

NRC Bulletin 88-04 identified two design concerns. The first concern involves potential dead-heading of one or more safety-related pumps with common miniflow lines or other piping configurations that do not preclude pump-to-pump interaction during miniflow operation. The second concern is whether the installed miniflow capacity is adequate for even a single pump in operation.

Evaluation:

This JCO addresses the two NRC Bulletin 88-04 design concerns for Farley Nuclear Plant Units 1 and 2 HHSI and LHSI pumps. The potential for pump-to-pump interaction has been reviewed by Westinghouse and it has been determined that Farley Nuclear Plant has a functional layout which prevents ECCS pumps from dead-heading on miniflow. Actual miniflow values were evaluated by Westinghouse and determined to be adequate. Surveillance testing has not revealed abnormal pump degradation which could be attributed to inadequate miniflow and continuing surveillance testing will provide data to detect degradation.

In response to Westinghouse letters ALA-87-827 and ALA-87-891, Alabama Power Company requested that Westinghouse evaluate this issue for Farley Nuclear Plant. A review of technical manuals and startup testing revealed the following:

Pump	Required Minimum Flow	Measured Flow Through Miniflow During Start-Up Testing
1A Charging/HHSI	60 GPM	68.9 GPM
1B Charging/HHSI	60 GPM	67.2 GPM
1C Charging/HHSI	60 GPM	67.7 GPM
1A RHR/LHSI	500 GPM	521 GPM
1B RHR/LHSI	500 GPM	515 GPM

Pump	Required Minimum Flow	Measured Flow Through Miniflow During Start-Up Testing
2A Charging/HHSI	60 GPM	69.0 GPM
2B Charging/HHSI	60 GPM	69.6 GPM
2C Charging/HHSI	60 GPM	69.15 GPM
2A RHR/LHSI	355 GPM*	590 GPM
2B RHR/LHSI	355 GPM*	580 GPM

*Technical Manual provides that pump may be run at 355 GPM for 1 hour per month over a 40 year plant life and six hours total for one month at startup.

Each RHR pump at Farley Nuclear Plant has its own independent miniflow path branching from independent discharge lines and there is a check valve (8716A and B) downstream of each miniflow line at the pump discharge. These check valves act as a means of pressure isolation in the weaker pump path, and because the isolation occurs beyond the miniflow inlets, the weaker pump can operate on miniflow at the required flowrate. Therefore, it can be concluded that there is no potential for a strong pump to dead-head a weaker pump in the LHSI system.

The three Charging/HHSI pumps discharge into a common miniflow line and the miniflow line for each pump discharge contains a flow orifice designed to permit 60 GPM per pump on miniflow. Westinghouse calculations, with all three Charging/HHSI pumps running and based on the measured miniflow rates through each pump and the current plant layout, showed that the effect of multiple parallel pumps running at the same time has negligible impact on the flow through each pump's miniflow line. For all combinations of pumps running, miniflow for each pump was confirmed to be in excess of 60 GPM. Consequently, it is concluded that no Charging/HHSI pump dead-heading will occur at Farley Nuclear Plant.

For a large break LOCA, miniflow operation for long periods of time is not expected because discharge will be to the reactor coolant system which depressurizes to a low value relatively early in the accident. Pump flowrates will be greater than those requiring miniflow protection. Furthermore, procedures for large and small break LOCA require that the charging pump miniflow valves be opened when RCS pressure increases above 1900 psig. Cooling water to the LHSI heat exchanger is also checked during an accident. Establishment of cooling water to the LHSI heat exchanger would prevent temperature rise in the RHR system during miniflow operation.

Mechanical minimum flow wear and aging effects, if present, are long term in nature and are expected to result in gradual wear to the pumps. Surveillance testing at Farley Nuclear Plant for the HHSI and LHSI pumps has not identified any increase in pump degradation which could be attributed to inadequate miniflow. Periodic surveillance testing required by technical specifications will continue to provide data that would detect pump degradation.

Conclusion

Continued operation with regard to 10CFR50.46 and General Design Criterion 35 is justified based on previous design reviews, expected pump response during accident conditions, and surveillance testing.