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Georgia Power
the southern electric system

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July 11, 1988

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

PLANT HATCH - UNITS 1, 2
NRC DOCKETS 50-321, 50-366
OPERATING LICENSES DPR-57, NPF-5
RESPONSE TO BULLETIN 88-04
POTENTIAL SAFETY-RELATED PUMP LOSS

Gentlemen:

The subject NRC Bulletin (NRCB) 88-04, dated May 5, 1988, "Potential Safety-Related Pump Loss" requested that Georgia Power Company (GPC) investigate and correct, as applicable, two concerns relative to the minimum flow line design of safety system pumps. Specifically, the concerns involve the potential for a pump to dead-head when it is operating in the minimum flow (miniflow) mode in parallel with another pump, and the adequacy of the miniflow capability. Within 60 days of receipt of NRCB 88-04, GPC was requested to provide a response that (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, (c) identifies an appropriate schedule for long-term resolution of this problem, 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 Systems for Light Water Nuclear Power Reactors."

The original design basis for sizing the miniflow lines was to provide sufficient flow to avoid overheating the pumps due to low flow. However, current pump vendor guidelines for minimum flow are based on avoiding hydraulic instability in addition to avoiding pump overheating, leading to higher suggested miniflow values than those used in original plant design. Hydraulic instabilities can occur at low flow rates due to flow separation across the impeller vane, which can lead to asymmetrical shaft and bearing loads in addition to pump and piping vibration. The pump vendor guidelines

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are generally only applicable for continuous or intermittent operation and not for low flow limits for infrequent operation, such as that experienced for only a limited postulated range of loss-of-coolant accident (LOCA) events.

In addition, the pump miniflow rate can be reduced (possibly leading to a condition where the pump is being run dead-headed) if there is a single miniflow line for a pair of pumps operating in parallel. If the pumps have different pump shutoff heads, the pump with the higher shutoff head will deliver a greater flowrate; if there is a significant difference between the shutoff heads, the pump with the lower shutoff head may become dead-headed. If the pumps' miniflow discharge lines are orificed (backloaded) in the individual pump discharge lines prior to the junction between the two pipes, and if the common line is large enough in flow area such that its resistance is a relatively small part of the overall hydraulic resistance, there should be little adverse pump-to-pump interaction. They can be expected to operate individually or in unison with no problems. However, if the miniflow discharge lines are not individually orificed, but the common line is orificed or contains no orifice, interaction between the two pumps may occur. The severity of the degradation of minimum flow through a pump depends on the shape of the head-flow curves of the pumps, and the mismatch between the pumps, as well as the amount of time spent in operation in the minimum flow mode.

To summarize our conclusions, GPC has determined that the concerns raised by this bulletin are not a problem at Plant Hatch. The safety systems evaluated operate for very short periods of time in the miniflow mode. The maximum expected continuous operation is a small percentage of the guidelines recommended by pump vendors for intermittent miniflow operation. Also, it is GPC's position that the current inspection requirements for safety system pumps and systems provided by the American Society of Mechanical Engineers Code Section XI and Technical Specifications should provide adequate protection against pump performance degradation. The remainder of the GPC response is provided as an enclosure to this letter. If you have any further questions in this regard, please contact this office.

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Mr. W. G. Hairston, III, states that he is Senior Vice President of Georgia Power Company and is authorized to execute this oath on behalf of Georgia Power Company, and that to the best of his knowledge and belief the facts set forth in this letter are true.

GEORGIA POWER COMPANY

By: W. G. Hairston III
W. G. Hairston, III
Senior Vice President,
Nuclear Operations

Sworn to and subscribed before me this 11th day of July 1988.

Joyce H. Usher
Notary Public

Notary Public, Cobb County, Ga.
My Commission Expires May 8, 1990

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Enclosure: Response to NRCB 88-04 for Plant Hatch

c: Georgia Power Company
Mr. J. T. Beckham, Jr., Vice President - Plant Hatch
GO-NORMS

U. S. Nuclear Regulatory Commission, Washington D.C.
Mr. L. P. Crocker, Licensing Project Manager - Hatch

U. S. Nuclear Regulatory Commission, Region II
Dr. J. N. Grace, Regional Administrator
Mr. J. E. Menning, Senior Resident Inspector - Hatch

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ENCLOSURE

PLANT HATCH - UNITS 1, 2
NRC DOCKETS 50-321, 50-366
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RESPONSE TO BULLETIN 88-04
POTENTIAL SAFETY-RELATED PUMP LOSS

Because of the design similarity of the boiling water reactor (BWR) product lines, GPC elected to participate in a BWR Owners' Group (BWROG) study. General Electric performed much of the work for the BWROG and identified the affected systems, the design basis of those systems with respect to miniflow operation, recommended short- and long-term modifications (on a generic basis), and a justification for continued operation (JCO). The potential for pump dead-heading and a schedule for long-term resolution of concerns was to be provided by each utility. Reference 1 was the BWROG response to the NRC which provided the above information.

The Plant Hatch safety-related systems that were investigated are the Residual Heat Removal (RHR) System, including the Low-Pressure Coolant Injection (LPCI), containment spray, pool cooling, and shutdown cooling functions; the core spray system (low pressure); the High Pressure Coolant Injection (HPCI) System; the Reactor Core Isolation Cooling (RCIC) System; the RHR Service Water (RHRSW) System, and the Plant Service Water (PSW) System.

The concerns stated in NRCB 88-04 are summarized as:

1. With two pumps operating in parallel in the miniflow mode, one of the pumps may be dead-headed, resulting in pump damage or failure.

2. Installed minimum pump flows may not be adequate to preclude pump damage or failures.

The RHRSW and PSW pumps are normally running well above minimum flow whenever they are operating, and they are therefore not affected by the concerns stated above.

The HPCI and RCIC systems also only briefly use the miniflow lines during systems startup (both systems have full-flow test loops). The existing minimum pump flow for these systems has been judged adequate, considering the short duration of operation in the miniflow mode during both testing and transient/accident mitigation. Also, since there are no parallel pumps for these systems, pump-to-pump interaction is precluded.

ENCLOSURE (Continued)

RESPONSE TO BULLETIN 88-04
POTENTIAL SAFETY-RELATED PUMP LOSS

The RHR system at Plant Hatch can be operated with parallel pairs of RHR pumps. The miniflow bypass line for each pump is connected to a common single line and controlled by a single miniflow bypass valve for each pair of pumps. However, restricting orifices are installed in the miniflow line of each pump prior to the junction to limit the pump minimum flow to its specified design value, alleviating the concern over pump-to-pump interaction. The CS system is composed of two pumps, each with an (orificed) miniflow line; and pump-to-pump interaction is therefore not a concern.

For the RHR and CS systems, short duration miniflow operation will occur during surveillance testing before the pump flow is increased to rated value, by the use of a full-flow test line. In addition, for RHR pumps (in the low-pressure coolant injection [LPCI] mode) and CS pumps, the only design events that can lead to pumps running in the miniflow mode are events that result in an ECCS initiation signal while the reactor is at high pressure (above the pump shutoff head). These are normally small-break LOCAs and loss-of-drywell-cooling isolation events. Of these, only certain small-break LOCAs actually require ECCS injection from LPCI or core spray after these systems operate at low flow.

Once initiated, the maximum duration that a LPCI or CS pump would operate in the miniflow mode for the spectrum of hypothetical LOCAs is less than 30 minutes. This is derived from postulated small-break LOCAs, wherein reactor depressurization to below the shutoff head of these pumps is delayed. For large-break LOCAs, where the full complement of ECC systems is more fully utilized, the reactor inherently depressurizes through the break. The present miniflow bypass line is expected to provide adequate protection for these pumps for the short durations postulated during both the small and large-break LOCAs, and fall within pump vendor guidelines for intermittent operation. When the RHR pumps are run in the suppression pool cooling, containment spray, or shutdown cooling mode, miniflow mode operation is limited to pump startup and there is no potential for injection against a high system pressure relative to the water source.

Class 1, 2, and 3 centrifugal and displacement type pumps installed in BWRs and required to perform a specific function in shutting down the reactor or in mitigating the consequences of an accident, and provided with an emergency power source, must undergo routine inservice inspection per ASME Boiler and Pressure Vessel Code Section XI, Article IWP-1000. These quarterly tests are in addition to the Technical Specification surveillance requirements intended to demonstrate compliance with the plant safety analyses. The Section XI tests are intended to detect changes in pump performance.

ENCLOSURE (Continued)

RESPONSE TO BULLETIN 88-04
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The inservice tests measure speed (if variable speed), inlet pressure, differential pressure, flowrate, vibration amplitude, and bearing temperature. Alert ranges and required action ranges are strictly defined, and requires either increased frequency of testing or declaring the pump as inoperative, respectively. Performance outside of the required action range would place the affected system in a Limiting Condition for Operation. Although these tests themselves would not detect pump dead-heading or inadequate minimum flow (since these are intended to be full-flow tests), any deleterious effects of operating with inadequate flow would be detected in advance of significant pump performance degradation. Therefore, any changes in pump performance would be detected and corrected per routine pump testing in advance of pump degradation due to cumulative low-flow effects from pump surveillance testing and normal system starts.

Through information supplied from both our nuclear steam supply system vendor, General Electric, and from pump vendors, GPC has determined that the concerns raised by this bulletin are not a problem at Plant Hatch. Safety-system pumps in the Residual Heat Removal (RHR), Core Spray (CS), High-Pressure Coolant Injection, and Reactor Core Isolation Cooling, and service water systems operate for very short periods of time in the miniflow mode. This is due, in part, to the full-flow test line configurations. In the case of the service water systems, the pumps are operated well above minimum flow whenever they are running. The RHR and CS pumps could operate in a miniflow mode following initiation by a LOCA signal, but the maximum expected continuous operation is a small percentage of the guidelines recommended by pump vendors for intermittent miniflow operation. Also, it is GPC's position that the current inspection requirements for safety-system pumps and systems provided by American Society of Mechanical Engineers Code Section XI and Technical Specifications should provide adequate protection against pump performance degradation.

This submittal concludes the NRCB 88-04 response for Plant Hatch.

Reference

1. Letter, D. N. Grace (BWROG) to NRC, "Response to NRC Bulletin 88-04, Potential Safety-Related Pump Loss," dated June 29, 1988.