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July 12, 1988
ST-HL-AE-2723
File No.: G3.3
10CFR50

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

South Texas Project Electric Generating Station
Units 1 & 2
Docket No. STN 50-498/499
Response to NRC Bulletin 88-004:
"Potential Safety Related Pump Loss"

Houston Lighting & Power Company (HL&P) has evaluated the subject bulletin received on May 11, 1988, and submits the attached response for Units 1 & 2 of the South Texas Project Electric Generating Station.

If you should have any questions on this matter, please contact Mr. M. A. McBurnett at (512) 972-8530.

J. H. Goldberg
Group Vice President, Nuclear

JHG/WPE/nl

Attachment: Response to NRC Bulletin 88-004.

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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the Matter	)	
	)	
Houston Lighting & Power	)	Dock Nos. 50-498
Company, et al.,	)	50-499
	)	
South Texas Project	)	
Units 1 and 2	)	

AFFIDAVIT

J. H. Goldberg being duly sworn, hereby deposes and says that he is Group Vice President, Nuclear of Houston Lighting & Power Company; that he is duly authorized to sign and file with the Nuclear Regulatory Commission the attached response to NRC Bulletin 88-004; is familiar with the content thereof; and that the matters set forth therein are true and correct to the best of his knowledge and belief.

J. H. Goldberg
Group Vice president, Nuclear

Subscribed and sworn to before me, a Notary Public in and for The State of Texas this 12 day of JULY, 1988.

JEANNIE SHOCK
Notary Public, State of Texas
My Commission Expires 9-22-92

Notary Public in and for the
State of Texas

NRC Bulletin No. 88-004
Potential Safety Related Pump Loss

Action Item 1

Promptly determine whether or not the South Texas Project Electric Generating Station 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.

Response

HL&P has reviewed minimum flow requirements for safety related pump applications. Several safety related pumps have minimum flow lines that join into a common header downstream of minimum flow orifices. The presence of the flow limiting orifices in each line limits pump-to-pump interaction. In addition, the common line is sized such that minimum flow of the pump is not significantly affected by the combination of pumps running. See Table 1 for details.

The Reactor Makeup Water (RM) System has a pump and piping system configuration which contains two pumps with a common miniflow line and a common restricting orifice. Administrative restrictions prevent the simultaneous operation of the two pumps.

Action 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 resistances 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.

Response

Operation of both RM pumps would result in little or no flow through one of the pumps.

The operating procedure for the RM system contains a requirement to keep the handswitch for one of the two RM pumps in the "Pull-to-Lock" position at all times. A warning against running both pumps simultaneously is also included in the procedure. Further evaluation of the flow characteristics of the RM system is not required due to these administrative controls.

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Action 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 minimum flow rates (or any proposed modification 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 do 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.

Response

An evaluation of the required minimum flow (as a percentage (%) of best-efficiency point (BEP) flow) for the active safety related pumps shown in Table 1 was made using Reference 1. The acceptance criteria for this screening process, as adapted from Reference 2, was as follows:

Pumps > 100 hp/stage -- 100% of the flow required to place the pump in the hydraulically stable regime for either continuous or intermittent service.

Pumps < 100 hp/stage -- 50% of the flow required to place the pump in the hydraulically stable regime for continuous operation, and 25% of the hydraulically stable flow for intermittent operation.

Those pumps with an actual (as tested) minimum flow higher than this screening criteria and higher than the pump supplier's recommended minimum flow were considered acceptable without further supplier input.

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Those pumps with an actual (as tested) minimum flow lower than either the screening criteria value or the pump supplier's recommended minimum flow were further evaluated in consultation with the pump supplier.

Each pump supplier contacted verified the actual minimum flow for its pump was adequate for long term operation with little degradation. The nature of any degradation would be accelerated wear of bearings, seals, wear rings, and other wear parts causing a gradual degradation of pump flow. This degradation would be readily detectable through routine evaluation of in-service test results which are part of the ASME Section XI pump operability program. The Section XI program includes criteria for determining the need for corrective action for a given pump, based upon its performance requirements.

Test records for systems with active safety related pumps were reviewed to verify that the actual flow in any mode of operation is greater than the pump supplier's recommended minimum flow. The test records showed three pump applications with actual minimum flow less than the supplier's recommended value: Centrifugal Charging Pump 1B, the Low Head Safety Injection (LHSI) pumps, and the High Head Safety Injection (HHSI) pumps. The actual minimum flow for the Unit 1 RM pumps has not been measured. These pumps are discussed below.

A. Reactor Makeup Water Pumps

The actual flow through the Unit 1 RM pumps' minimum flow line was not measured in its normal configuration during startup testing or subsequent in-service testing. Although calculations show that the minimum flow path is adequate, a recirculation test will be performed by September 30, 1988, to measure the actual minimum flow through the RM pump recirculation line. Corrective action will be taken as necessary. Actual minimum flows on the Unit 2 RM pumps, whose configuration is the same as Unit 1, meet or exceeded the supplier's recommended flow.

Continued operation of the Unit 1 Reactor Makeup Water Pumps is justified for the following reasons:

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1) The design for the system includes two one-hundred percent (100%) capacity pumps, and the pumps were not intended to be operated simultaneously. To implement this design philosophy, the operating procedure for the RM system contains a requirement to keep the handswitch for one of the two RM pumps in the "Pull-to-lock" position at all times. A warning against running both pumps simultaneously is also included in the procedure.

2) The RM pumps serve as the Seismic Category I makeup sources for the Component Cooling Water System and for the Spent Fuel Pool Cooling and Cleanup System during plant emergency operations in the event of loss of the normal source of makeup water. Calculations of flow conditions show that either pump can satisfy system demands and that the requirements for minimum flow for a single RM pump are satisfied during operation of the pump. Similarly, calculations show that the required minimum flow is achieved through the minimum flow path when no demand is placed on the system. These calculations, in combination with the satisfactory results of Unit 2 testing, are considered adequate assurance that sufficient minimum flow for the Unit 1 RM pumps will be supplied.

B. Centrifugal Charging Pumps

The actual minimum flow for Unit 1 Centrifugal Charging Pump 1B was determined to be adequate during preoperational testing. During recent surveillance testing, the actual minimum flow was measured to be slightly less than that recommended by the supplier. The supplier has provided interim approval for continued pump operation based upon the minimum flow condition only being experienced during certain operations such as pump startup, pump switchover, and pump surveillance testing. The amount of operating time at the minimum flow condition is expected to be a small percentage of the total pump operating time, and no detectable degradation is anticipated in the near term. Continued operation of this pump is therefore justified.

Long term reliability is under review and no problems are anticipated. This review will be complete by September 30, 1988.

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C. Safety Injection Pumps

As previously identified in NRC Inspection Report 50-498/8775, the injection phase minimum flowrates for the 1C HHSI pump and 1B and 1C LHSI pumps in Unit 1 were found to be slightly below the supplier's recommended minimum flow. Westinghouse reviewed the flow test data subsequent to the replacement of flow elements in the HHSI minimum flow line and in the LHSI minimum flow line. The test indicated that the 1C HHSI pump minimum flow was 92 gpm compared to the 100 gpm recommended by the vendor design; the 1B and 1C LHSI pump minimum flows were 185 gpm and 184 gpm respectively, compared to 200 gpm recommended by the vendor.

Westinghouse evaluation has indicated that the measured flow rates are adequate to prevent excessive temperature rise within the pumps and, therefore, present no near term operability concerns for the pumps. The reduced flow rates can lead to long term degradation of the pump's wear rings and water lubricated bearings. Such degradation would be detected during quarterly surveillance testing in the form of reduced developed head and/or an increasing trend in pump operating vibration levels.

The limited pump operation to date and scheduled operation for quarterly surveillance testing are not expected to result in degradation of the pumps or of their ability to deliver design flow for the duration of a safety injection actuation. These pumps are unlikely to show any change in vibration level or degradation in performance for the first three to four years of plant operation. Modifications to the system will be made to ensure that recirculation flow is in conformance with the supplier's recommendation prior to the end of the first refueling outage on Unit 1. Necessary modifications have been made for Unit 2. Based on these conditions and planned corrective action, continued operation of Unit 1 is justified.

In the post loss of coolant accident (LOCA) recirculation mode of operation, no minimum flow lines are provided for the HHSI or LHSI pumps. For the small break LOCA scenario, in which the pumps do not achieve the minimum flow requirements, minimum flow protection for the HHSI and LHSI pumps is ensured by operational procedures.

In the STP design, the HHSI and LHSI miniflow lines initially recirculate to the Refueling Water Storage Tank (RWST) during the injection phase. These RWST minimum flow lines are then isolated at switchover to cold leg recirculation to prevent radioactive water from being pumped into the RWST.

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The HHSI pumps would be stopped prior to the recirculation phase of the small break accident per the post-LOCA recovery procedures for those small break cases that do not satisfy the minimum flow requirement for the HHSI pumps. Thus there are no minimum flow concerns for HHSI in the recirculation phase. The LHSI pumps are used in accordance with 10CFR50.46 and General Design Criteria 35 for small break LOCA and long term cooling. The post-LOCA recovery procedures require operator action to ensure adequate protection for the LHSI pump upon securing the HHSI pumps for those small break cases that do not satisfy the LHSI pump minimum flow requirements during the recirculation phase of the accident. Therefore, considering both the injection and recirculation phases of SI as described above, continued operation of LHSI and HHSI is justified.

D. Unit 2

The affected Unit 2 safety related pumps will be tested in accordance with the Unit 2 startup test program to assure that pump minimum flow is satisfactory.

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REFERENCES

1. "Changes in Hydraulic Component Geometries Greatly Increased Power Plant Availability and Reduced Maintenance Cost: Case Histories", Makay & Barrett, Proceedings of 1st International Pump Symposium, May, 1984.

2. "Flow Recirculation in Centrifugal Pumps: From Theory to Practice", Karassik, ASME 1981.

Table 1
NRC Bulletin No. 88-004
Potential Safety-Related Pump Loss

SAFETY RELATED PUMP IDENTIFICATION	# OF PUMPS	COMMON RECIRC. LINE YES/NO	RECIRC. LINE SIZE	RECIRC. LINE ORIFICE	RECIRC. LINE FLOW	RECIRC. REQ. PUMP MANUF.	REMARKS
CONTAINMENT SPRAY PUMPS	3	YES (1)	NA	NA	NA	NA	(5)
LOW HEAD SAFETY INJECTION PUMPS	3	YES (2)	3" SCH. 40S	FLOW LIMIT & MEAS. ORIFICES	184 to 223 gpm	200 gpm (24 hrs.) 300 gpm (thereafter)	(7)
HIGH HEAD SAFETY INJECTION PUMPS	3	YES (2)	2" SCH. 80S	FLOW LIMIT & MEAS. ORIFICES	92 to 103 gpm	100 gpm	(6)
RESIDUAL HEAT REMOVAL PUMPS	3	NO	4" SCH. 40S	NA	2150 to 2200 gpm (15)	500 gpm	(8) (16)

Table 1
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Potential Safety-Related Pump Loss

SAFETY RELATED PUMP IDENTIFICATION	# OF PUMPS	COMMON RECIRC. LINE YES/NO	RECIRC. LINE			RECIRC. REQ. PUMP MANUF.	REMARKS
			SIZE	ORIFICE	FLOW		
CENTRIFUGAL CHARGING PUMPS	2	YES (3)	2" SCH. 160S	FLOW LIMITING ORIFICE	28 to 30 gpm (15)	28 1/2 gpm	(9)
AUXILIARY FEEDWATER PUMP	4	NO	1 1/2"	AUTO RECIRC VALVE	>100 gpm (15)	100 gpm	
CCW PUMP	3	NO	NA	NA	>10,000 gpm (13) (15)	5000 gpm	(16)
ECW PUMP	3	NO	NA	NA	>18,000 gpm (13)	NA	(16)
ECW SCREEN WASH PUMP	3	NO	NA	NA	163 gpm (13)	30 gpm	
REACTOR MAKEUP WATER PUMP	2	YES	2"	FLOW LIMITING ORIFICE	>84 gpm (14)	86 gpm	(10)
ESSENTIAL CHILLED WATER PUMP	3	NO	NA	NA	>891 gpm (13) (15)	200	
STANDBY JACKET WATER PUMP	3	NO	NA	NA	NA	NA	(4)
BORIC ACID TRANSFER PUMPS	2	NO	3/4"	3/4" VALVE	16 gpm (15)	15 gpm (11)	

Table 1
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Potential Safety-Related Pump Loss

SAFETY RELATED PUMP IDENTIFICATION	# OF PUMPS	COMMON RECIRC. LINE YES/NO	RECIRC. LINE SIZE	RECIRC. LINE ORIFICE	RECIRC. LINE FLOW	RECIRC. REQ. PUMP MANUF.	REMARKS
SPENT FUEL POOL COOLING PUMPS	2	NO	NA	NA	2500 gpm (13) (15)	NA	(12) (16)

NOTES:

(1) A test line is shared, however surveillance testing of CSS Pumps is a scheduled activity and only one pump is tested at a time.

(2) Full recirc. flow from all six S.I. Pumps (900 gpm) will not significantly affect the flow from any one pump because the common line is downstream of the miniflow orifices.

(3) The common line is downstream of the mini-flow orifices.

(4) Pump operates near its best efficiency point in all operating modes.

(5) The Containment Spray Pumps discharge to an open system, therefore no miniflow path exists.

(6) The HHSI pumps recirculation combines with the other safety injection pumps recirculation into a six inch line.

(7) The LHSI pumps recirculation combines with the other safety injection pumps recirculation into a six inch line.

(8) The recirculation returns to the pump suction after passing through the heat exchanger.

(9) The two inch return line downstream of the orifices does not significantly affect backpressure on the charging pumps.

(10) The pumps share a recirculation flow path. Administrative restrictions prevent simultaneous operation of the pumps.

(11) Each pump has a mixing line back to its respective boric acid tank. Minimum flow specified by HL&P exceeds manufacturer's recommendation.

(12) The Spent Fuel Pool Cooling pumps discharge to an open system, therefore no miniflow path exists.

(13) Minimum flow in any operating mode by test.

(14) Unit 2 value only.

(15) Unit 1 values are given here, Unit 2 testing is not complete.

(16) Greater than 100 horsepower per stage.