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R.O. WILLIAMS, JR.
VICE PRESIDENT
NUCLEAR OPERATIONS

September 8, 1988
Fort St. Vrain
Unit No. 1
P-88320

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

Docket No. 50-267

SUBJECT: Additional Response to NRC Bulletin 88-04

REFERENCE: 1) NRC Bulletin 88-04, dated 5/11/88 (G-88152)

2) PSC letter dated 7/11/88, Williams to Document Control Desk (P-88236)

Gentlemen:

NRC Bulletin 88-04, "Potential Safety-Related Pump Loss" (Ref. 1), requested all licensees to investigate and correct as applicable two miniflow design concerns. Public Service Company of Colorado previously reported (Ref.2) the results of their evaluation for all affected pumps with the exception of vertical turbine type pumps. Attachment 1 of this submittal reports the results of the analysis for vertical turbine type pumps and identifies one specific pump which has been determined to be a problem with respect to the concerns identified in Reference 1. Attachment 2, Justification for Continued Operation, is provided to justify PSC's continued operation with the present configuration. The conclusion of both of these attachments is that sufficient justification exists to warrant continued operation of Fort St. Vrain with the existing pump design configurations.

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If there are any further questions on this issue, please contact Mr. M. H. Holmes at (303) 480-6960.

Sincerely,

R. O. Williams, Jr.
Vice President
Nuclear Operations

ROW:CB:pjb

Attachments:

cc: Regional Administrator, Region IV
ATTN: Mr. T. F. Westerman, Chief
Projects Section B

Mr. Robert Farrell
Senior Resident Inspector
Fort St. Vrain

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the Matter	)	
	)	
Public Service Company of Colorado	)	Docket No. 50-267
Fort St. Vrain Unit No. 1	)	

AFFIDAVIT

R. O. Williams, Jr. being first duly sworn, depoces and says: That he is Vice President, Nuclear Operations, of Public Service Company of Colorado, the Licensee herein, that he has read the information presented in the attached letter and knows the contents thereof, a ' that the statements and matters set forth therein are true and co' ect to the best of his knowledge, information and belief.

R. O. Williams, Jr.
Vice President
Nuclear Operations

STATE OF Colorado)
)
COUNTY OF Denver)

Subscribe and sworn to before me, a Notary Public on this 12th day of September, 1988.

Notary Public

My commission expires September 24, ~~198~~ 1991.

ATTACHMENT 1

PSC RESPONSE TO NRCB 88-04
FOR VERTICAL TURBINE-TYPE PUMPS

NRC Bulletin 88-04, "Potential Safety-Related Pump Loss", requested all licensees to investigate and correct as applicable two miniflow design concerns. Public Service Company of Colorado previously reported in P-88236 the results of their evaluation for all affected pumps with the exception of vertical turbine type pumps. This response is provided to address the concerns of NRCB 88-04 with respect to vertical turbine type pumps.

NRCB 88-04 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.

PSC Response:

All safety-related vertical turbine pumps installed at FSV, which operate in a parallel miniflow mode, have been evaluated and have been found to operate in ranges which are not of concern relative to NRC Bulletin 88-04. This conclusion is based on piping configuration, operating parameters, and system design bases which are intended to preclude dead-heading of parallel pumps. Table 1 lists safety-related centrifugal and turbine pumps at FSV, and identifies those which operate in parallel.

NRCB 88-04 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.

PSC Response:

The situation described in Item 1 does not exist at FSV for the vertical turbine pumps analyzed, based on their design.

NRCB 88-04 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 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.

PSC Response:

Minimum flow bypass lines for vertical turbine-type pumps at FSV have been evaluated. Table 1 lists safety-related centrifugal and turbine pumps at FSV. All pumps were found to have satisfactory recirculation flow during miniflow operation with the exception of the following:

Bearing Water Makeup Pump (P-2105)

The Bearing Water Makeup Pump was found to be capable of operating in a miniflow recirculation mode where the recirculation flow would be significantly less than the minimum recirculation flow recommended by the pump manufacturer. An orifice in the Bearing Water Makeup Pump recirculation line restricts flow to 20 gpm, whereas the pump manufacturer recommends a minimum recirculation capacity of 63 gpm.

PSC is undertaking a detailed evaluation of this pump to determine its design basis, and the optimum solution for this problem. One option being studied is the replacement of a flow restricting orifice in the recirculation line and a set point change for the flow switch which controls the recirculation flow control valve. The problem is somewhat complicated, however, by the fact that the recirculation flow enters the Low Pressure Separator. An increase in recirculation flow may have an undesirable effect on the operation of the Low Pressure Separator and the bearing water system. There is some question as to the adequacy of the recirculation line to handle the increased flow. Testing of the line as well as detailed operational evaluation will be required to assure that the best possible solution is determined. Any plant modification required to resolve this problem will be implemented during the fourth refueling outage.

Justification for continued operation of this pump with its present configuration is provided in Attachment 2 of this letter.

NRCB 88-04 Item 4:

Within 60 days of receipt of this bulletin, provide a written 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 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 CFR50.46, "Acceptance Criteria for Emergency Core Cooling System for Light Water Nuclear Power Reactors."

PSC Response:

The identified problems and plan of action are as stated above in Item 3. The justification for continued operation regarding the Bearing Water Makeup Pump is provided in Attachment 2.

NRCB 88-04 Item 5:

Within 30 days of completion of the long-term resolution actions, provide a written response describing the actions taken.

PSC Response:

A written report will be submitted to the NRC within 30 days of completion of the long-term resolution actions involving the Bearing Water Makeup Pump. If hardware modifications are determined to be necessary, these will be completed during the fourth refueling outage.

NRCB 88-04 Item 6:

An evaluation of your actions in response to this bulletin should be documented and maintained at the plant site for a minimum of two (2) years. That evaluation should, as a minimum, address the piping system configuration in accordance with Item 1 above, each of the four factors discussed in Item 2, pertinent test data and field experience on minimum flow operation, and verification of the adequacy of current miniflow capacity by the pump manufacturer.

PSC Response:

This evaluation will be maintained in plant records filed under memorandum NDR-88-0749, dated August 30, 1988.

TABLE 1

Fort St. Vrain Safety Related Centrifugal and Turbine Pumps

Pump Tag No.	Pump Type	Configuration	Remarks
P-2101	Turbine	Series	Adequate miniflow design
P-2101-S	Turbine	Series	Adequate miniflow design
P-2102	Turbine	Series	Adequate miniflow design
P-2102-S	Turbine	Series	Adequate miniflow design
P-2103	Centrifugal	Parallel	Adequate miniflow design
P-2103-S	Centrifugal	Parallel	Adequate miniflow design
P-2105	Turbine	Single	Miniflow requirements not met
P-2106	Turbine	Series	Adequate miniflow design
P-2107	Turbine	Series	Adequate miniflow design
P-2109	Centrifugal	Parallel	Adequate miniflow design
P-2110	Centrifugal	Parallel	Adequate miniflow design
P-4118	Turbine	Parallel	Adequate miniflow design
P-4118-S	Turbine	Parallel	Adequate miniflow design
P-4201	Turbine	Parallel	Adequate miniflow design
P-4202	Turbine	Parallel	Adequate miniflow design
P-4202-S	Turbine	Parallel	Adequate miniflow design
P-4501	Turbine	Parallel	Adequate miniflow design
P-4501-S	Turbine	Parallel	Adequate miniflow design
P-4601	Centrifugal	Parallel	Adequate miniflow design
P-4601-S	Centrifugal	Parallel	Adequate miniflow design
P-4602	Centrifugal	Parallel	Adequate miniflow design
P-4602-S	Centrifugal	Parallel	Adequate miniflow design
P-4701	Centrifugal	Single	Adequate miniflow design
P-4702	Centrifugal	Single	Adequate miniflow design

ATTACHMENT 2

JUSTIFICATION FOR CONTINUED OPERATION

1. PURPOSE

The purpose of this evaluation is to provide justification for the continued operation of FSV in response to concerns identified by NRC Bulletin 88-04.

2. BACKGROUND

NRC Bulletin 88-04 "Potential Safety-Related Pump Loss" was issued on May 5, 1988, and requested all licensees to investigate and correct two miniflow design concerns, identified as follows:

1) potential for dead-heading of one or more pumps in safety-related systems that have a miniflow line common to two or more pumps or other piping configurations that do not preclude pump-to-pump interaction during miniflow operation.

2) determine whether or not the installed miniflow capacity is adequate for even a single pump in operation.

The NRC Bulletin requested that licensees respond within 60 days to summarize the problems and systems affected, identify short-term and long-term modifications necessary, identify long-term schedule, and provide justification for continued operation.

PSC performed the requested analysis for centrifugal pumps and submitted the results of the evaluation in P-88236, dated 7/11/88.

PSC has performed this additional analysis for vertical turbine-type pumps and has identified the Bearing Water Makeup Pump (P-2105) to be susceptible to the second concern identified in NRCB 88-04. This evaluation is therefore provided as justification for continued operation.

3. DISCUSSION

There are two separate and independent loops of normal bearing water, each of which supplies the two helium circulators in the associated primary coolant loop. Each normal bearing water loop has a Bearing Water Surge Tank (BWST) and three Bearing Water Pumps, any two of which operate in series to provide bearing water to the helium circulators in the associated primary coolant loop. The BWST in each loop is equalized in pressure with the helium entering the buffer helium recirculator in that loop and the BWSTs are maintained at slightly less (within 10 psi) than primary coolant pressure, regardless of fluctuations due to load changes in plant load or operating conditions.

In the event of loss of normal bearing water to a primary coolant loop, backup bearing water is automatically introduced to the affected helium circulators from the feedwater system by way of the emergency feedwater header (FSAR Section 4.2.2.3.). Makeup bearing water requirements to the BWSTs are also normally obtained from the feedwater system. A level controller for each BWST controls a valve to admit cooled and filtered feedwater into the BWST to maintain the desired water level.

In the event that makeup water to one or both BWSTs is unavailable from the feedwater system, the Bearing Water Makeup Pump, P-2105, is utilized to maintain the desired level in the BWSTs. As in normal operation, BWST level is maintained by level controllers LC-2135 (loop 1) and LC-2136 (loop 2) which control the position of LV-2135-1 and LV-2136-1. The Bearing Water Makeup Pump is automatically started when pressure in the emergency feedwater header falls below 1600 psig. P-2105 normally takes suction from the deaerator, but can also be supplied from the condensate storage tanks. If P-2105 were inoperable, and the normal bearing water makeup from emergency feedwater were not available, then the Emergency Bearing Water Makeup Pump, P-2108, would be utilized to supply makeup water from the condensate storage tanks to the BWSTs. In an extreme emergency, filtered firewater can be provided to the bearing water surge tanks by either the Bearing Water Makeup Pump or the Emergency Bearing Water Makeup Pump. During Safe Shutdown Cooling, which would be utilized following a Design Basis Earthquake in which all Class II equipment is postulated to fail, either P-2105 or P-2108 are relied on to supply filtered firewater to one of the BWSTs. P-2105 and P-2108 are both safety related. These pumps are seismically qualified and their motors are environmentally qualified.

The bearing water makeup requirements are about 40 gpm for each helium circulator when operating on its Pelton wheel. It is significantly less when operating on its steam turbine. P-2105 is a vertical turbine-type centrifugal pump rated for 170 gpm at 1730 feet differential head. It has a 150 Hp motor powered from 480 VAC essential bus No. 3. P-2105 can provide bearing water makeup when all four helium circulators are operating. P-2108 is a positive displacement, reciprocating pump having a rated flow of 40 gpm with a differential head of 1735 ft. It has a 25 Hp motor powered from 480 VAC essential bus No. 1. P-2108 can provide bearing water makeup for one operating helium circulator.

The P-2105 pump vendor recommends a minimum recirculation capacity of 63 gpm. Flow switch FS-21333, on the discharge pipe of P-2105, is set at a low flow of 20 gpm. When flow from P-2105 decreases to 20 gpm, FS-21333 actuates and automatically opens valve FV-21333 in the P-2105 one inch O.D. recirculation line which leads into the Low Pressure Separator. There is a 0.3 inch diameter orifice (M-21122) in the P-2105 recirculation line which is rated for 20 gpm flow with an inlet pressure of 758 psig and an outlet pressure of 15 psig. Therefore, if the pump were dead-headed, pump discharge flow would be 20 gpm, which is below the vendor's recommended 63 gpm.

4. JUSTIFICATION FOR CONTINUED OPERATION

Both P-2105 and P-2108 are required to be operable by Technical Specification LCO 4.2.2 in order for the helium circulators to be considered operable. If at least one helium circulator in each loop is not operable, then LCO 4.2.1 requires the reactor to be immediately placed in a low power condition or shutdown. Although P-2105 has lower recirculation capability than the minimum recommended by the vendor, PSC considers it to be operable since it has demonstrated that it can perform its design function of supplying sufficient bearing water makeup to the BWSTs when the normal makeup water supply from the feedwater system is unavailable. It is estimated that P-2105 operates over one thousand hours a year when the emergency feedwater header is isolated during shutdown, startup and power operating conditions. P-2105 was replaced in 1977 and overhauled in 1981. Since 1981, P-2105 has operated to supply adequate makeup water to the BWSTs with shutdowns only for minor repairs and servicing.

P-2105 is relied upon during Safe Shutdown Cooling, since the FSV licensing basis requires the single failure of a component (in this case P-2108) be postulated. Safe Shutdown Cooling involves a 90 minute interruption of forced circulation followed by a forced circulation cooldown with firewater cooling a steam generator and boosted firewater supplying motive power to one helium circulator. The normal bearing water system is relied upon to supply bearing water to the operating helium circulator. Safe Shutdown Cooling would be established following a Design Basis Earthquake, High Energy Line Break or Maximum Tornado, which are postulated to result in loss of Class II equipment. P-2105 is also relied upon during the plant cooldown following postulated fires outside the congested cable areas, and is included in Fire Protection Shutdown/Cooldown Train B (Fire Protection Program Plan Section FP.4.3). During Safe Shutdown Cooling or Train B cooling following a fire, the BWSTs would be pressurized to about 370 psi initially, with pressure gradually decreasing as the cooldown progresses. Since only one helium circulator operates in these cooling modes, bearing water makeup requirements would be about 40 gpm. P-2105 could degrade somewhat from its rated 170 gpm with approximately 750 psi differential head, and continue to perform the safety function of maintaining an adequate level in the BWST associated with the primary coolant loop utilized for cooldown.

5. CONCLUSION

Due to many years of satisfactory performance of P-2105 with the 20 gpm recirculation, PSC considers that this pump can be relied upon to perform its safety function in an emergency involving loss of normal bearing water makeup from the feedwater system and loss of P-2108. While it is unlikely that an event would occur which would necessitate reliance on P-2105 for decay heat removal between startup after the current outage and the fourth refueling, (scheduled for spring 1989), when any necessary modifications to P-2105 recirculation line will be completed, P-2105 has demonstrated that it is fully capable of performing its safety function. Should P-2105 malfunction during normal operation, and cannot be made operable within 24 hours, LCO 4.2.2 and LCO 4.2.1 require action to place the reactor in a low power or shutdown condition. Therefore, FSV can be safely operated with the existing P-2105 low recirculation capacity.