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ACCESSION NBR:8807180245 DOC.DATE: 88/07/08 NOTARIZED: YES DOCKET #
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SUBJECT: Responds to NRC Bulletin 88-004 re potential safety-related pump loss.

DISTRIBUTION CODE: IE11D COPIES RECEIVED:LTR 1 ENCL 1 SIZE: 9
TITLE: Bulletin Response (50 DKT)

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July 8, 1988

IE Bulletin 88-04

Director of Nuclear Reactor Regulation
U S Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

MONTICELLO NUCLEAR GENERATING PLANT
Docket No. 50-263 License No. DPR-22

IE BULLETIN 88-04 RESPONSE

In response to NRC Bulletin No. 88-04, "Potential Safety-Related Pump Loss", the following information is provided:

1. Bulletin Action

Promptly determine whether or not its 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.

Response

All safety-related centrifugal pumps, and the associated miniflow lines, at the Monticello nuclear plant were reviewed for the potential for pump to pump interaction during miniflow operation. The only pumps identified that have a potential for pump to pump interaction are the Residual Heat Removal (RHR), Core Spray, High Pressure Coolant Injection (HPCI), and the Reactor Core Isolation Cooling (RCIC) pumps.

Each of the pumps mentioned above is provided with its own miniflow line containing a control valve and/or orifice plate to maintain the desired flow. Downstream of these flow control elements, the miniflow lines join into a common header which returns the flow to the suppression pool. Analysis of miniflow lines indicates that there is no potential for adverse pump to pump interactions. These results are due largely to the small pressure loss which occurs in the common header in relation to the total miniflow pressure loss.

2. Bulletin Action

If the situation described in item 1 exists, evaluate the system for flow division taking into consideration:

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(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

As stated in the response above, calculations were performed to confirm that no pump to pump interaction exists during miniflow operation. The calculations took into consideration:

(a) the actual line and component resistances for the as-built configuration;

(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.

The analyses confirmed that there are no adverse pump to pump interactions.

3. Bulletin Action

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 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.

Response

HPCI, RCIC, RHR, and Core Spray systems all have full flow test lines and are not operated or tested in the minimum flow mode during normal operation. The only times during normal operation that the pumps experience minimum flow conditions is during pump starts and pump shutdowns. In addition, for the RHR/LPCI and Core Spray pumps, the only design events that can lead to pumps running in the minimum flow 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 LOCA's and loss of drywell cooling isolation events. Of these, only certain small break LOCA's actually require ECCS injection from LPCI or Core Spray after these systems operate at low flow. The system operating procedures for RHR and Core Spray contain precautions for low flow operation of the pumps. Emergency Operating Procedures allow the operator to secure or place an ECCS pump in the manual mode, if adequate core cooling is assured by at least two independent indicators.

System operation in the minimum flow mode is limited to pump startup during testing, pump start for suppression pool cooling and shutdown cooling, and system start on a LOCA signal. The total expected time in the minimum flow mode over the plant life is at most one percent of the 30,000 hours maximum given by the pump vendor for intermittent operation. The maximum expected continuous duration in the minimum flow mode is 30 minutes for postulated small break LOCA's. Therefore, the potential for excessive wear attributable to minimum flow operation is negligible.

Recent inspection of BWR RHR pumps has indicated no pump impeller damage (due to minimum flow) that degraded performance over the inspection period. It is estimated that the pumps had been operated in the minimum flow mode for up to 30 hours during this period. This further substantiates that short term operation in the minimum flow mode has little or no impact on the life of these pumps.

Pump suppliers were contacted to verify current miniflow rates. Due to the pump vendors' backlog of this type of

request, no definitive response date could be set. Supplemental information will be supplied to the NRC staff within 60 days of receipt of information from pump vendors.

4(a). Bulletin Action

Within 60 days of receipt of this bulletin, provide a written response that summarizes the problems and the systems affected.

Response

See above.

4(b). Bulletin Action

Identify 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.

Response

Operating procedures were reviewed and revised as necessary to place limits on pump flow conditions in accordance with known pump supplier recommendations.

Operating procedures will be revised as necessary to place limits on pump flow conditions in accordance with any new recommendations received from the pump vendors.

The need for hardware modifications will be evaluated after information from the pump vendors is received.

4(c). Bulletin Action

Identify an appropriate schedule for long-term resolution of any significant problems that are identified as a result of this bulletin.

Response

No problems requiring long-term resolution have been identified. Additional evaluations and a supplemental response will be made following receipt of pump vendors information.

4(d). Bulletin Action

Provide 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."

Response

General Electric has prepared a "generic" Justification for Continued Operation that is applicable to the Monticello Nuclear Plant. This justification is contained in Attachment 1.

Please contact us if you have any questions related to the actions we have taken in response to NRC Bulletin No. 88-04.

C E Larson
Vice President Nuclear Generation

c: Regional Administrator, Region III, NRC
Sr Resident Inspector, NRC
NRR Project Manager, NRC
G Charnoff

Attachment

UNITED STATES NUCLEAR REGULATORY COMMISSION

NORTHERN STATES POWER COMPANY

MONTICELLO NUCLEAR GENERATING PLANT DOCKET NO. 50-263

RESPONSE TO NRC BULLETIN 88-04

Northern States Power Company, a Minnesota corporation, with this letter is submitting information requested by NRC Bulletin 88-04.

This letter contains no restricted or other defense information.

NORTHERN STATES POWER COMPANY

By C E Larson

C E Larson
Vice President Nuclear Generation

On this 8th day of July, 1988 before me a notary public in and for said County, personally appeared C E Larson, Vice President Nuclear Generation, and being first duly sworn acknowledged that he is authorized to execute this document on behalf of Northern States Power Company, that he knows the contents thereof, and that to the best of his knowledge, information, and belief the statements made in it are true and that is is not interposed for delay.

Judy L. Klapperick

JUDY L. KLAPPERICK
NOTARY PUBLIC—MINNESOTA
ANOKA COUNTY
My Commission Expires Sept. 29, 1991

ATTACHMENT 1

NRC IE BULLETIN NO. 88-04 RESPONSE

JUSTIFICATION FOR CONTINUED OPERATION

The NRC concerns stated in IE Bulletin 88-04 are summarized as:

1. With two pumps operating in parallel in the minimum flow 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 failure.

These concerns are addressed by the responses below which provide the basis for concluding that continued operation is justified.

All Class 1, 2, and 3 centrifugal and positive displacement pumps installed in BWR's required to perform a specific function in shutting down the reactor or in mitigating the consequences of an accident that are provided with an emergency power source must undergo routine in-service 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; Article IWP-1500 ("Detection of Change") states:

> The hydraulic and mechanical condition of a pump, relative to a previous condition, can be determined by attempting to duplicate, by test, a set of basic reference parameters. Deviations detected are symptoms of changes and, depending upon degree of deviation, indicate need for further tests or corrective action.

The in-service tests measure speed (if variable speed), inlet pressure, differential pressure, flow rate, vibration amplitude, and bearing temperature. Alert ranges and required action ranges are strictly defined, and required either increased frequency of testing or declaring the pump as inoperative, respectively. Performance outside of the required action range would put the 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.

The potential for pump excessive wear attributable to minimum flow operation and/or dead-heading is negligible. Pump vendors suggest minimum flow guidelines for intermittent operation, defined as less than two hours of minimum flow operation in any 24-hour period. For a plant design life of 40 years, this is equivalent to approximately 30,000 hours of low flow operation. However, system operation in the minimum flow mode is limited to pump startup during startup testing, monthly surveillance testing, and during system start on a LOCA signal. A full flow test return line is available for performing system diagnostic and preventative testing for ECCS pumps. This equates to less than one percent of the 30,000 hour limit implied by pump vendors. Since dead-heading is a low flow phenomenon, the potential for dead-heading is also less than one percent of the limit.

BWR operating experience demonstrates that short-term operation in the minimum flow mode and/or dead-heading has little or no impact on pump life. Recent inspections of BWR RHR pumps have indicated no pump impeller excessive wear due to minimum flow. It is estimated that the pumps had been operating for up to 30 hours in the minimum flow mode in the period since the previous inspection.

There have been occurrences where pumps have been operated dead-headed inadvertently. These pumps have continued to function normally with no apparent adverse performance effects.

For the RHR and core spray pumps, the only design basis events that would lead to pumps running in the minimum flow mode and/or dead-heading are events that result in an ECCS initiation signal while the reactor is at high pressure (above the pump shutoff head). These events are normally small break LOCA's and loss of drywell cooling isolation events. Of these, only certain small break LOCA's actually require ECCS injection from LPCI or core spray after running at low flow.

Once initiated, the maximum duration that a LPCI or core spray pump may operate in the minimum flow mode for the spectrum of hypothetical LOCA's is less than 30 minutes. This is derived from postulated small break LOCA's, wherein reactor depressurization to below the shut-off head of these pumps is delayed. For large break LOCA's, where the full complement of ECC systems is more fully utilized, the reactor inherently depressurizes through the break. The present minimum flow bypass line is expected to provide adequate protection for these pumps for compliance with ECCS requirements for the short durations postulated during both the small and large break LOCA's.

For other scenarios, there is adequate time to secure the RHR and core spray pumps, and restart them as necessary, precluding extended operation in the minimum flow mode. As an example, analyses performed demonstrating compliance to 10CFR50 Appendix R have taken credit for LPCI or core spray injection several hours after a LOCA signal would have been generated. In this case, the

operator would secure the RHR or core spray pumps when it is recognized that they are not immediately needed, per the plant Emergency Procedure Guidelines. The pumps would be restarted when vessel injection becomes necessary.

As discussed above, only certain small break LOCA's actually require ECCS injection for LPCI or core spray where the pumps may be operated in the minimum flow mode. However, because of the excess ECCS capacity that is available, limiting LOCA scenarios for most BWRs do not depend on both pumps of a pair of parallel pumps to operate in order to satisfy 10CFR50.46 and 10CFR50 Appendix A, General Design Criteria 35 requirements during and following a LOCA.