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SUBJECT: Submits comments on NRC proposed resolution of generic issue 23, "Reactor Coolant Pump Seal Failure" & on approach described in draft Reg Guide DG-1008.

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Syed K. Shaukat
56 FR 16130
4/9/91

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September 30, 1991
NMP1L 0613

Chief, Regulatory Publications Branch
Division of Freedom of Information
and Publications Services
Office of Administration
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

Gentlemen:

SUBJECT: COMMENTS ON GENERIC ISSUE 23, "REACTOR COOLANT PUMP SEAL FAILURE"

By notice in the Federal Register (56 FR 16130), the U.S. Nuclear Regulatory Commission (NRC) has solicited public comment on the Staff's current understandings, findings and potential recommendations regarding Generic Issue 23 (GI-23), "Reactor Coolant Pump Seal Failure". The notice identifies Draft Regulatory Guide DG-1008, "Reactor Coolant Pump Seals", as a proposed approach to resolving GI-23 and also identifies a number of additional documents providing technical background and related information developed by the Staff and their contractors. Finally, the notice contains a number of questions related to specific areas of interest for which the Staff seeks additional information.

This letter provides comment from Niagara Mohawk Power Corporation based on experience at Nine Mile Point Unit One (NMP1). Responses are provided to the questions provided in the Federal Register where relevant experience is available. Comment is also provided on the proposed approach for resolving GI-23 described in Draft Regulatory Guide DG-1008.

Responses to Questions Contained in 56 FR 16130

The responses provided below address the questions in the Federal Register. The number preceding each response corresponds to the number of the question in the Federal Register.

1.1 Experience in the late 1970s and early 1980s was that degradation of shaft seals in reactor recirculation pumps (RRPs) occurred frequently. Seal failures, in the sense of large uncontrolled leakage challenging safety systems and requiring immediate plant shutdown, were not experienced; a conservative operating philosophy resulted in pumps being secured to minimize the possibility of degradation proceeding to the point of gross failure. (The plant is capable of operating at full

power with a pump secured.) In cases where degradation continued after shutdown of the pump, degradation of seals in other pumps occurred, or it was judged preferable to make immediate replacement rather than risk a future outage, the plant was removed from service.

This early service experience was not considered to be acceptable, and efforts to improve the seal performance began in the early 1980s. The improvements have been successful; since 1984, no instances of degradation in performance of RRP shaft seals have occurred, and no forced outages for seal replacement have been required. Hence, experience since 1984 has been significantly better than the experience prior to that date.

1.2 The improvements in operating experience with RRP seals at NMP1 were achieved primarily through changes in maintenance and seal design. The necessary actions were identified by a working group consisting of engineering, maintenance, and operations personnel working with seal vendors and others knowledgeable in plant and seal operation. A synopsis of the actions taken is provided below:

- Maintenance improvements made included development of improved maintenance techniques and tooling, development of criteria for refurbishment and replacement of the reusable parts of the seal cartridges, and training of personnel in the use of the new methods. These maintenance actions, in combination with replacement of all seals during every refueling outage, provided some improvement in seal performance.

- Observation of in-plant seal performance showed that the onset of degradation of a seal frequently coincided with minor changes in pressure and temperature caused by routine plant evolutions (e.g., changes in heat load or swapping of pumps/heat exchangers in the closed-loop cooling water system, control-rod swaps). Analysis and laboratory tests demonstrated that specific features of the seal design made the seals sensitive to small changes in pressure and temperature.

- A new seal design was developed to replace the original design. The objective was a robust design insensitive to routine temperature and pressure changes and capable of reliably achieving a service life of two fuel cycles. Prototypes of the new design were installed into two pumps in 1986. They operated satisfactorily, and the new design is now fully implemented at the plant.

1.3 Beginning in the early 1980s, seals were routinely replaced during each refueling outage. Since full implementation of the new seal design, the routine replacement interval is after two fuel cycles of operation. This results in half of the seals being replaced during each refueling outage.

2. Tests are currently being performed on the new RRP seal design to characterize its performance under the degraded cooling conditions expected in a station blackout. The test program includes a series of

tests of single seal stages under various controlled, high-temperature conditions to develop an understanding of the physical phenomena and a series of tests of complete seal cartridges under station blackout conditions. The series of single-stage tests and approximately half of the series of seal-cartridge tests are complete. Results to date are encouraging; peak seal-face leak rates during the seal-cartridge tests have been less than 0.5 gpm, and total seal-face leakage, integrated over the 8-hour test duration (twice the required station blackout coping time for NMP1), has been less than 40 gallons.

3.1 Current operating procedures provide guidance to the operators for an alarmed high seal leakage condition. The procedures instruct operators to monitor the Drywell Equipment Drain Tank for leakage and alert the operators to the possibility of seal failure.

3.2 The principal instrumented parameters used in monitoring seal performance are interstage pressure, seal-cavity temperature, cooling-water temperature, and combined seal leakage. These parameters have been adequate for operators to monitor seal performance and detect degradation.

3.3 The plant staff has worked closely with the seal vendor to incorporate vendor requirements into plant maintenance procedures. Specific criteria for refurbishment of seals were required as part of the documentation of the new seals. These criteria are in the plant procedures, and vendor personnel have trained plant staff in their use.

3.4 If interseal pressure deviates from a defined window, normal plant practice would be to continue plant operation with the pump secured. In the event that seal leakage causes an alarm condition, the operators are instructed to monitor the Drywell Equipment Drain Tank.

3.5 Procedures are already widely used, and quality assurance checks mainly monitor procedural compliance. The key to improving the reliability and safety of shaft seals in the industry is assuring that the major advances in the state-of-the-art which have occurred in the last 15 years are widely implemented.

4. No comments.

5. Testing of seals to assess their leakage performance under degraded cooling conditions should have the following characteristics:

- Temperature and pressure conditions experienced by the seals should be representative of those expected during a degraded-cooling event.
- The duration of the test should exceed the expected duration of a degraded cooling event in the plant or plants of interest.
- The test program should include evaluation of the performance of the elastomers in the test. Where extrusion is a possibility, the extrusion gaps should be at or near the maximum values permitted by the design tolerances.
- The test program should include assessment of the effects of axial motion of the shaft during the event.

- Several tests, a minimum of three or four, should be made. Various states of seal-face wear, varying from newly refurbished faces to faces with wear representative of that seen in service, should be included in the tests.

- Some evaluation, either experimental or analytical, of the potential for seal-face opening (sometimes referred to as "popping") should be included to provide some understanding of the margins available in the seal design.

Draft Regulatory Guide DG-1008, "Reactor Coolant Pump Seals"

The following are comments and recommendations regarding the Regulatory Positions proposed in Section C of the draft guide.

Section C.1 QA Considerations

The Staff has noted [56 FR 16130, NUREG/CR-4948] that seal reliability in the industry has improved in recent years. This is consistent with the experience at NMP1. The improvements at NMP1 were made without imposition of Appendix B to 10CFR50. The improvements made were principally the result of developing a new seal design which takes advantage of the substantial advances in the state-of-the-art since the original seal design was developed, and the result of developing improved maintenance techniques, tooling, and criteria. We consider that imposition of Appendix B to 10CFR50 would likely have slowed efforts to make the needed improvements by increasing the financial and human resources used. Imposition of the proposal could well have the undesirable effect of distracting attention away from, and thereby slowing the recognition of, the real need of adopting some of the major advances in the state-of-the-art made in the past 15 years in favor of documentation changes related to existing equipment and practices. The proposal to impose Appendix B to 10CFR50 should not be implemented.

Section C.2 Operating Procedures and Instrumentation

The objectives of this section are reasonable, and should improve safety if implemented at any plant not already complying with them. The details of Section C.2.2, however, need some clarification:

- The requirements, as written can be construed to require that all valves referenced in operating procedures must have position instrumentation. Many seals have a large number of small manual valves which are referenced in operating procedures, such as seal-cavity vent valves, drain valves, cooling-water isolation valves, etc. These valves are not instrumented for position, and they do not need to be. A more limited scope of application to position instrumentation of the valves should be defined.

- Radial and axial shaft vibration and position indication are not considered to be useful for monitoring seal performance and should not be required for seal-related reasons. Radial vibration of the pump shaft is important for monitoring of the pumps, but this is outside the scope of the proposed regulatory guide.

- Measurements of the values of cooling water flows are not essential and should not be required. Flow switches, alarming on high or low flows depending on the application, are adequate for monitoring seals for degradation.

- Seal leakage and staging flows should be monitored, but not necessarily on an individual basis. Measurement of leakage to a collection tank in combination with seal staging pressures are adequate for monitoring seal performance.

Section C.3 Seal Cooling for Off-Normal Conditions

This section would require that active seal cooling be maintained at all times, including during some low-probability events such as station blackout and catastrophic loss of closed-loop or service-water cooling. The requirement to add an emergency back-up to the normal seal cooling system if these low-probability events could result in loss of the normal seal cooling is overly prescriptive. It does not recognize other alternatives, such as use of a seal design capable of maintaining low leakage rates without active cooling, for coping with these events.

This section should be revised to be less prescriptive by requiring that either (1) normal cooling systems shall be available during these events, or (2) means of limiting seal leakage without normal cooling shall be provided. The use of an emergency cooling system independent of the normal seal-cooling system and use of a seal design capable of limiting leakage without cooling available should be identified as examples of acceptable means of complying with Option 2. General guidance regarding the content of a test program to demonstrate acceptable seal leakage should be added. The approach should be similar to that for the guidance in Appendix A regarding emergency cooling systems.

Very truly yours,

C. D. Terry
Vice President
Nuclear Engineering

AER/krc
001801GG

xc: Mr. D. S. Brinkman, Senior Project Manager, NRR
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'91 SEP 30 P6:08

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'91 SEP 30 P6:05

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