U.S. NUCLEAR REGULATORY COMMISSION

REGION III

Reports No. 50-282/92027(DRS); 50-306/92027(DRS)

Docket Nos. 50-282; 50-306

Licenses No. DPR-42; DPR-60

Licensee: Northern States Power Company 414 Nicollet Mall Minneapolis, MN 55401

Facility Name: Prairie Island Nuclear Generating Plant, Units 1 and 2

Inspection At: Prairie Island Site Welch, Minnesota

Inspection Conducted: December 9 - 10, 1992

Inspector: Meligto/So

12/24/92 Date 12/24/92

Approved By: Hordingt Bruce L. Burgess, Chief

Operational Programs Section

Inspection Summary

Inspection on December 9 - 10, 1992 (Reports No. 50-282/92027(DRS); No. 50-306/92027(DRS))

Areas Inspected: Special, announced inspection of cooling water system for potential water hammer occurrence during a loss of offsite power event.

Results: Based on the review, the inspector concluded that under the worst design basis condition, water hammer could occur in the cooling water system. The inspector discussed the possibility of additional check valve and system operational tests to confirm the possibility of a water hammer occurrence and to minimize the effect when it nappens.

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DETAILS

1. Persons Contacted

Northern States Power Company

K. Albrecht, General Superintendent, Engineering
B. Stephens, Superintendent, System Engineering, Mechanical
M. Carlson, Technical Support Engineer

2. Introduction

The inspection was conducted to assess cooling water (CL) system configuration and operation for the occurrence of water hammer. Similar inspections were conducted at other NRC RIII plants. The scope of this inspection included discussion with licensee staff, review of P&IDs, piping drawings, correspondence, and the following documents:

- DBD-SYS-35, Design Bases Document for Cooling Water System, Revision 0, dated January 11, 1991.
- Operation Procedure B35, Cooling Water System, Revision 1, dated March 23, 1989.

3. General System Configuration

The CL system consists of five pumps feeding a ring header shared by the two reactor units. At present, two of the pumps are diesel driven and three are motor driven. Two of these five pumps must be in service during normal plant operation, and the third pump may be needed during the hotter summer days. One of the two diesel driven pumps has sufficient capacity to supply cooling water to both emergency diesel generators (EDGs) during a Loss Of Offsite Power (LOOP) event and subsequent reactor trip of both units. After installation of two additional EDGs, one of the three motor driven pumps will be powered from a Class 1E power supply.

4. Water Hammer Event

During a LOOP event, the two diesel driven pumps would be ready for operation within 20 seconds, and the Class 1E motor driven pump would be ready for operation within 35 seconds. Any water column separation during the time between all pumps stopped and a selected pump start is prevented by two sets of check valves (CVs). The first set consisted of five 20" CVs at the pump discharge nozzle areas, located at EL. 684.5' to 695.9', above the pump suction bays (EL. 654.5'). The second set consisted of eight 6" CVs, located at EL. 729.5' to 742', below the highest points of the system (EL. 765').

Although these two sets of CVs are installed to prevent water column separation, during a CL pre-operational test in 1973, a water hammer occurred. Due to lack of documentation, the extent of the problem and associated damage, if any, is unknown. The cause of the event was determined to be water column separation due to a 35 second delay between start of the safety-related diesel driven pumps subsequent to stopping the motor driven pumps. The corrective action taken was to reduce the time delay to 20 seconds. The corrective action appeared to be adequate in that no damage was identified on any of the heat exchangers or area coolers. However, some damage on pipe hangers was reported during In-service Inspection (ISI) of the CL system.

The inspector considered the planned system modification involving one motor driven pump connected to a Class 1E power supply. Since pump start will be delayed 35 seconds during a LOOP, the potential for a water hammer event will be re-established. Consideration of the worst case condition (both diesel driven pumps unavailable during a LOOP due to equipment tag-out or failure to start), resulted in the potential for a water hammer event caused by the start of a single motor driven pump. This water hammer will generate about 60% of the force calculated during the 1973 water hammer. This condition was evaluated to be acceptable by the 1 because due to a lack of damage identified subsequent to the 1973 water hammer event.

While concerning with the licensee's assessment, the inspector discussed the following with the licensee:

- System post modification test to simulate the potential water hammer condition, or impose operational constraints for the worst case design basis condition.
- Incorporate the worst case design basis water hammer loading condition during a LOOP into the DBD-SYS-35.

Licensee management agreed that they would consider the inspector's recommendations.

5. Hanger Damage

Based on the inspector's request, the licensee performed a record search for all past piping and hanger damage. There was no damage recorded for the CL system during the last 10 years of ISI program review except for the following:

- Hanger CWRH-41 at EL. 746' was found with a bent rod in September 1985.
- Hanger CWRH-365 at EL. 713' on a CL return header was found with a minor concrete crack near one base plate, and one slightly bent I-beam in August 1988. The deficiencies were attributed to welding during construction.
- Hanger CWRH-1 at EL. 750.5' was found with a bent rod in September 1988.

With the exception of CWRH-365, no engineering evaluation for severity and root cause was completed for CWRH-41 and 1. In response, the licensee stated that the ISI program was modified to require review of ISI discrepancies and generation of Nonconforming Item Reports when necessary.

6. CV Maintenance

The two sets of CVs were important in the prevention of water column separation during a LOOP. The inspector reviewed the licensee's CV maintenance program. Among the eight 6" CVs, only two were opened for maintenance in June 1991. Both valves were found having deteriorated internals, and were repaired. The licensee stated that acoustic and magnetic tests will be conducted for the remaining six CVs in the near future.

Among the five 20" CVs, four were replaced between 1985 to 1990. The first replacement in 1985 was due to deteriorated internals, but all subsequent CV replacements were performed in accordance with the preventive maintenance program.

The licensee stated that the present CV program complies with ASME Section XI, and has addressed the NRC correrns stated in IE Bulletin 83-03, and Information Notice 38-70.

7. Solenoid Operated Valves (SOVs)

Kewaunee Nuclear Power Plant, the sister plant of Prairie Island Nuclear Generating Plant, reported water hammer occurrences; and attributed the cause to fast opening and closing Solenoid Operated Valves. (NRC Region III Inspection Report 50-305/92023). SOVs are also employed at Prairie Island to control CL flow to area and equipment coolers, but are different from the type installed at Kewaunee. SOVs in Kewaunee are the direct electric coil operating type, and open or close in 0.04 to 0.06 seconds. SOVs in Prairie Island are pilot operated, and require 0.1 to two seconds to open or close, depending on the amount of differential pressure across the valve. The licensee stated that there have not been any problems reported regarding water hammers caused by the opening or closing of fast acting SOVs.

8. Exit Interview

The Region III inspector met with the licensee representatives (denoted in Paragraph 1) at the conclusion of the inspection on December 10, 1992. The inspector summarized the purpose and findings of the inspection. The licensee representatives acknowledged this information. The inspector also discussed the likely informational content of the inspection report with regard to documents or processes reviewed during the inspection. The licensee representatives did not identify any such documents and processes as proprietary.