



DUKE POWER

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U.S. Nuclear Regulatory Commission
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Subject: McGuire Nuclear Station Unit 2
Docket No. 50-370
Voluntary Special Report

Gentlemen:

Attached is a Voluntary Special Report concerning the Unit 2 Boron Thermal Regeneration System being placed in the recirculation mode which resulted in a 300-350 gallon leak from the Unit 2 Chemical and Volume Control System. This report is being submitted as a Voluntary Special Report. This event is considered to be of no significance with respect to the health and safety of the public.

Very truly yours,

Tony L. McConnell
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ADJ/NGA/cbl

Attachment

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McGUIRE SAFETY REVIEW GROUP INPLANT REVIEW REPORT

- 1.0 REPORT NUMBER: 91-10
- 2.0 DATE OF REVIEW: February 5 through March 5, 1991
- 3.0 SUBJECT DESCRIPTION: A review was conducted of the circumstances relating to the incident described on Problem Investigation Report (PIR) 2-M91-0025. The purpose of the review was to determine the cause of the incident and possible solutions to preclude the recurrence of problems of the type described by the PIR.
- 4.0 EVALUATION AND COMMENT: PIR 2-M91-0025 documented an incident in which placing the Unit 2 Boron Thermal Regeneration (NR) System in the recirculation mode resulted in a 300-350 gallon leak from the Unit 2 Chemical and Volume Control (NV) system.

4.1 Background

During normal operation of the Chemical and Volume Control (NV) system, letdown flow from the Reactor Coolant (NC) system passes through the regenerative heat exchanger, the letdown heat exchanger, a mixed bed (MB) demineralizer, one of two NC filters, and the Volume Control Tank (VCT).

To permit operation of the NR system, a flowpath is provided which allows part or all of the letdown flow to pass through the NR system. The letdown flow is diverted to the NR system from a point downstream of the MB demineralizers. The amount of letdown flow diverted to the NR system is controlled by valve 2NV-347 (NR System Flow Control). Flow is returned to the NV system from the NR system at a point upstream of the second NC filter. (See page 9 of 9.)

The NR system chilled water loop is sampled quarterly for corrosion inhibitor concentration and the presence of biological growth to

maintain the integrity of the chiller equipment and piping. Sampling is conducted with the NR system chilled water loop in the recirculation mode.

Technical Specification (TS) 3.4.6.2 requires that NC system unidentified leakage shall be limited to 1 gpm. VCT level change provides an indirect method for leakage detection. This method takes into account the NC pump seal water injection rate, the letdown rate, and the charging rate into the NC system.

4.2 Description of Event

On February 5, 1991, Operations (OPS) personnel were placing the Unit 2 NR system chilled water in the recirculation mode to allow sampling of the chilled water by Chemistry personnel. The procedure in use was OP/2/A/6200/02, Boron Thermal Regeneration System, Enclosure 4.7, Placing Number 2 NR Chilled Water In Recirculation.

Shortly after the Number 2 NR chilled water was placed in recirculation, at approximately 1341, OPS personnel observed that the VCT level was decreasing and valve 2NV-347 was in an intermediate (between open and closed) position. OPS personnel opened valve 2NV-347 and the VCT level decrease stopped. At that time, OPS personnel were dispatched to the Auxiliary (Aux) Building to investigate for possible leaks.

At 1413:12, OPS personnel received an EMF-35L (Unit Vent Particulate Monitor) Trip II (i.e. high radiation) alarm at $4.99 \text{ E}+02$ counts per minute (cpm). OPS personnel contacted Radiation Protection (RP) shift personnel, then reset the alarm. The Trip II condition cleared. The EMF-35L Trip II setpoint at this time was $5.0 \text{ E}+02$ cpm.

At 1454:58, EMF-35L Trip II realarmed at $4.79 \text{ E}+02$ cpm. OPS personnel also observed that EMF-36 (Unit Vent Gaseous Monitor) had been trending higher, but was then decreasing towards normal. RP personnel pulled airborne samples in the immediate area of the spill.

Subsequent analysis of these samples indicated there was no increase in airborne particulate activity levels as a result of the spill. The OPS personnel which were sent to look for leaks discovered water on the floor in the Unit 2 valve gallery (Aux Building 733 elevation, column 50/KK-MM). OPS personnel estimated that the total water loss was approximately 300-350 gallons in 5 to 7 minutes. By 1517, OPS personnel had performed several NC system leakage calculations. The results of these calculations indicated that the unidentified leakage rate was less than 1 gallon per minute (gpm) as required by Technical Specification 3.4.6.2. At this point, OPS and RP personnel were unable to pinpoint the actual leakage source due to the configuration of lead radiation shielding in the valve gallery.

On February 5, 1991, OPS personnel revised procedure OP/2/A/6500/02, Boron Thermal Regeneration System, Enclosure 4.7, Placing Number 2 NR Chilled Water in Recirculation, to include measures to prevent valve 2NV-347 from closing unexpectedly. A new step, 2.2, was added to remove valve 2NV-347 from automatic control and open the valve prior to starting the NR system chilled water recirculation.

On February 6, 1991, RP and Mechanical Maintenance (MM) personnel began removing shielding from the valve gallery. This work continued into February 7, 1991, and by 1300, the possible leakage source had been determined to be valves 2NV-349 (Mixed Bed Demineralizer 2A Sluicing Resin Isolation), 2NV-350 (Mixed Bed Demineralizer 2B Sluicing Resin Isolation), and 2NV-365 (Cation Bed Demineralizer Sluicing Resin Isolation). RP and Maintenance Engineering Services (MES) personnel were unable to determine by visual examination which valve was the leakage source. With the assistance of Chemistry personnel, these valves were pressurized to approximately 140 psig using the Spent Resin Sluice Pump. Once the valves were pressurized, the leakage source was identified as valve 2NV-350. MM personnel retorqued the bonnet bolts on valve 2NV-350, which reduced the leakage to approximately one drop every two seconds.

4.3 Conclusion

This incident has been assigned a cause of Possible Equipment Failure. The NR system (sometimes referred to in procedures as BTRS) is not used at McGuire. The piping and equipment is, however, maintained in a usable condition. This is the basis for the sampling which was being conducted on the Unit 2 NR Chilled Water loop on February 5, 1991. Since the NR system is not used, the NV system flowpath to the NR system is isolated. Isolation has been accomplished by closing valve 2NR-1, NV Letdown to Moderating Heat Exchanger Number 1 Tube Side Inlet valve, and removing the instrument air supply from the valve. Valve 2NR-1 is a fail closed valve so this prevents letdown flow from being admitted to the NR system. Procedure OP/2/A/6200/02, Enclosure 4.7 specifies that prior to starting the Unit 2 NR system recirculation, the Unit 2 NR Chiller be switched "off" and the Unit 2 NR Chiller pump be placed in "Auto". The "BTRS Mode Switch" is then placed to "Dilute". This starts the chiller pump and, therefore, NR chilled water recirculation. Since the chiller is switched off, and no letdown flow can enter the system through valve 2NR-1, valve 2NV-347 should not operate to divert flow to the NR system.

However, when the NR system recirculation was started, valve 2NV-347 cycled to an intermediate position due to an undetermined cause. Since there was no available NR system flowpath (with valve 2NR-1 closed), this resulted in increased pressure in the NV system piping upstream of valve 2NV-347. Based on the design setting for relief valve 2NV-156, Letdown Heat Exchanger Outlet Header Safety Relief, the pressure could have reached a maximum of 255 psig. This pressurization resulted in external leakage from valve 2NV-350, which is a diaphragm valve.

After OPS personnel observed the intermediate (i.e. partially closed) position of valve 2NV-347 and the decreasing VCT level, valve 2NV-347 was fully opened. Once valve 2NV-347 was open the VCT level decrease

stopped. The pressure in the letdown piping would also have decreased, thereby, slowing/stopping the leakage from valve 2NV-350.

Total water loss from the NV system was estimated to be between 300 and 350 gallons. The spill was contained primarily within the Unit 2 valve gallery.

When the letdown piping upstream of valve 2NV-347 was pressurized by Chemistry personnel, using the Spent Resin Sluice Pump, the leak reappeared. The leak was identified by RP and MM personnel as valve 2NV-350. The bonnet bolts on valve 2NV-350 were retorqued and the leakage rate was reduced to approximately one drop every two seconds. The diaphragm for valve 2NV-350 was subsequently replaced.

OPS personnel issued procedure changes for procedure OP/2/A/6200/02, Enclosure 4.7, which requires the opening of valve 2NV-347 prior to placing the NR system in recirculation.

OPS and Projects personnel are evaluating the permanent isolation of the air supply to valve 2NV-347, to fail the valve to the open position. The NR system chilled waterloop has now been drained. Removal and Restoration (R&R) 01-193 was issued by OPS personnel on March 2, 1991 to remove from service the power supplies for the NR system pumps and compressors.

A review of the Operating Experience Program (OEP) data base for the previous twenty-four months prior to this event revealed no other examples in which a Possible Equipment Failure resulted in a spill from the NV system. This incident is not considered to be recurring.

There were no personnel injuries, radiation overexposures, or unmonitored releases of radioactive material exceeding legal limits as a result of this incident.

4.4 Safety Analysis

The unexpected, partial closing of valve 2NV-347 resulted in a higher than normal pressure in the NV system piping upstream of valve 2NV-347. Normal pressure on this piping is approximately 70 psig. The highest pressure which this piping would have experienced would have been approximately 255 psig, based on the setting of relief valve 2NV-156. The design pressure on this piping is also 255 psig; therefore, the integrity of the piping was not compromised.

The increased pressure in the NV system piping resulted in external leakage from valve 2NV-350. Total leakage, based on a level decrease in the VCT, was estimated to be approximately 300-350 gallons. This corresponds to a leakage rate of 60-70 gpm during a five minute period.

OPS personnel were first alerted of a potential leak based on a decreasing VCT level. They then observed that valve 2NV-347 was indicating an intermediate position versus its normal fully open position. OPS personnel opened valve 2NC-347, and the VCT level decrease stopped.

Two level channels govern the water inventory in the VCT. These channels provide local and remote level indication, level alarms, level control, makeup control, and emergency makeup control. During normal power operation, a low level in the VCT initiates automatic makeup which injects a pre-selected blend of boric acid and water into the NV pumps suction header. When the VCT level is restored to normal, makeup stops. If the reactor makeup control system does not supply sufficient makeup to keep the VCT level from decreasing to a lower level, a low level alarm is actuated. Manual action to isolate letdown flow may correct the situation or, if the level continues to decrease, an emergency low level signal from the VCT level instrumentation causes the suction supply for the NV pumps to transfer to the Refueling Water Storage Tank (FWST).

The leakage from the NV system through valve 2NV-350 was contained primarily in the Unit 2 valve gallery. However, at the time of the spill, there was approximately 75 square feet of floor area outside the valve gallery which was contaminated. This spill area was promptly contained and initial cleanup reduced this area to approximately 20-30 square feet. The contaminated area was subsequently reduced to the area of the Unit 2 valve gallery.

This incident did not affect the health and safety of the public.

5.0 CORRECTIVE ACTIONS

- Immediate:
- 1) OPS personnel opened valve 2NV-347 and VCT level decrease stopped.
 - 2) OPS personnel were dispatched to the Aux Building to look for leaks.
 - 3) RP personnel collected and analyzed airborne samples in the area of the spill. No airborne particulate activity was identified.
 - 4) OPS personnel performed NC system leakage calculations. The unidentified leak rate was determined to be .460 - .448 gpm.
 - 5) OPS personnel revised procedure OP/2/A/6200/02 to require that valve 2NV-347 be manually opened prior to recirculation of the Unit 2 chilled water loop.
- Subsequent:
- 1) OPS personnel identified leakage in the Unit 2 valve gallery.
 - 2) RP and MM personnel removed shielding in the Unit 2 valve gallery.

- 3) Chemistry personnel pressurized the letdown piping and the leakage source was identified as valve 2NV-350.
- 4) Bonnet bolts on valve 2NV-350 were retorqued by MM personnel and the leakage rate was reduced.
- 5) MM personnel replaced the diaphragm for valve 2NV-350 on March 21, 1991.
- 6) The Unit 1 and Unit 2 NR Chilled water loops were drained.
- 7) Removal and Restoration 01-193 was issued, which removed the power from the Unit 1 and Unit 2 NR system pumps and compressors.

Committed: 1) OPS and Projects personnel are evaluating the permanent isolation of the air supply to valve 2NV-347, to fail the valve to the open position.

FLOW DIAGRAM

NV / NR System Interface

LEGEND

Locked Closed = LC

Fail Open = FO

Fail Closed = FC

Leaking Valve = *

