UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
WASHINGTON, DC 20555-0001

July 31, 2006

NRC INFORMATION NOTICE 2006-17: RECENT OPERATING EXPERIENCE OF SERVICE WATER SYSTEMS DUE TO EXTERNAL CONDITIONS

ADDRESSEES

All holders of operating licenses for nuclear power reactors, except those who have permanently ceased operations and have certified that fuel has been permanently removed from the reactor vessel.

PURPOSE

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice (IN) to inform addressees of operating experience within the past few years affecting the operability of the service water system at several nuclear power plants. The NRC expects that recipients will review the information for applicability to their facilities and consider actions, as appropriate, to avoid similar problems. However, suggestions contained in this IN are not NRC requirements; therefore, no specific action or written response is required.

DESCRIPTION OF CIRCUMSTANCES

During 2004 through 2005, 15 events occurred related to blockages in service water systems. These events were primarily self-revealing. The various blocking agents included silt, sand, small rocks, grass or weeds, frazil ice, and small aquatic fauna, such as fish. All these events were of low safety significance but illustrate the susceptibility of the safety-significant service water system. For instance, in September 2005, NRC inspectors identified a condition at Fort Calhoun that allowed small rocks to regularly enter the raw water system, contribute to tripping of a pump and strainer motors, and interfere with traveling screen operation (NRC Inspection Report 50-285/2005-11, Agencywide Documents Access and Management System (ADAMS) Accession No. ML052920543). In June 2005, NRC inspectors found a portion of a service water accumulator outlet line at Salem to be nearly full of silt (NRC Inspection Report 50-272/2005-03, ADAMS Accession No. ML052090344).

Salem - Hope Creek Nuclear Power Plants

On December 2, 2004, crude oil was found leaking from a ship (Athos I) on the Delaware River upstream of the Salem and Hope Creek Generating Stations. To mitigate the potential for oil intrusion into the cooling water systems, the licensee placed booms around the intake structures at both stations. The booms are effective at controlling oil that is at or near the

surface; however, the effectiveness of the booms was lessened because the spilled oil was "heavy" crude and was suspended at varying depths in the river. On December 3, 2004, the licensee commenced shutdown of both Salem units due to the conditions on the river. There were no issues associated with the shutdowns. Hope Creek was already shut down for a refueling outage. The licensee restarted both Salem units after review of heat exchanger performance and monitoring of the oil spill.

Cooper Nuclear Station

On November 20, 2004, the service water system was clogged with sediment, resulting in an unexpected pressure drop in both loops of service water, high differential pressure alarms on both strainers, and isolation of the nonessential service water loads. Both trains exceeded the differential pressure operability limit of 15 psid. Backwash automatically initiated and successfully cleaned the Loop A strainer, but the analogous action for Loop B did not succeed in cleaning the strainer. Operators opened the strainer bypass valve to restore service water flow and subsequently cleaned both strainers.

On October 20, 2005, while preparing for online maintenance of the service water system, operators started a fourth service water pump and received high differential pressure alarms on both Loops A and B. The automatic backwash did not sufficiently decrease the differential pressure, and operators bypassed the strainer. Following these actions, the service water system header pressures returned to normal. During the event, operators declared both loops of service water inoperable. Both loops exceeded the strainer differential pressure structural integrity limit of 15 psid. The high differential pressure across the strainers was the result of debris (small rocks and sediment) introduced by the start of the fourth pump. With both loops of service water inoperable, operators declared both emergency diesel generators inoperable.

In 2005, the NRC Region IV office organized a special inspection based on the repetitive nature of this type of event (NRC Inspection Report 50-298/2005-15, ADAMS Accession No. ML061160027).

Watts Bar Nuclear Plant

On November 22, 2004, while performing a manual valve exercising procedure, the licensee identified that a centrifugal charging pump backup cooling line from the essential raw cooling water system was completely blocked with silt. Approximately 2.5 gallons of muddy paste passed through the 1-inch drain valve before the valve became blocked. The line had to be cleared mechanically. This line is significant in that this is the only high head pump with a backup source of cooling water (NRC Inspection Report 50-390, 391/2004-05, ADAMS Accession No. ML050280344).

DISCUSSION

Cooper Nuclear Station

In both events, for a few minutes service water flow was lost to the nonessential header and greatly reduced to the essential headers. In each case, the successful Loop A automatic backwash precluded the need for a manual scram, which would have been required if the loss

of turbine equipment cooling water had been prolonged. In each event, the Loop B filtering function was overwhelmed by the inrush of sediment. The Loop B automatic backwash function failed due to the lack of downstream pressure, which provides the motive force for the backwashing operation. The licensee believes that the contributing external factor was the low level of the Missouri River, the source of the service water system. Both of these events occurred during autumn, following the navigation season. A weir wall is installed in the river in front of the intake structure. The low river level caused an increased portion of the water that flows into the intake structure to go around (rather than over) the weir wall and jet into the service water bay. This circuitous flow entrained more sand due to the high flow and deposited it in the intake structure near the service water pump intakes in the low-flow areas.

At the time of the October 2005 event, the licensee had not completed its actions to modify the setpoint for automatic backwash of the strainer, alter the strainer intermittent backwash frequency, modify the strainer differential pressure alarm setpoint, and implement weir-wall and traveling-screen modifications.

NRC inspectors noted that the licensee had not performed certain actions committed to in its response to NRC Generic Letter (GL) 89-13, “Service Water System Problems Affecting Safety-Related Equipment,” specifically to periodically monitor silt levels and to periodically examine the intake structure basin for silt, debris, and deterioration (including corrosion), using divers or by dewatering the intake structure bay. At the time of the event, the licensee had not examined the intake structure bay to assess its condition.

Watts Bar Nuclear Plant

The licensee generated 13 problem evaluation reports from early 2002 through late 2005 for blockages identified in raw cooling water lines. The licensee identified silt accumulation in portions of systems providing raw cooling water for both essential and nonessential purposes and for high pressure water for fire protection. These accumulations were identified in both stagnant and active cooling water lines, typically in system low points and in piping with low water velocity. In 1999 and 2002, clam accumulations resulted from missed biocide treatments. The licensee implemented periodic ultrasonic testing and flushing to identify and minimize blockages due to silt and clam accumulations. The initial frequency of ultrasonic testing was every 6 months, later shortened to every 3 months. However, the licensee determined that this program did not cover all susceptible lines and components.

The centrifugal charging pump backup cooling line was not included in the ultrasonic testing monitoring program. In 2000, a maintenance rule panel review left the flushing frequency for this line at 18 months, not recognizing the consequences of silt accumulation. This conclusion was consistent with the general site perception that silt accumulation was not a significant problem. The blockage was found by means of an 18-month manual valve test. Most other lines were being flushed or tested every 3 months. This issue resulted in a White finding in the NRC’s Significance Determination Process.

Raw water systems draw from a section of the Tennessee River downstream of the Watts Bar dam. The suspended solids count in the river water increases after periods of heavy rains upstream. The suspended solids are transported into the affected systems where they settle at points with low fluid velocities.

The licensee's corrective actions for the violation included increasing the frequency of ultrasonic testing, developing higher velocity flush procedures, and modifying systems to improve flushing. Lessons learned included the following observations:

- Silt accumulation in smaller diameter lines may not flush as readily as in larger diameter lines.
- Silt accumulates in stagnant lines off the main headers.
- Lines with a vertical drop off the main headers are more susceptible to silt accumulation than lines with horizontal legs off the main headers.

RELEVANT GENERIC COMMUNICATIONS

NRC Generic Letter 89-13, "Service Water System Problems Affecting Safety-Related Equipment"

NRC GL 89-13 lists the following five recommendations for licensees:

- Significantly reduce the incidence of flow blockage problems resulting from biofouling.
- Conduct a test program to verify the heat transfer capability of all safety-related heat exchangers cooled by service water, including initial and periodic retesting.
- Ensure by a routine inspection and maintenance program for open-cycle service water system piping and components that corrosion, erosion, protective coating failure, silting, and biofouling cannot degrade the performance of the safety-related systems supplied by service water.
- Confirm that the service water system will perform its intended function in accordance with the licensing basis for the plant.
- Confirm that maintenance practices, operating and emergency procedures, and training that involves the service water system are adequate for ensuring that safety-related equipment cooled by the service water system will function as intended and that operators of this equipment will perform effectively.

NRC Information Notice 2004-07: "Plugging of Safety Injection Pump Lubrication Oil Coolers with Lakeweed"

NRC IN 2004-07 also discusses operating experience related to service water system susceptibilities due to external events.

CONCLUSION

The above events involve instances in which sediment and debris has blocked flow in one or more service water lines. A number of the events described above involved the failure to take adequate and timely corrective actions that could have prevented the event from occurring. Often there were multiple previous occurrences that could have alerted licensees to take more aggressive or broader corrective actions.

CONTACT

This information notice requires no specific action or written response. Please direct any questions about this matter to the technical contacts listed below.

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