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

April 7, 2004

NRC INFORMATION NOTICE 2004-07: PLUGGING OF SAFETY INJECTION PUMP LUBRICATION OIL COOLERS WITH LAKEWEED[1]

Addressees:

All holders of operating licenses or construction permits 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 alert addressees to plugging of the high-pressure safety injection pump lubrication oil coolers with lakeweed, which occurred at the Kewaunee Nuclear Power Plant (KNPP), a pressurized-water reactor, during full-power operations. The NRC expects recipients to review the information in this notice for applicability to their facilities and consider actions, as appropriate, to avoid similar problems. However, suggestions contained in this information notice do not constitute NRC requirements and, therefore, do not require any specific action or written response.

Description of Circumstances:

At the time of this event, the safety injection pump lubrication (lube) oil coolers at KNPP were horizontal, straight tube, two-pass heat exchangers with twenty ⅜-inch (0.95-cm) (outer diameter) tubes per pass. Lubrication oil from the high-pressure safety injection pumps circulated on the shell side, and service water from Lake Michigan passed through on the tube (service water) side.

On January 15, 2004, during a routine quarterly maintenance inspection of the “A” safety injection pump lube oil cooler, visual examination revealed silt and biological blockage (lakeweed) at 17 of 20 tube pass inlets. The "as-found" tube-side flow measured 3.0 to 3.8 gallons/minute (gpm) (11.4 to 14.4 liters/minute, lpm) before cleaning, and 5.95 to 6.05 gpm (22.5 to 22.9 lpm) after cleaning. This concern prompted an investigation into the condition of the “B” safety injection pump lube oil cooler, during which the licensee determined that 17 of 20 tubes in each pass of this cooler were also blocked. A flow test, conducted with the cooler's end bell removed, revealed that there was no flow from 17 of the 20 tubes, as seen from the outlet of the cooler, and the "as-found" flow rate measured similar to that of the “A” safety injection pump lube oil cooler.

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[1] Throughout this report, "lakeweed" is considered a mixture of plant fiber, diatom, algae filament, fungi, protozoa, and bacteria.

The licensee and the NRC believe that the small tube diameter and tube sheet design contributed to the lakeweed fouling on the tube side of the lubrication oil coolers.

The licensee determined that this condition had potentially rendered both safety injection pump trains inoperable, and this discovery raised doubts regarding the future operability of the safety injection pumps. As a result, plant operators declared both trains of the high-pressure safety injection system inoperable at 12:20 a.m. on January 16, 2004, and initiated a plant shutdown at 1:20 a.m. the same day.

Discussion:

Generic Letter (GL) 89-13, "Service Water System Problems Affecting Safety-Related Equipment," requested that licensees evaluate system heat exchangers that perform safety-related functions. The NRC also requested that licensees initiate a maintenance, test, and inspection program (as necessary) to comply with GL 89-13 and General Design Criterion (GDC) 44, "Cooling Water," as defined by Appendix A to Title 10, Part 50, of the Code of Federal Regulations (10 CFR Part 50). The GL further stated that licensees' programs should account for heat exchanger fouling, plugging, and the potential for reduced flow and heat removal capability.

With respect to safety injection pump coolers, the operability assessment would (as a minimum) evaluate the delivered flow with the service water system in accident alignment, service water temperature at its design limits (upper and lower bounds), and the safety injection pump moving fluid at accident temperatures for a prolonged period of time (i.e., for the duration of the post-accident function).

Operating experience at KNPP and another operating plant shows that fouling with lakeweed is a concern with heat exchangers that have an inner diameter (ID) of less than ½ inch (1.27 cm). This concern is heightened if the heat exchanger in question is in a low point in the system and experiencing low flow. Coolers with higher flow velocities and larger diameter heat exchanger tubes have been shown to be less susceptible to fouling and flow blockage. The higher velocities tend to keep solids suspended, and the larger diameter tubing provides less potential for the accumulation of lakeweed or other marine organisms at the tube inlets.

Instances of lakeweed fouling of safety-related heat exchangers have occurred at other sites, as follows (this is not an all-inclusive list):

- Point Beach Nuclear Plant experienced lakeweed clogging of the G1/G2 diesel coolers. The heat exchangers had ⅜-inch (0.95-cm) tubes.

- R.E. Ginna Nuclear Power Plant has diesel generator cooling with two lube oil and jacket water heat exchangers in series, one with ⅜-inch (0.95-cm) tubes, and the other with ½-inch (1.27-cm) tubes. Ginna has not experienced significant blockage of the larger tubing but has reported blockage on the smaller tubing and continues to monitor lakeweed fouling on all the heat exchangers.

- Brunswick Steam Electric Plant, Unit 1, noted that cooling flow to both residual heat removal pump seal coolers was approximately 1 gpm (3.8 lpm). The licensee removed the coolers from service and found that they were partially filled with silt. The seal coolers are in a low point of the service water system. Upon opening these coolers, the licensee frequently discovers lakeweed creating a matte over the inlet tubesheets.

Licensees need to be aware that plugging and blockage of heat exchanger tubing attributable to a buildup of silt, sand, or biological material may decrease the ability of the heat exchanger or cooler to perform its required heat removal function. This may also affect other safety-related components, such as pumps; emergency diesel generators; and heating, ventilation, and air conditioning equipment, causing them to potentially fail when called upon to perform their safety-related function.

This information notice does not require any specific action or written response. If you have any questions about the information in this notice, please contact one of the technical contacts identified below or the appropriate project manager in the NRC's Office of Nuclear Reactor Regulation (NRR).

/RA/
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2004-05	Spent Fuel Pool Leakage to Onsite Groundwater	03/03/2004	All holders of operating licensees for nuclear power reactors (except those who have permanently ceased operations and have certified that fuel has been permanently removed from the reactor vessel) and for research and test reactors, and all holders of fuel storage licenses and construction permits.
2004-04	Fuel Damage During Cleaning at a Foreign Pressurized Water Reactor	02/24/2004	All holders of operating licenses for light-water reactors, except those who have permanently ceased operations and have certified that fuel has been permanently removed from the reactor.
2004-03	Radiation Exposures to Members of the Public in Excess of Regulatory Limits Caused by Failures to Perform Appropriate Radiation Surveys During Well-logging Operations	02/24/2004	All well-logging licensees.

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