

UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
WASHINGTON, D.C. 20555

May 4, 2004

NRC INFORMATION NOTICE 2004-10: LOOSE PARTS IN STEAM GENERATORS

Addressees:

All holders of operating licenses for pressurized-water reactors (PWRs), except those who have permanently ceased operations and have certified that fuel has been permanently removed from the reactor.

Purpose:

The U.S. Nuclear Regulatory Commission is issuing this information notice to inform addressees about loose parts found in steam generators. This notice discusses only a few illustrative examples of loose parts found in steam generators. The NRC anticipates that recipients will review the information for applicability to their facilities and consider taking actions, as appropriate, to avoid similar issues. However, no specific action or written response is required.

Description of Circumstances:

In its fall 2003 inspection, Exelon Generation Company found several loose parts in its Braidwood Unit 2 steam generators. For example, an object 3.18 cm (1.25 inch) long and 1.91 cm (0.75 inch) in diameter was discovered during a secondary-side visual inspection of one steam generator. Exelon then reviewed the eddy current data for the tubes surrounding the part and in hindsight identified tube wear in one tube and a possible loose part signal in three tubes. The tube wear caused by the loose part measured 38 percent through-wall as determined by a +Point™ coil. The indication of tube wear was present in prior cycles, but was not reported because the indication was distorted due to its location (i.e., near an expanded preheater baffle plate support).

In another steam generator, Exelon identified a piece of weld slag measuring 2.86 cm (1.125 inches) by 2.54 cm (1 inch) by 0.89 cm (0.35 inch) on the top of the cold-leg tubesheet. The weld slag was originally identified during a foreign object search-and-retrieval inspection in 2002, but could not be retrieved. No tube wear was associated with this object. Four tubes surrounding this object were plugged and stabilized in 2003. In addition, Exelon found two manufacturing fitup bars (also referred to as backing bars) measuring 2.54 cm (1 inch) by 2.54 cm (1 inch) by 7.62 cm (3 inches) on top of a preheater baffle plate. These bars were used to assist in the assembly of the steam generator and were welded on the bottom of another preheater baffle plate. These fitup bars serve no structural or operational function.

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After visually identifying the presence of these fitup bars, the licensee could ascertain from eddy current data that one of these bars had been present on the top of the preheater baffle plate since the spring of 1990 and the other since the fall of 1994. These bars resulted in tube wear.

One bar caused two wear scars (with maximum depths of 28 percent and 21 percent through-wall) in one tube and the other bar caused one wear scar (maximum depth of 5 percent through-wall). After visually identifying these fitup bars in 2003, Exelon attributed a 39-percent through-wall volumetric indication detected in a neighboring tube in 1994 and plugged in 1997 to wear associated with the fitup bar. These two backing bars could not be removed from the steam generator, so Exelon plugged and stabilized all of the tubes surrounding them. As part of its evaluation, Exelon also assessed the potential for other fitup bars to cause tube damage (refer to NRC Letter to Exelon Nuclear, Subject: Summary of Conference Call With Exelon Nuclear Regarding the 2003 Steam Generator Inspections at Braidwood Unit 2, January 15, 2004, ADAMS Accession No. ML033580377).

In its fall 2003 inspection, Nuclear Management Company (NMC) reported several potential loose part indications on the tubes in the hot leg top of the tubesheet region in the Prairie Island Unit 2 steam generators. These potential loose part indications were present in previous inspections and have not resulted in any tube wear. NMC typically performs visual inspection of the top of the tubesheet and a search for loose parts in the annulus region of one steam generator during each outage regardless of indications of possible loose parts. Before resuming plant operation, NMC evaluates and resolves possible loose part indications which include an inspection of these indications with a rotating probe. (NRC Letter to NMC, Subject: Prairie Island Nuclear Generating Plant, Unit 2 - Summary of Conference Call With Nuclear Management Company, LLC Regarding the 2003 Steam Generator Inspections, November 26, 2003, ADAMS Accession No. ML033210569).

On June 22, 2002, Exelon shut down its Byron Unit 2 plant when the steam generator primary-to-secondary leak rate reached a level of 284 liters (75 gallons) to 303 liters (80 gallons) per day. A subsequent investigation into the source of the leak identified one leaking tube. In this leaking tube, a volumetric flaw was identified above a cold-leg tube support near the feedwater inlet. Inspections performed around the leaking tube resulted in the identification of several other flaws. Given the nature (volumetric) and location of the signals (periphery near feedwater inlet), the flaws were attributed to wear from a loose part; however no loose parts were observed during the eddy current inspection. The leaking tube and other degraded tubes were plugged and stabilized. In its September 2002 refueling outage inspection, Exelon performed sludge lancing and foreign object search-and-retrieval inspections and confirmed the presence of loose parts in the Byron Unit 2 steam generators, including the parts believed to have resulted in the leaking tube (NRC Letter to Exelon, Subject: Byron Station, Unit 2, Summary of Conference Calls with Exelon Generation Company Regarding Its 2002 Steam Generator Tube Inspection Results, November 8, 2002, ADAMS Accession No. ML022950043).

On May 10, 2002, Wolf Creek Nuclear Operating Corporation detected indications of an unusual noise coming from steam generator D followed by an alarm in the plant's loose parts monitoring system (NRC Memorandum, Subject: Response to Request for Information on Loose Parts Found In the Steam Generator at Wolf Creek Generating Station, August 27, 2002, ADAMS Accession No. ML022340708). After a detailed evaluation of available information,

plant management directed the shutdown of Wolf Creek on May 13, 2002, in order to identify the source of the noise. During its inspections, the licensee retrieved two loose parts, a guide tube support pin nut, and a locking device from the primary side of steam generator D. There were no indications within the steam generator of serious damage to the tubes, tubesheet, welds, or divider plate. The loose parts did not result in any primary-to-secondary tube leakage. In the subsequent refueling outage (fall 2003), detailed inspections of steam generator D resulted in repairs to the tube sheet and a mechanical plug. An additional loose part from the split pin was identified to be lodged in one of the steam generator tubes which resulted in the plugging of that tube. Additionally, all guide tube split pins were replaced with stainless steel split pins.

Discussion:

Loose parts have been found in steam generators for a number of years (refer to NRC Information Notice 83-24, "Loose Parts In the Secondary Side of Steam Generators at Pressurized Water Reactors," dated April 28, 1983). These parts may be introduced into the steam generators from maintenance activities or degradation in primary- or secondary-system components. Some of these parts have resulted in degradation of the steam generator tubes, and in some cases have led to tube leaks. Tube degradation may be the result of the mechanical interaction between the loose part and the tube or may be the result of chemical impurities (e.g., lead, chlorides) introduced into the steam generator by the part. Licensees have found that to ensure that loose parts do not impair tube integrity, it is important to take measures to limit their introduction into the steam generator. In addition, it is important to have programs for detecting and monitoring loose parts in case loose parts are introduced into steam generators. Recent operating experience of most plants indicates that loose parts have not significantly affected tube integrity; however, they have resulted in tube degradation. Since many licensees are beginning to extend the operating interval between tube inspections (especially at plants with advanced tube materials), it is important to ensure that programs continue to effectively limit the introduction of loose parts, promptly detect loose parts that do enter, and implement appropriate corrective action upon identification of loose parts in steam generators.

Licensees can take actions to prevent the introduction of loose parts into the steam generators. By preventing the introduction of loose parts into the primary and secondary system, damage from loose parts will be avoided. Procedures for precluding the introduction of loose parts into the primary and secondary system typically include (a) detailed accountability for all tools and equipment used during a maintenance operation, (b) appropriate controls on foreign objects such as eyeglasses and film badges including barriers to keep material from dropping into a system (e.g., feedwater), (c) cleanliness requirements, (d) accountability procedures for components and parts removed from major components (e.g., reassembly of cut and removed components), and (e) post-maintenance inspections.

Actions taken in response to the detection of a loose part in a steam generator vary depending on the nature and location of the part and its effect on tube integrity. In many cases, parts are removed from a steam generator upon detection. However, retrieval of a loose part is not always practical or possible. In these cases, an engineering evaluation will determine whether the part will impair tube integrity if it is left in service. This evaluation may result in preventive

tube plugging and stabilization of the affected and surrounding tubes or may result in other corrective actions such as insertion of additional access points in the steam generator shell to provide access for removing the part.

The above examples and other operating experience illustrate several important points with respect to managing steam generator loose parts. For example, verifying the integrity of primary- and secondary-system components (such as support pins and fitup bars) may prevent the introduction of loose parts into the steam generator from these sources. Operating experience also indicates that loose part monitoring systems may provide an early indication that a part is in a steam generator, permitting prompt corrective action to be taken before any significant tube damage occurs. The importance of supplementing the steam generator tube eddy current examinations with secondary side visual inspections is also supported by recent operating experience indicating that some loose parts may not be detected during the eddy current examination. In addition, operating experience indicates that tube damage from minor loose parts may not always be detectable due to the presence of interfering signals.

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 listed below or the appropriate project manager in the NRC's Office of Nuclear Reactor Regulation (NRR).

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Information Notice No.	Subject	Date of Issuance	Issued to
2004-09	Corrosion of Steel Containment and Containment Liner	04/27/2004	All holders of operating licenses for nuclear power reactors except those who have permanently ceased operation and have certified that fuel has been permanently removed from the reactor vessel.
2004-08	Reactor Coolant Pressure Boundary Leakage Attributable to Propagation of Cracking in Reactor Vessel Nozzle Welds	04/22/2004	All holders of operating licensees for nuclear power boiling-water reactors (BWRs), except those who have permanently ceased operations and have certified that fuel has been permanently removed from the reactor vessel.
2004-07	Plugging of Safety Injection Pump Lubrication Oil Coolers with Lakeweed	04/07/2004	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.
2004-06	Loss of Feedwater Isokinetic Sampling Probes at Dresden Units 2 and 3	03/26/2004	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.

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