SSINS No.: 6835
IN 87-19

UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF INSPECTION AND ENFORCEMENT
WASHINGTON, D.C. 20555

April 9, 1987

IE INFORMATION NOTICE NO. 87-19: PERFORATION AND CRACKING OF ROD CLUSTER CONTROL ASSEMBLIES

Addressees:

All Westinghouse nuclear power pressurized-water reactor (PWR) facilities holding an operating license or a construction permit.

Purpose:

This notice is provided to inform recipients of a potentially significant safety problem that could result from the perforation and cracking of the rod cluster control assemblies (RCCAs) in Westinghouse PWRs. It is expected that recipients will review the information for applicability and consider action, as appropriate, to preclude a similar problem from occurring at their facilities. However, suggestions contained in this information notice do not constitute NRC requirements; therefore, no specific action or written response is required.

Description of Circumstances:

An estimate that was intended to be conservative indicated that the RCCAs would last for at least 15 years before the absorber cladding, a thin tube, would show excessive thinning as a result of sliding wear. These components were inspected at Point Beach Nuclear Plant, Unit 2, in 1983 after 13 years of operation. As a result of this inspection Point Beach reported on August 18, 1983 that sliding wear was minor, but one control rod had a 2-in. crack near the tip of the rod and severe fretting wear had occurred on several tubes. Subsequent inspections at the Kewaunee and Haddam Neck nuclear power plants, which have been in operation for more than 12 years, confirmed the fretting wear. In addition, Haddam Neck reported tube cracking in 32 of 47 RCCAs.

In the event of a breach of the tubing resulting from wall thinning, perforation, or cracking, the immediate effect is the introduction of activation products from the neutron absorber material into the reactor coolant. Although there are large margins, another concern is the potential reduction in shutdown margin and negative reactivity worth.

Discussion:

Each RCCA contains 16 rods. The rods at Point Beach, Kewaunee, and Haddam Neck were constructed with an outer tube of 0.019-in.-thick 304 stainless steel that retains the absorber material (80% silver, 15% indium, 5% cadmium). Some newer plants use hafnium as the absorber material, while others use boron carbide surrounded by a 0.038-in.-thick tube. The control RCCAs are inserted or withdrawn to compensate for various reactivity changes during operation of the reactor and can trip to provide shutdown capability. The shutdown RCCAs are fully withdrawn from the core when the reactor is critical.

At Kewaunee, marks of fretting wear about 1 inch in length, were found adjacent to the guide blocks that position the rods when the RCCAs are in their withdrawn position. The 1-in.-thick stainless steel blocks are spaced on 12-in. centers and each rod in the cluster passes through all eight of the blocks. At Point Beach the tubing wore in two modes: fretting and sliding of the rods over the guide blocks during rod motion. Five RCCAs at Haddam Neck had wall thinning resulting from fretting and four of these were actually wearing into the absorber material. All of the others had fretting wear, but to a lesser extent.

The fretting resulted from flow-induced vibratory contact between the rods and the guide blocks during long periods of steady-state power operation. Vibration is hydraulically induced by flow of the reactor coolant; therefore it is a continuous process when the reactor coolant pumps are in operation. According to Westinghouse Electric Corp. fretting wear encompassed one-third of the circumference of the rod and the depth varied with the amount of time the RCCAs were in the withdrawn position.

At Point Beach significant number of short hairline cracks at the lower extremity of the tubing were observed near the end plug region of the rod. The cracks extended axially for 4 in. and penetrated the stainless tubing, exposing the absorber material. No circumferential cracks were found. Examination of the cracks showed that irradiation-induced swelling of the absorber was the principal cause of tensile stress in the cladding, which resulted in cracking after substantial irradiation.

Where excessively worn rods were found, they have been replaced. While the issue is being studied by NRC and the industry, several licensees have been given approval to slightly change the position of the fully withdrawn RCCA in order to distribute the wear among different locations on the tubing. Westinghouse Electric Corp. reported that an increase in the amount of the silver isotope, Ag-110m in the reactor water is a reliable indication of exposure of absorber material due to cracking or fretting wear.

No specific action or written response is required by this information notice. If you have any questions about this matter, please contact the Regional Administrator of the appropriate regional office or this office.

Edward L. Jordan, Director
Division of Emergency Preparedness
and Engineering Response
Office of Inspection and Enforcement

Technical Contact: Paul Cortland, IE
(301) 492-4175

Attachment: List of Recently Issued IE Information Notices

*See Previous Concurrences

				D:DEPER:IE	*DD:DEPER:IE
				ELJordan	SASchwartz
				04/6/87	03/10/87
*DEPER:IE	*DEPER:IE	*PSB:IE	*NRR	*DEPER:IE	*DEPER:IE
PCortland:bt	AWDromerick	DGable	RLobel	RLBaer	JERosenthal
02/18/87	03/02/87	03/02/87	02/26/87	03/04/87	03/05/87

Attachment 1
IN 87-19
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LIST OF RECENTLY ISSUED
IE INFORMATION NOTICES

Information Notice No.	Subject	Date of Issue	Issued to
87-18	Unauthorized Service on Teletherapy Units by Nonlicensed Maintenance Personnel	4/8/87	All NRC licensees authorized to use radioactive material in teletherapy units
87-17	Response Time of Scram Instrument Volume Level Detectors	4/7/87	All GE BWR facilities holding an OP or CP
87-16	Degradation of Static "O" Ring Pressure Switches	4/2/87	All LWR facilities holding an OL or CP
87-15	Complaince with the Posting Requirements of Subsection 223b of the Atomic Energy Act of 1954, as Amended	3/25/87	All power reactor facilities holding a CP and all firms supplying components or services to such facilities
87-14	Actuation of Fire Suppression System Causing Inoperability of Safety-Related Ventilation Equipment	3/23/87	All power reactor facilities holding an OL or CP
86-106 Sup. 2	Feedwater Line Break	3/18/87	All power reactor facilities holding an OL or CP
87-13	Potential for High Radiation Fields Following Loss of Water from Fuel Pool	2/24/87	All power reactor facilities holding an OL or CP except Fort St. Vrain.
86-106 Sup. 1	Feedwater Line Break	2/13/87	All power reactor facilities holding an OL or CP
87-12	Potential Problems With Metal Clad Circuit Breakers, General Electric Type AKF-2-25	2/13/87	All power reactor facilities holding an OL or CP
87-11	Enclosure of Vital Equipment Within Designated Vital Areas	2/13/87	All power reactor facilities holding an OL or CP

OL = Operating License
CP = Construction Permit

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The tubing was worn by fretting resulting from flow-induced vibratory contact between the rods and the guide blocks during long periods of steady-state power operation. Vibration is hydraulically induced by flow of the reactor coolant; therefore it is a continuous process when the reactor coolant pumps are in operation. In general, fretting wear was 1/2-in. long and encompassed one-third of the circumference of the rod. The depth varied with the amount of time the RCCAs were in the withdrawn position. The worst measured depth of tubing penetration from fretting wear was 65 percent of tubing thickness.

A significant amount of short hairline cracks at the lower extremity of the tubing was observed near the end plug region of the rod. The cracks extended axially for 4 in. and penetrated the stainless tubing. No circumferential cracks were found. Examination of the cracks showed that irradiation-induced swelling of the absorber was the principal cause of tensile stress in the cladding, which resulted in cracking after substantial irradiation.

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