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

February 16, 1989

INFORMATION NOTICE NO. 89-15: SECOND REACTOR COOLANT PUMP SHAFT FAILURE AT CRYSTAL RIVER

Addressees:

All holders of operating licenses or construction permits for nuclear power reactors.

Purpose:

This information notice is being provided to alert addressees to indications of potential sudden failure of a reactor coolant pump (RCP) shaft. It is expected 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 information notice do not constitute NRC requirements; therefore, no specific action or written response is required.

Description of Circumstances:

On January 18, 1989, the Crystal River Unit 3 plant experienced a loop "A" low coolant flow alarm and an automatic power runback from 75 percent of full power to 64 percent of full power. Operators noted a drop in the "A" reactor coolant pump motor current from 90 percent to 25 percent.

A preliminary review of the vibration and other coastdown data suggests that the pump shaft and the impeller have decoupled. This may be due either to fracture of the shaft itself or to failure of the cap screws and drive pins which hold the impeller to the shaft. The root cause of the failure will be more fully known when the pump is disassembled. The pump was manufactured by Byron Jackson.

Both the low flow alarm and motor current decreases were also symptomatic of the previous pump shaft failure in 1986.* During the 1986 event, pump vibration remained high after the shaft break, indicating interference to motor spin at the fracture interface, and after the pump was tripped, the pump motor rotation stopped within a few seconds. The licensee believes that the lack of pump vibration and the longer post trip motor coastdown after the recent pump failure indicate a lack of interference at the fracture interface.

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*The 1986 failure is described in Information Notice 86-19, "Reactor Coolant Pump Shaft Failure at Crystal River."

Following the 1986 pump shaft failure, the licensee replaced the shafts in all four coolant pumps. Two of the reactor coolant pumps received new shafts of a different material (Alloy A-479 XM-19) and a different design. The new design did not contain the groove that was determined to be the crack initiation location for the 1986 fracture. One pump was fitted with a new shaft of the same material as that of the shaft that failed (Alloy A-286), but the licensee believes the new shaft did not contain a groove. The "A" pump was fitted with a new shaft of the same design and material as that of the shaft that had failed previously.

In addition, following the 1986 failure, the licensee refurbished and improved the vibration monitoring equipment on each coolant pump and located vibration monitor alarms on the main control panel. The reactor coolant pump vibration is continuously monitored by the Bently-Nevada Dynamic Data Manager System. This system monitors the motor casing accelerometer inputs along with the pump shaft proximity probes (X & Y, Keyphasor) on all four reactor coolant pumps.

Increased vibration on the "A" RCP was noted in November 1988. A review of the vibration monitoring data revealed a loss of rotor stiffness. The vibration monitor vendor (Bently-Nevada) believed that the pump shaft had cracked. The licensee examined the "A" RCP shaft with ultrasonic testing equipment and concluded that the shaft had not cracked. Cracks in the lower motor housing support were identified and corrected. After repair of the lower motor housing support, the licensee reported normal pump vibration. However, pump vibrations of varying magnitudes were again noted shortly thereafter.

The ultimate objective of the vibration monitoring system is to correlate the vibration data with crack growth and to provide an early warning such that a shaft break can be avoided. The program depends on an early detection of shifts in steady state values of maximum shaft displacement, first and second harmonics and corresponding phase angles. Since shifts in the second harmonic and its phase angle are sensitive indicators of changes in shaft stiffness and crack growth, particular attention to these parameters is important.

Additional RCP shaft failures are discussed in Information Notice 85-03, "Separation of Primary Reactor Coolant Pump Shaft and Impeller," and its supplement.

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

Charles E. Rossi

Charles E. Rossi, Director
Division of Operational Events Assessment
Office of Nuclear Reactor Regulation

Technical Contacts: Jai Rajan, NRR
(301) 492-0917

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Attachment: List of Recently Issued NRC Information Notices

LIST OF RECENTLY ISSUED
NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
89-14	Inadequate Dedication Process for Commercial Grade Components Which Could Lead to Common Mode Failure of a Safety System	2/16/89	All holders of OLs or CPs for nuclear power reactors.
89-13	Alternative Waste Management Procedures in Case of Denial of Access to Low-Level Waste Disposal Sites	2/8/89	All holders of NRC specific licenses.
89-12	Dose Calibrator Quality Control	2/9/89	All NRC medical licensees.
89-11	Failure of DC Motor-Operated Valves to Develop Rated Torque Because of Improper Cable Sizing	2/2/89	All holders of OLs or CPs for nuclear power reactors.
89-10	Undetected Installation Errors In Main Steam Line Pipe Tunnel Differential Temperature-Sensing Elements at Boiling Water Reactors.	1/27/89	All holders of OLs or CPs for BWRs.
89-09	Credit for Control Rods Without Scram Capability in the Calculation of the Shutdown Margin	1/26/89	All holders of OLs or CPs for test and research reactors.
89-08	Pump Damage Caused by Low-Flow Operation	1/26/89	All holders of OLs or CPs for nuclear power reactors.
89-07	Failures of Small-Diameter Tubing in Control Air, Fuel Oil, and Lube Oil Systems Which Render Emergency Diesel Generators Inoperable	1/25/89	All holders of OLs or CPs for nuclear power reactors.

OL = Operating License
CP = Construction Permit

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WJensen:Db	RLobel		JRajan	TMarsh	LShao
2/2/89	2/2/89	2/3/89	2/3/89	2/3/89	2/ /89

C:EAB:NRR	*C:OGCB:NRR	D:DOEA:NRR
WDLanning	CHBerlinger	CERossi
2/ /89	2/8/89	2/10/89

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AHB with changes noted.

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