

Jim McKnight
05F22

UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
WASHINGTON, D.C. 20555-0001

September 28, 1995

NRC INFORMATION NOTICE 95-43: FAILURE OF THE BOLT-LOCKING DEVICE ON THE REACTOR COOLANT PUMP TURNING VANE

Addressees

All holders of operating licenses or construction permits for nuclear power reactors designed by Westinghouse Electric Corporation (W).

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice to alert addressees to a recent event involving problems that have resulted in the loss of integrity of bolt-locking devices in the turning vane diffuser attachment of Westinghouse reactor coolant pumps (RCPs). 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 are not NRC requirements; therefore, no specific action or written response is required.

Description of Circumstances

On June 3, 1994, the licensee for the Seabrook Nuclear Power Station conducted an underwater examination of reactor vessel internals. Foreign material was found on the reactor vessel internals lower core plate. In a subsequent video inspection, a bolt was found on the bottom of the reactor vessel and two bolt-locking devices were found on the lower core plate. One locking device was intact, and the other was deformed and had portions missing. The licensee identified the bolt and locking devices as a cap screw and locking cups that are used in the RCPs to attach and secure the turning vane diffuser to the thermal barrier flange.

Discussion

The Seabrook Plant is a four-loop Westinghouse pressurized-water reactor plant with Westinghouse Model 93A-1 RCPs. The RCP hydraulic section consists of a casing, an impeller, a diffuser adapter, a thermal barrier, and a turning vane diffuser. The turning vane diffuser is stationary and is attached to the thermal barrier flange by 23 bolts. The bolts are 3.8 centimeters [1.5 inches] in diameter and 25 centimeters [10 inches] long. The ends of the bolts are threaded. The bolts are designed to secure the turning vane diffuser to the thermal barrier flange with a preload of 2,712 newton meters [2,000 ft-lbs] of torque. The function of the bolt locking device is to prevent bolt rotation and subsequent loss of bolt preload. The locking devices are fabricated from 304 stainless steel and are cylindrical members

9509220300

updated on 9/29

PDR I&E Notice 95-043

950928


DF01
[scribble]

with a single longitudinal split. The locking devices are inserted into the annulus formed by the outer diameter of the bolt head and the counterbore for the bolt head machined in the turning vane flange. The spring action of the locking device cylinder is designed to snap two bosses on the cylinder into mating holes in the counterbore. The anti-rotation function of the locking device is accomplished by staking the top edge of the cylinder at two locations into slots in the bolt head. The bolts and locking devices are exposed to the reactor coolant fluid within the pump but are not part of the reactor coolant system pressure boundary.

During the 1994 Seabrook refueling outage, all four RCPs were inspected to determine the origin of the loose parts. The bolt and one of the locking devices found in the vessel were traced to RCP "B," and the other locking device was from RCP "D." Various degrees of degradation were detected on some locking devices in all four RCPs. The licensee postulated that the bolt and the locking devices dropped into the turning vane diffuser as a result of degradation of the locking devices and the loss of the preload torque on the bolt. The bolt and locking devices were carried by the cold-leg flow stream into the reactor vessel lower head and to the lower core support plate. The licensee replaced the bolts and locking devices on all four RCPs with a new design.

The degradation of the locking device and the release of the bolt was evaluated by the licensee with assistance from Westinghouse. The evaluation is documented in Licensee Event Report No. 94-010-01, dated January 16, 1995. The root cause of the release of the turning vane cap screw and locking cups was attributed to the original design not adequately considering the effects of flow-induced vibration on the locking cup and the turning vane cap screw. The licensee postulated that flow-induced vibration caused the locking cups to erode and release from the turning vane. The cap screw subsequently backed out as a result of the loss of the preload torque and the effects of vibration and gravity.

This information notice requires no specific action or written response. If you have any questions about the information in this notice, please contact the technical contact listed below or the appropriate Office of Nuclear Reactor Regulation (NRR) project manager.


Dennis M. Crutchfield, Director
Division of Reactor Program Management
Office of Nuclear Reactor Regulation

Technical contact: Francis Grubelich, NRR
(301) 415-2784

Attachment:
List of Recently Issued NRC Information Notices

Attachment filed in Jacket

LIST OF RECENTLY ISSUED
NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
95-42	Commission Decision on the Resolution of Generic Issue 23, "Reactor Coolant Pump Seal Failure"	09/22/95	All holders of OLs or CPs for nuclear power reactors.
95-41	Degradation of Ventilation System Charcoal Resulting from Chemical Cleaning of Steam Generators	09/22/95	All holders of OLs or CPs for nuclear power reactors.
95-40	Supplemental Information to Generic Letter 95-03, "Circumferential Cracking of Steam Generator Tubes"	09/20/95	All holders of OLs or CPs for nuclear power reactors.
95-39	Brachytherapy Incidents Involving Treatment Planning Errors	09/19/95	All U.S. Nuclear Regulatory Commission Medical Licensees.
95-38	Degradation of Boraflex Neutron Absorber in Spent Fuel Storage Racks	09/08/95	All holders of OLs or CPs for nuclear power reactors.
95-37	Inadequate Offsite Power System Voltages during Design-Basis Events	09/07/95	All holders of OLs or CPs for nuclear power reactors.
95-36	Potential Problems with Post-Fire Emergency Lighting	08/29/95	All holders of OLs or CPs for nuclear power reactors.
95-35	Degraded Ability of Steam Generators to Remove Decay Heat by Natural Circulation	08/28/95	All holders of OLs or CPs for pressurized water reactors (PWRs).
95-34	Air Actuator and Supply Air Regulator Problems in Copes-Vulcan Pressurizer Power-Operated Relief Valves	08/25/95	All holders of OLs or CPs for nuclear power reactors.

OL = Operating License
CP = Construction Permit

annulus formed by the outer diameter of the bolt head and the counterbore for the bolt head machined in the turning vane flange. The spring action of the locking device cylinder is designed to snap two bosses on the cylinder into mating holes in the counterbore. The anti-rotation function of the locking device is accomplished by staking the top edge of the cylinder at two locations into slots in the bolt head. The bolts and locking devices are exposed to the reactor coolant fluid within the pump but are not part of the reactor coolant system pressure boundary.

During the 1994 Seabrook refueling outage, all four RCPs were inspected to determine the origin of the loose parts. The bolt and one of the locking devices found in the vessel were traced to RCP "B," and the other locking device was from RCP "D." Various degrees of degradation were detected on some locking devices in all four RCPs. The licensee postulated that the bolt and the locking devices dropped into the turning vane diffuser as a result of degradation of the locking devices and the loss of the preload torque on the bolt. The bolt and locking devices were carried by the cold-leg flow stream into the reactor vessel lower head and to the lower core support plate. The licensee replaced the bolts and locking devices on all four RCPs with a new design.

The degradation of the locking device and the release of the bolt was evaluated by the licensee with assistance from Westinghouse. The evaluation is documented in Licensee Event Report No. 94-010-01, dated January 16, 1995. The root cause of the release of the turning vane cap screw and locking cups was attributed to the original design not adequately considering the effects of flow-induced vibration on the locking cup and the turning vane cap screw. The licensee postulated that flow-induced vibration caused the locking cups to erode and release from the turning vane. The cap screw subsequently backed out as a result of the loss of the preload torque and the effects of vibration and gravity.

This information notice requires no specific action or written response. If you have any questions about the information in this notice, please contact the technical contact listed below or the appropriate Office of Nuclear Reactor Regulation (NRR) project manager.

orig /s/'d by DMCrutchfield
 Dennis M. Crutchfield, Director
 Division of Reactor Program Management
 Office of Nuclear Reactor Regulation

Technical contact: Francis Grubelich, NRR
 (301) 415-2784

Attachment: List of Recently Issued NRC Information Notices

DOCUMENT NAME: 95-43.IN

*See previous concurrence

To receive a copy of this document, indicate in the box: "C" = Copy without attachment/enclosure "E" = Copy with attachment/enclosure "N" = No copy

OFFICE	PECB:DRPM	E	EMEB:DE	E	EMEB:DE	E	ADM:PUB	N	SC/PECB:DRPM	N
NAME	NFields*		FGrubelich*		KManoly*		Tech Editor*		EGoodwin*	
DATE	08/15/95		08/15/95		08/15/95		08/02/95		08/22/95	

OFFICE	C/EMEB:DE	E	DD/DE	E	D/DE	E	PECB:DRPM	E	C/PECB:DRPM	
NAME	RWessman*		GLainas*		BSheron*		RKiessel*		ACHaffee*	
DATE	08/22/95		08/23/95		08/23/95		09/12/95		09/14/95	

OFFICE	D/DRPM
NAME	DCrutchfield
DATE	9/15/95

annulus formed by the outer diameter of the bolt head and the counterbore for the bolt head machined in the turning vane flange. The spring action of the locking device cylinder is designed to snap two bosses on the cylinder into mating holes in the counterbore. The anti-rotation function of the locking device is accomplished by staking the top edge of the cylinder at two locations into slots in the bolt head. The bolts and locking devices are exposed to the reactor coolant fluid within the pump but are not part of the reactor coolant system pressure boundary.

During the 1994 Seabrook refueling outage, all four RCPs were inspected to determine the origin of the loose parts. The bolt and one of the locking devices found in the vessel were traced to RCP "B," and the other locking device was from RCP "D." Various degrees of degradation were detected on some locking devices in all four RCPs. The licensee postulated that the bolt and the locking devices dropped into the turning vane diffuser as a result of degradation of the locking devices and the loss of the preload torque on the bolt. The bolt and locking devices were carried by the cold-leg flow stream into the reactor vessel lower head and to the lower core support plate. The licensee replaced the bolts and locking devices on all four RCPs with a new design.

The degradation of the locking device and the release of the bolt was evaluated by the licensee with assistance from Westinghouse. The evaluation is documented in Licensee Event Report No. 94-010-01, dated January 16, 1995. The root cause of the release of the turning vane cap screw and locking cups was attributed to the original design not adequately considering the affects of flow-induced vibration on the locking cup and the turning vane cap screw. The licensee postulated that flow-induced vibration caused the locking cups to erode and release from the turning vane. The cap screw subsequently backed out as a result of the loss of the preload torque and the effects of vibration and gravity.

This information notice requires no specific action or written response. If you have any questions about the information in this notice, please contact the technical contact listed below or the appropriate Office of Nuclear Reactor Regulation (NRR) project manager.

Dennis M. Crutchfield, Director
 Division of Reactor Program Management
 Office of Nuclear Reactor Regulation

Technical contact: Francis Grubelich, NRR
 (301) 415-2784

Attachment: List of Recently Issued NRC Information Notices

DOCUMENT NAME: S:\DRPM SEC\INFON02.SEA *See previous concurrence
 To receive a copy of this document, indicate in the box: "C" = Copy without attachment/enclosure "E" = Copy with attachment/enclosure "N" = No copy

OFFICE	PECB:DRPM	E	EMEB:DE	E	EMEB:DE	E	ADM:PUB	N	SC/PECB:DRPM	N
NAME	NFields*		FGrubelich*		KManoly*		Tech Editor*		EGoodwin*	
DATE	08/15/95		08/15/95		08/15/95		08/02/95		08/22/95	

OFFICE	C/EMEB:DE	E	DD/DE	E	D/DE	E	PECB:DRPM	E	C/PECB:DRPM	
NAME	RWessman*		GLainas*		BSheron*		RKiessel*		ACHaffee*	
DATE	08/22/95		08/23/95		08/23/95		09/12/95		09/14/95	

OFFICE	D/DRPM	
NAME	DCrutchfield	
DATE	/ /95	

9115 #2
 OFFICIAL RECORD COPY

annulus formed by the outer diameter of the bolt head and the counterbore for the bolt head machined in the turning vane flange. The spring action of the locking device cylinder is designed to snap two bosses on the cylinder into mating holes in the counterbore. The anti-rotation function of the locking device is accomplished by staking the top edge of the cylinder at two locations into slots in the bolt head. The bolts and locking devices are exposed to the reactor coolant fluid within the pump but are not part of the reactor coolant system pressure boundary.

During the 1994 Seabrook refueling outage, all four RCPs were inspected to determine the origin of the loose parts. The bolt and one of the locking devices found in the vessel were traced to RCP "B," and the other locking device was from RCP "D." Various degrees of degradation were detected on some locking devices in all four RCPs. The licensee postulated that the bolt and the locking devices dropped into the turning vane diffuser as a result of degradation of the locking devices and the loss of the preload torque on the bolt. The bolt and locking devices were carried by the cold-leg flow stream into the reactor vessel lower head and to the lower core support plate. The licensee replaced the bolts and locking devices on all four RCPs with a new design.

The degradation of the locking device and the release of the bolt was evaluated by the licensee with assistance from Westinghouse. The evaluation is documented in Licensee Event Report No. 94-010-01, dated January 16, 1995. The root cause of the release of the turning vane cap screw and locking cups was attributed to the original design not adequately considering the affects of flow-induced vibration on the locking cup and the turning vane cap screw. The licensee postulated that flow-induced vibration caused the locking cups to erode and release from the turning vane. The cap screw subsequently backed out as a result of the loss of the preload torque and the effects of vibration and gravity.

This information notice requires no specific action or written response. If you have any questions about the information in this notice, please contact the technical contact listed below or the appropriate Office of Nuclear Reactor Regulation (NRR) project manager.

Dennis M. Crutchfield, Director
Division of Reactor Program Management
Office of Nuclear Reactor Regulation

Technical contact: Francis Grubelich, NRR
(301) 415-2784

Attachment: List of Recently Issued NRC Information Notices

DOCUMENT NAME: G:\NICK\INFONO2.SEA *See previous concurrence

To receive a copy of this document, indicate in the box: "C" = Copy without attachment/enclosure "E" = Copy with attachment/enclosure "N" = No copy

OFFICE	PECB:DRPM	E	EMEB:DE	E	EMEB:DE	E	ADM:PUB	N	SC/PECB:DRPM	N
NAME	NFields*		FGrubelich*		KManoly*		Tech Editor*		EGoodwin*	
DATE	08/15/95		08/15/95		08/15/95		08/02/95		08/22/95	
OFFICE	C/EMEB:DE	E	DD/DE	E	D/DE	E	PECB:DRPM		C/PECB:DRPM	
NAME	RWessman*		GLainas*		BSheron*		RKiessel*		ACK Lee	
DATE	08/22/95		08/23/95		08/23/95		09/12/95		9/14 /95	
OFFICE	D/DRPM									
NAME	DCrutchfield									
DATE	/ /95									

annulus formed by the outer diameter of the bolt head and the counterbore for the bolt head machined in the turning vane flange. The spring action of the locking device cylinder is designed to snap two bosses on the cylinder into mating holes in the counterbore. The anti-rotation function of the locking device is accomplished by staking the top edge of the cylinder at two locations into slots in the bolt head. The bolts and locking devices are exposed to the reactor coolant fluid within the pump but are not part of the reactor coolant system pressure boundary.

During the 1994 Seabrook refueling outage, all four RCPs were inspected to determine the origin of the loose parts. The bolt and one of the locking devices found in the vessel were traced to RCP "B," and the other locking device was from RCP "D." Various degrees of degradation were detected on some locking devices in all four RCPs. The licensee postulated that the bolt and the locking devices dropped into the turning vane diffuser as a result of degradation of the locking devices and the loss of the preload torque on the bolt. The bolt and locking devices were carried by the cold-leg flow stream into the reactor vessel lower head and to the lower core support plate. The licensee replaced the bolts and locking devices on all four RCPs with a new design.

The degradation of the locking device and the release of the bolt was evaluated by the licensee with assistance from W. The evaluation is documented in Licensee Event Report No. 94-010-01, dated January 16, 1995. The root cause of the release of the turning vane cap screw and locking cups was attributed to the original design not adequately considering the affects of flow-induced vibration on the locking cup and the turning vane cap screw. The licensee postulated that flow-induced vibration caused the locking cups to erode and release from the turning vane. The cap screw subsequently backed out as a result of the loss of the preload torque and the effects of vibration and gravity.

This information notice requires no specific action or written response. If you have any questions about the information in this notice, please contact the technical contact listed below or the appropriate Office of Nuclear Reactor Regulation (NRR) project manager.

Dennis M. Crutchfield, Director
 Division of Reactor Program Management
 Office of Nuclear Reactor Regulation

Technical contact: Francis Grubelich, NRR
 (301) 415-2784

Attachment:
 List of Recently Issued NRC Information Notices

DOCUMENT NAME: G:\NICK\INFON02.SEA *See previous concurrence

To receive a copy of this document, indicate in the box: "C" = Copy without attachment/enclosure "E" = Copy with attachment/enclosure "N" = No copy

OFFICE	PECB:DRPM	E	EMEB:DE	E	EMEB:DE	E	ADM:PUB	N	SC/PECB:DRPM	N
NAME	NFields*		FGrubelich*		KManoly*		Tech Editor*		EGoodwin*	
DATE	08/15/95		08/15/95		08/15/95		08/02/95		08/22/95	

OFFICE	C/EMEB:DE	E	DD/DE	E	D/DE	E	PECB:DRPM		C/PECB:DRPM	
NAME	RWessman*		GLainas*		BSheron*		RKiesel		AChaffee	ATB
DATE	08/22/95		08/23/95		08/23/95		9/12/95		/	/95

OFFICE	D/DRPM	
NAME	DCrutchfield	
DATE	/	/95

annulus formed by the outer diameter of the bolt head and the counterbore for the bolt head machined in the turning vane flange. The spring action of the locking device cylinder is designed to snap two bosses on the cylinder into mating holes in the counterbore. The anti-rotation function of the locking device is accomplished by staking the top edge of the cylinder at two locations into slots in the bolt head. The bolts and locking devices are exposed to the reactor coolant fluid within the pump but are not part of the reactor coolant system pressure boundary.

During the refueling outage, all four RCPs were inspected to determine the origin of the loose parts. The bolt and one of the locking devices found in the vessel were traced to RCP "B," and the other locking device was from RCP "D." Various degrees of degradation were detected on some locking devices in all four RCPs. The licensee postulated that the bolt and the locking devices dropped into the turning vane diffuser as a result of degradation of the locking devices and the loss of the preload torque on the bolt. The bolt and locking devices were carried by the cold-leg flow stream into the reactor vessel lower head and to the lower core support plate. The licensee replaced the bolts and locking devices on all four RCPs with a new design.

The degradation of the locking device and the release of the bolt was evaluated by the licensee with assistance from W. The evaluation is documented in Licensee Event Report No. 94-010-01, dated January 16, 1995. The root cause of the release of the turning vane cap screw and locking cups was attributed to the original design not adequately considering the affects of flow-induced vibration on the locking cup and the turning vane cap screw. The licensee postulated that flow-induced vibration caused the locking cups to erode and release from the turning vane. The cap screw subsequently backed out as a result of the loss of the preload torque and the effects of vibration and gravity.

This information notice requires no specific action or written response. If you have any questions about the information in this notice, please contact the technical contact listed below or the appropriate Office of Nuclear Reactor Regulation (NRR) project manager.

Dennis M. Crutchfield, Director
 Division of Reactor Program Management
 Office of Nuclear Reactor Regulation

Technical contact: Francis Grubelich, NRR
 (301) 415-2784

Attachment:
 List of Recently Issued NRC Information Notices

DOCUMENT NAME: G:\NICK\INFON02.SEA

To receive a copy of this document, indicate in the box: "C" = Copy without attachment/enclosure "E" = Copy with attachment/enclosure "N" = No copy

OFFICE	PECB:DRPM	<input checked="" type="checkbox"/>	EMEB:DE	<input type="checkbox"/>	EMEB:DE	<input type="checkbox"/>	ADM:PUB <i>NF 102</i>	SC/PECB:DRPM
NAME	NFields <i>NF</i>		FGrubelich <i>FG</i>		KManoly <i>KM</i>		Tech Editor	EGoodwin <i>EG</i>
DATE	8/15/95		8/15/95		8/15/95		8/2/95	8/23/95 <i>EG</i>
OFFICE	C/EMEB:DE		DO/DE		DO/DE		PECB:DRPM	C/PECB:DRPM
NAME	RWessman <i>RW</i>		GLinas		BSharon		RKiesel	ACHaffee
DATE	8/22/95		8/23/95		8/23/95		1/95	1/95
OFFICE	D/DRPM							
NAME	DCrutchfield							
DATE	1/95							

OFFICIAL RECORD COPY

#2-8/22