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July 1, 2010
MFN 10-192

Attn: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

**Subject: Part 21 Reportable Condition Notification:
Failure of HPCI Turbine Overspeed Reset Control Valve Diaphragm**

Reference 1 provided the GE Hitachi Nuclear Energy (GEH) Part 21 60-Day Interim Report Notification regarding the subject failure. GEH has completed the evaluation of the HPCI Turbine Overspeed Reset Control Valve Diaphragm failure, and has concluded that this is a reportable condition in accordance with the requirements of 10CFR 21.21(d).

Background

A diaphragm used in a 1" HPCI turbine stop valve / mechanical trip hold valve operator failed at a domestic BWR 4 in July 2009. The failure resulted in a HPCI turbine lube oil leak, which was the indication that the diaphragm had failed. The BWR 4 plant completed an Apparent Cause Evaluation and concluded that a material defect in the diaphragm allowed the diaphragm to tear after being installed for 2 years 8 months.

The diaphragm that failed was a Robertshaw (RS) part number 25471-A2, and was installed in a Robertshaw model VC-210 diaphragm control valve operator. The diaphragm was made from Buna-n rubber and was designed to have two layers of Dacron reinforcement fabric over all pressure bearing surface areas of the diaphragm. The diaphragms are manufactured by Chicago-Allis using a 2-plate compression mold process.

The diaphragms are purchased as commercial grade and are dedicated by GEH and supplied as safety related under GE part number Q25471-A2. The failed diaphragm was manufactured in 2006.

Discussion

Reinforcement fabric is considered a critical design requirement that is essential to ensure durability, reliability, and prevents tearing of the diaphragm material when these diaphragms are used in the HPCI turbine lube oil system as turbine trip and reset valves.

An inspection was performed on six diaphragms, three manufactured in 2006 and three manufactured in 2008. All six of these diaphragms were found to have areas without fabric

reinforcement. Inspection of the three samples from 2006 found non-uniform reinforcement. Inspection of the three samples from 2008 found all diaphragms were void of reinforcement in the sidewalls and inspection indicates that the reinforcement fabric was torn away from the inner sidewall during the manufacturing process. The inspections identified no diaphragms that were in full compliance with the design requirements for two layers of reinforcing fabric over all pressure bearing surfaces of the diaphragm.

GEH also performed a failure analysis on the failed diaphragm. This analysis confirmed that the primary cause of diaphragm failure was due to the non-existence of reinforcement fabric in the area that failed. An inspection was performed by an independent laboratory on the initial failed diaphragm manufactured in 2006 and a second diaphragm manufactured in 2008. The results of those inspections and analyses support GEH's findings.

Safety Analysis

The failure of the HPCI turbine over-speed reset control valve's diaphragm would result in a loss of HPCI turbine lube and control oil through the failed diaphragm. Depending on the amount of oil lost and the system demands, this loss could ultimately result in a failure of the HPCI System. Failure is not imminent, but cannot be precluded. Other safety related equipment is sufficient to mitigate design basis events in the event of a loss of HPCI.

Conclusion

Inspection of 6 diaphragms manufactured in 2006 and 2008, purchased from Robertshaw as part number 25471-A2, indicates that a manufacturing defect exists that results in only one single ply of reinforcement, and areas without any fabric reinforcement on the diaphragm sidewall. The missing reinforcement material in the sidewalls and the placement of only a single ply of reinforcement constitutes a deviation from design requirements and is associated with the manufacturing process of the diaphragms. Diaphragms with areas void of reinforcement fabric will result in the loss of diaphragm durability, ultimately resulting in decreased service life, and potential failure of diaphragms by tearing. The failure of the diaphragms to have two layers of reinforcing fabric is not considered a cause of failure but rather a finding that should be corrected.

Because of the similarity of the defects in all diaphragms inspected, it is credible to believe that this type of deviation from technical requirement also exists in other diaphragms manufactured by Chicago Allis and sold by GE as part number Q25471-A2 and 25471-A2Q, and as part of Control Valve Assembly DD233A3600P001. The identified defective diaphragms were present in two lots; one manufactured in 2006 and one in 2008. Based on the observations it is reasonable to believe that other diaphragms manufactured in 2006 and 2008 have similar deviations. GEH has been unable to determine if the identified manufacturing deviation exists in diaphragms manufactured prior to 2006. Since GEH is not able to rule out defects in diaphragms manufactured prior to 2006, it is credible to believe that similar deviations existed in diaphragms manufactured prior to 2006. In order to determine the possible extent of condition, all diaphragms in service or in stock at plants as spare parts inventory are suspect. Since the diaphragms have a designated service life of 5 years, and a shelf life of 10 years, the extent of condition is bounded by replacement of all diaphragms purchased by plants since 1995 (see attachment 2 (item vi)).

GEH has concluded that the described deviation from technical requirement was due to a manufacturing defect and that this same deviation from technical requirement is present in diaphragms manufactured in 2006 and 2008 and may extend to earlier manufactured

diaphragms. GEH has evaluated the consequences of the failure of this diaphragm and concluded that this type of failure could result in the HPCI system not performing its safety function. The HPCI system is considered an essential safety related system. Failure of the HPCI system is considered a major degradation of essential safety related equipment. Therefore this condition is determined to be a Substantial Safety Hazard and is a **Reportable** condition per 10CFR Part 21.

Recommended Action

The manufacturer has corrected the fabrication process to produce diaphragms that comply with existing design requirements. Diaphragms with properly installed fabric are resistant to flaw propagation, which led to the failure that was observed.

GEH is not able to determine the exact date when this deviation from technical requirements was introduced into the manufacturing process, and therefore recommends each site listed on Attachment 1 replace existing diaphragms with new diaphragms. Since failure is not imminent and diaphragm failures would likely be discovered during normal HPCI surveillances, absent other indications, it is sufficient to replace the non-conforming diaphragms at the next normally scheduled system maintenance outage. All replacement diaphragms should be manufactured in June 2010, or later.

Additional information as required by §21.21(d)(4) is provided in Attachment 2.

If you have any questions, please call me at (910) 819-4491.

Sincerely,



Dale E. Porter
Safety Evaluation Program Manager
GE-Hitachi Nuclear Energy Americas LLC

References

1. Letter from D.E. Porter (GEH) to Document Control Desk (US NRC), **Subject: Part 21 60-Day Interim Report Notification: Failure of HPCI Turbine Overspeed Reset Control Valve Diaphragm**, MFN 10-123, March 22, 2010

Attachments:

1. US Plants With Affected Diaphragms
2. Reportable Condition Notification Information per §21.21(d)(4)

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cc: S. S. Philpott, USNRC
S. J. Pannier, USNRC
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PRC 10-10 File
eDRF 0000-0119-7286

Attachment 1
US Plants With Affected Diaphragms

	<u>Utility</u>	<u>Plant</u>
<u>X</u>	Detroit Edison Co.	Fermi 2
<u>X</u>	Exelon Generation Co.	Limerick
<u>X</u>	Exelon Generation Co.	Peach Bottom
<u>X</u>	FPL Energy	Duane Arnold
<u>X</u>	Nebraska Public Power District	Cooper
<u>X</u>	PPL Susquehanna LLC.	Susquehanna
<u>X</u>	Progress Energy	Brunswick
<u>X</u>	Southern Nuclear Operating Co.	Hatch
<u>X</u>	Tennessee Valley Authority	Browns Ferry

Attachment 2**Reportable Condition Notification Information per §21.21(d)(4)**

- (i) Name and address of the individual or individuals informing the Commission:

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- (ii) Identification of the facility, the activity, or the basic component supplied for such facility or such activity within the United States which fails to comply or contains a defect:

The basic component that failed is a High Pressure Coolant Injection (HPCI) turbine overspeed reset control valve diaphragm, GE Hitachi Nuclear Energy Part Number Q25471-A2 and 25471-A2Q. These diaphragms are installed in Robertshaw model VC-210 control valves identified as part number DD233A3600P001.

- (iii) Identification of the firm constructing the facility or supplying the basic component which fails to comply or contains a defect:

The diaphragms are manufactured by Chicago-Allis as commercial grade. They are dedicated and sold as safety-related by GE Hitachi Nuclear Energy.

- (iv) Nature of the defect or failure to comply and the safety hazard which is created or could be created by such a defect or failure to comply:

A HPCI overspeed turbine reset control valve diaphragm Q25471-A2, failed in service at a nuclear power plant. It failed in an area adjacent to the outer edge of the diaphragm at the preformed radius. The failure was a tear or rupture in the diaphragm sidewall that caused a loss of turbine hydraulic oil. The cause of the failure is attributed to a lack of reinforcing fabric on the sidewall of the diaphragm. This diaphragm failure and resultant loss of turbine hydraulic oil could result in a failure of the HPCI System. HPCI failure is not imminent, but cannot be precluded. Loss of HPCI is a degradation of essential safety-related equipment and is reportable under 10CFR21. Other safety related equipment is sufficient to mitigate design basis events in the event of a loss of HPCI.

- (v) The date on which the information of such defect or failure to comply was obtained:

A Potential Reportable Condition evaluation was initiated by GEH in accordance with 10CFR Part 21 and GEH procedures on January 22, 2010. A Part 21 60-Day Interim Report Notification, MFN 10-123 was issued to the NRC on March 22, 2010. The Interim Report Notification made a commitment to complete the evaluation by July 23, 2010.

- (vi) In the case of a basic component which contains a defect or failure to comply, the number and the locations of these components in use at, supplied for, being supplied for, or may be supplied for, manufactured, or being manufactured for one or more facilities or activities subject to the regulations in this part:

GEH has confirmed that diaphragms fabricated by Chicago-Allis in 2006 and 2008 are missing the sidewall fabric and are subject to this potential failure. However GEH is not able to identify the initial date this defect was introduced into the manufacturing process. Since this diaphragm has a service life of 5 years and a shelf life of 10 years, considering diaphragms manufactured by Chicago-Allis since 1995 bounds the concern. Though it is a potential problem for the sites listed below, GEH is only aware of one instance of diaphragm failure that caused a significant loss of turbine lubricating oil.

Plant	Part number	Part Description	Date Shipped
Limerick	DD233A3600P001	Control Valves	12/10/2008 2/10/2003 7/2/1999 8/14/1998
Duane Arnold	DD233A3600P001	Control Valve	10/4/2007
Peach Bottom	DD233A3600P001	Control Valves	9/27/2007 10/4/2002 4/11/1996 9/25/1995
Cooper	DD233A3600P001	Control Valve	9/9/2003
Susquehanna	DD233A3600P001	Control Valves	5/2/2001 10/31/2000 4/19/1996
Fermi	DD233A3600P001	Control Valves	9/25/1995
Duane Arnold	Q25471-A2	Diaphragms	7/10/2009 7/5/2007
Brunswick	Q25471-A2	Diaphragm	3/20/2009
Susquehanna	Q25471-A2	Diaphragm	1/26/2009
Browns Ferry	Q25471-A2	Diaphragm	10/5/2006
Cooper	Q25471-A2	Diaphragm	5/15/2006
Hatch	25471-A2Q	Diaphragm	11/5/2004
Cooper	25471-A2Q	Diaphragms	11/5/2004 11/9/2001 2/24/1999 7/2/1997
Duane Arnold	25471-A2Q	Diaphragm	8/28/2003
Susquehanna	25471-A2Q	Diaphragm	8/4/1998
Browns Ferry	25471-A2Q	Diaphragm	6/8/1998

- (vii) The corrective action which has been, is being, or will be taken; the name of the individual or organization responsible for the action; and the length of time that has been or will be taken to complete the action:

GEH worked with Robertshaw and Chicago-Allis to evaluate the diaphragm failure. The cause was determined to be an initiating anomaly in the sidewall that propagated as a result of a lack of sidewall reinforcing fabric. The manufacturing process has been improved to be in compliance with the diaphragm specification to include fabric on the sidewalls. Both the manufacturer and GEH have increased the

- level of QA inspections and a supply of compliant diaphragms has been manufactured and is now available.
- (viii) Any advice related to the defect or failure to comply about the facility, activity, or basic component that has been, is being, or will be given to purchasers or licensees:
- Use of diaphragms with areas void of reinforcement fabric will not necessarily result in a diaphragm failure, but will result in the loss of diaphragm durability, potentially resulting in a decreased service life, and potential failure of the diaphragm by tearing. Prior to 1981 diaphragms were designed and supplied without reinforcing fabric. Reinforcing fabric was added as a design enhancement in 1981 to increase service life.
- GEH is not able to determine the exact date when this defect was introduced into the manufacturing process, and therefore recommends each site replace existing diaphragms with new diaphragms at the next normally scheduled system maintenance outage. All replacement diaphragms should be manufactured in June 2010, or later.
- (ix) In the case of an early site permit, the entities to whom an early site permit was transferred.
- There are no early site permit concerns.