



**HITACHI**

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February 15, 2011  
MFN 11-023

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

**Subject: Part 21 Reportable Condition Notification:  
Design Life of D and S Lattice Marathon Control Blades**

GE Hitachi Nuclear Energy (GEH) has completed its evaluation of the cracking of Marathon Control Rod Blades (CRB) at an international BWR/6. This issue was initially reported on October 20, 2010 as GEH letter MFN 10-327 (Reference 1). Additional information was provided on December 1, 2010 as GEH letter MFN 10-351 (Reference 2).

GEH has determined that the design life, of D and S lattice Marathon Control Blades may be less than previously stated. The design life if not revised, could result in significant control blade cracking and could, if not corrected, create a Substantial Safety Hazard and is considered a reportable condition under 10CFR Part 21.21(d). Marathon C lattice Control Blades are not affected by this condition. The information contained in this document informs the NRC of the conclusions and recommendations derived from GEH's investigation of this issue.

Please contact me if there are any questions on this information.

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 Dale E. Porter (GEH) to Document Control Desk (US NRC), Subject: Part 21 60-Day Interim Report Notification: Crack Indications in Marathon Control Rod Blades, October 20, 2010, MFN 10-327.
2. Letter from Dale E. Porter (GEH) to Document Control Desk (US NRC), Subject: Update to MFN 10-327: Crack Indications in Marathon Control Rod Blades, December 1, 2010, MFN 10-351.

Attachments:

1. GEH Evaluation
2. Notification Information Required by 21.21(d)(4)
3. US Plants Potentially Affected

cc: S. S. Philpott, USNRC  
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PRC File  
DRF Section No. 0000-0129-4275

## **Attachment 1 – Description of Evaluation**

### **Background**

GE Hitachi Nuclear Energy (GEH) manufactures Marathon Control Rod Blades (CRB) for D lattice, BWR/2-4 plants, S lattice, BWR/6 plants, and C lattice, BWR/4-5 plants, as well as for other reactor vendor plants with similar configurations. GEH maintains a continuous surveillance program to monitor Marathon CRB performance in the BWR fleet as required by the NRC Safety Evaluation NEDE-31758P-A. This surveillance program primarily consists of visual inspections of highly irradiated near “End-of-Life” Marathon CRBs. The most recent update report for the Marathon surveillance program was issued to the BWR fleet in May 2010 (Report # 0000-0071-8269-R2). Since that update was issued GEH has completed the planned visual inspection of four discharged CRBs at an international BWR/6, identified as “Plant O” in the surveillance report. The visual inspection of these assemblies has revealed cracks on all four CRBs. Some of the cracks were larger than those previously observed and reported in the surveillance report. The cracks were more numerous and occur at locations of lower reported local B<sup>10</sup> depletion than previously documented.

### **Investigation**

The investigation into the cause of CRB tube cracking has been completed. The investigation has identified an additional cause for concern associated with cracking of high depletion Marathon Control Rod Blades used in D and S lattice type BWR plants.

A rapid thermal transient, with cold-water injection resulting from actuation of the Automatic Depressurization System specific to Plant “O” has been determined to be a significant contributor to the extent of cracking seen on the Marathon Control Blades. The extent of cracking seen on Marathon CRBs at Plant “O” has been determined to not represent a condition anticipated to occur at other plants with Marathon CRBs unless a similar or more severe thermal transient should occur. The cause of cracking of CRB tubes is Irradiation Assisted Stress Corrosion Cracking (IASCC). The IASCC results from susceptible material from irradiation, aggressive environment from oxidizing BWR water and excessive tensile stress caused from B<sub>4</sub>C swelling.

As a result of this investigation GEH recommends a Marathon lifetime reduction as follows. The recommended Marathon CRB lifetime reduction imposes a 60% local B<sup>10</sup> depletion limit, or 54% for D lattice ¼ segment and 55% for S lattice ¼ segment lifetime limit.

Some D & S lattice Marathon CRBs manufactured after 2006 have an improved square geometry and their lifetime is greater than stated above. Lifetimes of these specific blades will be updated and maintained in GEH Marathon CRB lifetime document. GEH will update and maintain the GEH BWR Control Rod Lifetime document NEDE-30931-12-P, Table 3-3 with revised “End-of-Life” ¼ Segment and 4 Segment Average B<sup>10</sup> depletions for all applicable control blades.

These revised lifetime depletion limits are higher than those previously communicated that were bounding values for planning purposes. The values stated above are based on the final evaluation of all technical data.

The new lifetime limits will substantially reduce the likelihood of CRB operation with excessive cracking and will assure the CRBs will perform their required safety functions.

#### **ABWR and ESBWR Design Certification Documentation Applicability**

The issues described above have been reviewed for applicability to documentation associated with 10CFR 52 and it has been determined that there is no affect on the technical information contained in either the ABWR certified design or the ESBWR design in certification.

**Attachment 2****(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 contains a defect is Marathon Control Rod Blades for D and S lattice plants. The following part numbers identify these CRBs:

<b>PLANT TYPE</b>	<b>PROJECT/PLANT</b>	<b>QTY</b>	<b>SHIP YEAR</b>	<b>Part Number#</b>
S	CLINTON	13	2002	107E1425G001
S	CLINTON	4	2002	107E1425G001
S	CLINTON	12	2004	107E1425G001
S	CLINTON	12	2005	107E1425G001
S	CLINTON	4	2007	105E3995G001
S	GRAND GULF	8	2007	105E3995G001
S	GRAND GULF	12	2008	105E3995G001
S	GRAND GULF	11	2010	105E3995G001
S	PERRY	4	1992	107E6101G001
S	PERRY	9	1993	107E6121G001
S	PERRY	5	1999	107E1425G001
S	PERRY	6	2001	107E1425G001
S	PERRY	25	2003	107E1425G001
S	PERRY	10	2005	107E1425G001
S	PERRY	10	2005	107E1425G001
S	PERRY	10	2006	107E1425G001
S	PERRY	15	2008	105E3995G001
S	RIVER BEND	9	2001	107E1425G001
S	RIVER BEND	2	2004	107E1425G001
S	RIVER BEND	9	2007	105E3995G001
S	RIVER BEND	5	2007	105E3995G001
S	RIVERBEND	9	2009	105E3995G001

<b>PLANT TYPE</b>	<b>PROJECT/PLANT</b>	<b>QTY</b>	<b>SHIP YEAR</b>	<b>Part Number#</b>
S	RIVERBEND	11	2010	105E3995G001
D	BROWNS FERRY	27	2002	107E1421G001
D	BROWNS FERRY	5	2002	107E1421G001
D	BROWNS FERRY	8	1998	107E1421G001
D	BROWNS FERRY	9	1998	107E1421G001
D	BROWNS FERRY	29	1999	107E1421G001
D	BROWNS FERRY	8	1998	107E1421G001
D	COOPER	25	1991	103E1697G007
D	COOPER	12	1995	107E6120G002
D	COOPER	6	2003	107E1421G001
D	COOPER	6	2004	107E1421G001
D	COOPER	4	2006	105E3991G001
D	COOPER	6	2008	105E3991G001
D	COOPER	12	2009	105E3991G001
D	COOPER	18	2009	105E3991G001
D	DRESDEN	4	2001	107E1421G001
D	DRESDEN	18	2002	107E1421G001
D	DRESDEN	18	2003	107E1421G001
D	DRESDEN	10	2004	107E1421G001
D	DRESDEN	1	2005	107E1421G001
D	DRESDEN	9	2007	107E1421G001
D	DRESDEN	10	2010	105E3991G003
D	DRESDEN	9	2009	105E3991G003
D	DUANE ARNOLD	10	2005	107E1421G001
D	DUANE ARNOLD	1	2009	105E3991G003
D	FITZPATRICK	4	1991	103E1697G008
D	FITZPATRICK	15	1996	107E6120G006
D	FITZPATRICK	14	1998	107E1421G002
D	FITZPATRICK	8	2008	105E3991G003
D	FITZPATRICK	8	2010	105E3991G003
D	FITZPATRICK	5	2000	107E1421G002
D	FITZPATRICK	6	2002	107E1421G002
D	FITZPATRICK	4	2002	107E1421G002
D	FITZPATRICK	8	2004	107E1421G002
D	HATCH	5	2004	107E1421G004
D	MONTICELLO	8	2003	107E1421G003
D	MONTICELLO	12	2005	107E1421G003

<b>PLANT TYPE</b>	<b>PROJECT/PLANT</b>	<b>QTY</b>	<b>SHIP YEAR</b>	<b>Part Number#</b>
D	MONTICELLO	16	2006	105E3991G002
D	MONTICELLO	12	2009	105E3991G002
D	OYSTER CREEK	1	1988	103E1076G009
D	OYSTER CREEK	4	1990	103E1076G010
D	OYSTER CREEK	12	1994	107E6120G004
D	OYSTER CREEK	1	2000	107E1421G001
D	OYSTER CREEK	12	2004	107E1421G001
D	OYSTER CREEK	10	2006	107E1421G001
D	OYSTER CREEK	2	2006	107E1421G001
D	PEACH BOTTOM	13	2000	107E1421G001
D	PEACH BOTTOM	9	2001	107E1421G001
D	PEACH BOTTOM	7	2002	107E1421G001
D	PEACH BOTTOM	11	2003	107E1421G001
D	PEACH BOTTOM	9	2004	107E1421G001
D	PEACH BOTTOM	4	2005	107E1421G001
D	PEACH BOTTOM	2	2007	107E1421G001
D	PEACH BOTTOM	4	1992	107E6035G002
D	PEACH BOTTOM	18	1998	107E1421G001
D	PEACH BOTTOM	24	1999	107E1421G001
D	PEACH BOTTOM	2	2008	105E3991G003
D	PEACH BOTTOM	2	2010	105E3991G003
D	PEACH BOTTOM	5	1995	107E6120G002
D	PEACH BOTTOM	12	1997	107E1421G001
D	PILGRIM	3	2003	107E1421G003
D	PILGRIM	10	2004	107E1421G003
D	PILGRIM	8	2009	105E3991G002
D	QUAD CITIES	2	2000	107E1421G001
D	QUAD CITIES	8	2002	107E1421G001
D	QUAD CITIES	10	2002	107E1421G001
D	QUAD CITIES	18	2004	107E1421G001
D	QUAD CITIES	13	2005	107E1421G001
D	QUAD CITIES	1	2006	107E1421G001
D	QUAD CITIES	4	2007	105E3991G003
D	QUAD CITIES	13	2007	105E3991G003
D	QUAD CITIES	14	2007	107E1421G001
D	QUAD CITIES	7	2009	105E3991G003
D	QUAD CITIES	10	2010	105E3991G003

PLANT TYPE	PROJECT/PLANT	QTY	SHIP YEAR	Part Number#
D	VERMONT YANKEE	8	1990	103E1076G012
D	VERMONT YANKEE	4	1991	103E1697G007
D	VERMONT YANKEE	4	1993	107E6120G002
D	VERMONT YANKEE	6	1994	107E6120G002
D	VERMONT YANKEE	4	1996	107E6120G002
D	VERMONT YANKEE	4	1997	107E1421G001
D	VERMONT YANKEE	1	1999	107E1421G001
D	VERMONT YANKEE	4	2001	107E1421G001
D	VERMONT YANKEE	8	2004	107E1421G002
D	VERMONT YANKEE	4	2008	105E3991G003

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

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

GE Hitachi Nuclear Energy Marathon Control Rod Blades have the potential to develop significant cracks on the absorber tubes that contain boron carbide capsules. Significant cracking of the absorber tubes could result in loss of boron carbide that could affect Control Blade Reactivity Worth Requirements.

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

A Potential Reportable Condition Evaluation, in accordance with 10CFR Part 21, was initiated on August 24, 2010. A 60-day interim notification was issued on October 20, 2010 to extend the evaluation period.



- (vi) In the case of a basic component which contains a defect or fails to comply, the number and location 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.**

The population for Marathon Control Rod Blade with the potential for cracking includes all Marathon Control Rods Blades installed in BWR/2-4, D lattice plants and BWR/6, S lattice plants. Marathon C lattice Control Blades are not affected. A list of all US plants that have been supplied these Marathon Control Rod Blades is provided in Attachment 3 of this document. A list of all part numbers and quantities sold is listed in the table in question ii.

- (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 is reducing the "End-of-Life" depletion limits of its Marathon CRBs used in D and S lattice plants. The current 100% local  $B^{10}$  depletion limit is reduced to a 60% local  $B^{10}$  depletion limit, or 54% D lattice  $\frac{1}{4}$  segment and 55% S lattice  $\frac{1}{4}$  segment lifetime limit.

Some D & S lattice Marathon CRBs manufactured after 2006 have an improved square geometry and their lifetime is greater than stated above. Lifetimes of these specific blades will be updated and maintained in the GEH BWR Control Rod Lifetime document, NEDE-30931-12-P. GEH will update and maintain Table 3-3 of the lifetime document with revised "End-of-Life" Quarter Segment and 4 Segment Average  $B^{10}$  Depletions for all applicable control blades.

- (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.**

For all plants containing D and S lattice Marathon Control Blades, remove Marathon CRBs from service prior to exceeding the revised lifetime limits.

If any Marathon CRB is in service and exceeds the new recommended lifetime limit, continue operating those blades while monitoring reactor coolant boron and tritium per normal plant procedures. If no significant increase in boron and/or tritium is observed, continue operation until the end of the cycle. If a significant increase in reactor coolant boron and/or tritium is detected, contact GEH. Continued monitoring for reactor coolant boron and/or tritium concentrations is recommended to detect cracking of any design CRB.

Continue to support the GEH Marathon CRB surveillance program as directed by NEDE-31758P-A.

- (ix) In the case of an early site permit, the entities to whom an early site permit was transferred.**

This is not an early site permit concern.

**Attachment 3 – US Plants Potentially Affected**

<b>D &amp; S Lattice Plants</b>	<b>C Lattice Plants</b>	<b>Utility</b>	<b>Plant</b>
<u>X</u>	___	Constellation Nuclear	Nine Mile Point 1
___	<u>X</u>	Constellation Nuclear.	Nine Mile Point 2
___	<u>X</u>	Detroit Edison Co.	Fermi 2
<u>X</u>	___	Dominion Generation	Millstone 1
___	<u>X</u>	Energy Northwest	Columbia
<u>X</u>	___	Entergy Nuclear Northeast	FitzPatrick
<u>X</u>	___	Entergy Nuclear Northeast	Pilgrim
<u>X</u>	___	Entergy Nuclear Northeast	Vermont Yankee
<u>X</u>	___	Entergy Operations, Inc.	Grand Gulf
<u>X</u>	___	Entergy Operations, Inc.	River Bend
<u>X</u>	___	Exelon Generation Co.	Clinton
<u>X</u>	___	Exelon Generation Co.	Oyster Creek
<u>X</u>	___	Exelon Generation Co.	Dresden 2 & 3
___	<u>X</u>	Exelon Generation Co.	LaSalle 1 & 2
___	<u>X</u>	Exelon Generation Co.	Limerick 1 & 2
<u>X</u>	___	Exelon Generation Co.	Peach Bottom 2 & 3
<u>X</u>	___	Exelon Generation Co.	Quad Cities 1 & 2
<u>X</u>	___	FirstEnergy Nuclear Operating Co.	Perry 1
<u>X</u>	___	FPL Energy	Duane Arnold
<u>X</u>	___	Nebraska Public Power District	Cooper
<u>X</u>	___	Xcel Energy	Monticello
___	<u>X</u>	PPL Susquehanna LLC.	Susquehanna 1 & 2
<u>X</u>	___	Progress Energy	Brunswick 1 & 2
<u>X</u>	___	Southern Nuclear Operating Co.	Hatch 1 & 2
<u>X</u>	___	Tennessee Valley Authority	Browns Ferry 1 - 3