ENCLOSURE 2

MFN 09-266

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GEH Marathon Control Rod Lifetime Surveillance Update

Non-Proprietary Version

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GE Hitachi Nuclear Energy

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GEH Marathon Control Rod Lifetime Surveillance Update

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1. INTRODUCTION

Since the beginning of the Marathon control rod product line, GEH has actively maintained a surveillance program consisting of visual inspections of Marathon control rods. This is in accordance with the approved Safety Evaluation Report (SER) for the Marathon control rod (Ref. 1). A summary of the status of this surveillance program was last forwarded to NRC and to the BWR fleet via MFN 08-355 (Ref. 5). This report updates Reference 5, including:

- New inspection results
- A listing of planned inspections
- A summary of the recently completed Marathon Post-Irradiation Examination (PIE)
- A discussion of a design change to the original D/S lattice Marathon absorber tube design.
- A summary of root cause analyses and 10CFR Part 21 analyses relating to the observance of crack indications.
- A discussion of new control rod designs.

GEH will continue to provide updates of the Marathon control rod surveillance program on an annual basis, at minimum.

2. INSPECTION DATA

Tables 1 and 2 contain a summary of [[ ]] visual inspections of Marathon control rods that GEH has performed or reviewed to date. Since MFN 08-355 (Ref. 5), four additional inspections of high depletion, D/S lattice Marathon control rods have been performed, with no crack indications noted. These added inspections are noted in bold in Table 1. In addition, five visual inspections of C lattice Marathon control rods have been performed, also with no crack indications found, identified in bold in Table 2.

Control rods that have reached end of life, or near end of life are identified in Tables 1 and 2. For the purposes of this report, control rods are considered to be at 'end of life' if the peak local depletion exceeds 90% of the peak local depletion for a Marathon control rod at its lifetime limit in a GEH BWR (Reference 7). Similarly, control rods are considered to be 'near end of life' if the peak local depletion exceeds 80% of the peak local depletion for a Marathon control rod at its lifetime limit in a GEH BWR.

Table 1: D/S Lattice Marathon Inspection Results

Plant	Square Tube Type*	Inspection Date	Approx. Fluence (snvts)	Peak Local Depletion (%)	Results
Plant A (US BWR/4)	D/S	[[			
Plant D (International BWR)	D/S				
					]]

Table 1: D/S Lattice Marathon Inspection Results (Continued)

Plant	Square Tube Type*	Inspection Date	Approx. Fluence (snvts)	Peak Local Depletion (%)	Results
Plant E (US BWR/2)	D/S	[[			
Plant J (International BWR)	D/S				
Plant K (International BWR)	D/S				
Plant L (US BWR/6)	D/S				
Plant M (US BWR/4)	D/S				
Plant P (International BWR)	D/S				
					]]

* "D/S" square tubes are used for GEH D lattice (BWR/2-4) and S lattice (BWR/6) applications.

*** Part of etch-indication population. See Safety Communication SC07-02 (Reference 6).

Table 2: C Lattice Marathon Inspection Results

Plant	Square Tube Type*	Inspection Date	Approx. Fluence (snvts)	Peak Local Depletion (%)	Results
Plant B (International BWR)	C	[[			
Plant C (International BWR)	C				
Plant F (US BWR/4)	C				
Plant G (International BWR/4)	C				
					]]

* "C" square tubes are used for GEH C lattice (BWR/4,5) applications.

** [[ ]]

*** Part of etch-indication population. See Safety Communication SC07-02 (Reference 6).

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Taken together, the inspection data does not suggest a generic design issue with the Marathon control rod.

From paragraph C on page xxiv of the Marathon control rod SER (Ref. 1), GEH is responsible for the following action if a material integrity problem should arise:

"(1) arrangements will be made to inspect additional Marathon control rods to the extent necessary to identify the root cause"

Accordingly, GEH has completed, or is taking, the following actions.

- [[

  ]]

- GEH is pursuing additional inspections of high depletion Marathon control rods. A listing of planned control rod inspections is contained in Section 3.

In paragraph C on page xxiv of the Marathon control rod SER (Ref. 1), GEH is also responsible for the following action if a material integrity problem should arise:

"(2) if appropriate, GE shall recommend a revised lifetime limit to the NRC based on the inspections and other applicable information available."

The available inspection data does not suggest a generic design or material issue with the Marathon control rod, which would require a reduced lifetime recommendation. Therefore, GEH has not recommended a revised lifetime for Marathon control rods. As noted, GEH is actively pursuing additional visual inspections of high-depletion Marathon control rods, as discussed in Section 3.

3. PLANNED INSPECTIONS

In accordance with the Marathon SER (Ref. 1), GEH is continuing to pursue visual inspections of high depletion Marathon control rods. Table 3 shows a listing of planned inspections.

Table 3: Planned Marathon Control Rod Inspections

Plant	Square Tube Type*	Control Rod Type	Planned Inspection Date	Number of CRBs to be Inspected	Approx. Fluence (snvts)	Peak Local Depletion (%)
Plant F (US BWR/4)	C	Marathon***	Spring 2010	[[		
Plant O (International BWR/6)	D/S	Marathon	2010			
Plant N (International BWR)	D/S	Marathon-5S	Summer 2011			
Plant M (US BWR)	D/S	Marathon-5S	Fall 2011			]]

* "D/S" square tubes are used for GE D lattice (BWR/2-4) and S lattice (BWR/6) applications. "C" square tubes are used for GE C lattice (BWR/4,5) applications.

*** Part of etch-indication population. See Safety Communication SC07-02 (Reference 6).

Notes for Table 3:

- Plant F has agreed to inspect 2 Marathon control rods during or after their Spring 2010 refueling outage.
- Plant O is discharging four end-of-life Marathon control rods in 2010. GEH has requested an opportunity to perform visual inspections.
- Plants M and N will inspect Marathon-5S control rods in 2011 as the lead assemblies for this type.

4. POST-IRRADIATION EXAMINATION (PIE)

GEH recently completed a destructive examination of one of the Plant A Marathon control rods that showed crack indications (Table 1). The full report of this examination is Reference 8. The major findings of the examination are:

- [[
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The conclusions from the PIE are:

- The root cause of the crack is [[ ]]
- Contributing factors are:
  - [[
  -
]]

5. ROOT CAUSE ANALYSES

Root cause analyses were performed following the discovery of crack indications at Plant A, and at Plant E, and as part of the completed Post-Irradiation Examination. Relevant observations of these root cause analyses are summarized as follows.

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The conclusion of all of the root causes analyses is that the available data does not suggest a generic design flaw.

6. 10CFR PART 21 EVALUATIONS

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7. MARATHON SQUARE ABSORBER TUBE DESIGN MODIFICATION

Figure 1 shows a design modification that has been made to the geometry of the Marathon 'square' absorber tube. [[

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[[

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Figure 1: D/S Lattice Square Absorber Tube Geometry Modification

Finite element analysis is used to demonstrate that the new geometry meets all design requirements for maximum outer diameter strain due to capsule swelling, internal pressure, and maximum stress from loads imposed by channel bow. The new geometry is demonstrated to meet stuck rod requirements, and all control rod welds affected by the new absorber tube geometry are demonstrated to withstand loads from scram, seismic events and channel bow.

The new D/S lattice square tube geometry began implementation in 2006. All 2008 and future deliveries will use the new square absorber tube geometry. No changes have been made to the C lattice square tube design.

8. NEW DESIGNS

GEH is currently pursuing approval of two new Marathon control rod designs: one is the original equipment for ESBWR (Ref. 2,3), the other is a new replacement control rod design for BWR/2-6, called the Marathon-5S (Ref. 4). Licensing topical reports for these two new designs have been submitted for review with the NRC (Ref. 2,3,4). In addition, GEH is completing the Marathon-7S design, which is a longer-life control rod, using the simplified Marathon-5S outer absorber tube.

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Table 4: Marathon Capsule to Absorber Tube Gap Comparison

Marathon Design	Licensing Topical Report(s)	Local Depletion at Capsule Contact with Absorber Tube Inside Diameter (Nominal)
Marathon – D/S Lattice	NEDE-31758P-A (Ref. 1)	[[
Marathon – C Lattice	NEDE-31758P-A (Ref. 1)	
ESBWR Marathon	NEDE-33243P Rev. 1 (Ref. 2) NEDE-33244P Rev. 1 (Ref. 3)	
Marathon-5S – D/S Lattice	NEDE-33284P Rev. 1 (Ref. 4)	
Marathon-5S – C Lattice	NEDE-33284P Rev. 1 (Ref. 4)	
Marathon-7S – D/S Lattice	Pending	
Marathon-7S – C Lattice	Pending	]]

*Nominal depletion at contact based on original square absorber tube geometry. Nominal depletion at contact for the modified D/S lattice square tube geometry is [[ ]].

The ESBWR Marathon and Marathon-5S control rods use the same capsule cross-sectional geometry and outer absorber tube inside diameter. As discussed in Section 3.6 of Reference 3 and Section 3.6 of Reference 4, both control rods are designed such that **[[**

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9. REFERENCES

1. NEDE-31758P-A, "GE Marathon Control Rod Assembly", October 1991.
2. NEDE-33243P Rev. 2, "Licensing Topical Report: ESBWR Marathon Control Rod – Nuclear Design Report", July 2008.
3. NEDE-33244P Rev. 1, "Licensing Topical Report: ESBWR Marathon Control Rod – Mechanical Design Report", November 2007.
4. NEDE-33284P, Rev. 1 "Licensing Topical Report: Marathon-5S Control Rod Assembly", November 2007.
5. MFN 08-355, "Marathon Control Rod Surveillance Program Status", April 2008.
6. Safety Communication SC07-02, "Update: Etch Indications on Marathon Control Rod Blade Absorber Tubes", January 2007.
7. NEDE-30931-11-P, GE BWR Control Rod Lifetime", March 2009.
8. GENE-0000-0095-4020-R1, "Marathon Control Rod Post-Irradiation Examination (PIE)", April 2009.