

December 22, 2008

ORGANIZATION: GE-Hitachi Nuclear Energy (GEH)
PROJECT: Economic Simplified Boiling Water Reactor (ESBWR) Design Certification
SUBJECT: AUDIT REPORT AND SUMMARY (2007 & 2008) FOR GLOBAL
NUCLEAR FUELS CONTROL BLADE AND FUEL ASSEMBLY DESIGN

From July 30 to August 2, 2007, the U.S. Nuclear Regulatory Commission (NRC) conducted a Global Nuclear Fuels (GNF) control blade and fuel assembly design audit at GEH's headquarters in Wilmington, NC. A follow-up audit was performed at GEH's headquarters on August 6 and 7, 2008, to review the latest version of ESBWR control rod topical reports NEDE-33243P Rev 1, "ESBWR Control Rod Nuclear Design" and NEDE-33244P Rev 1, "ESBWR Control Rod Mechanical Design Report." The purpose of both visits was to resolve remaining open items necessary to finalize the Safety Evaluation Report (SER) for the ESBWR DCD Section 4.2 and applicable topical reports. This memo provides a list of attendees in Table 1 and a summary of ESBWR related topics and open items briefed during the audit exit in the enclosure.

We will delay placing this document in the public document room for a period of ten (10) working days from the date of this letter to provide you with the opportunity to review for proprietary aspects only. If you believe that any information in the enclosure is proprietary, please identify such information line by line and define the basis pursuant to the criteria of 10 CFR 2.390 before the public release date.

During continuing review of the ESBWR design certification, staff will be considering information gained during these audits and will communicate any additional issues or requests for information with the applicant on the ESBWR docket.

/RA/

Bruce M. Bovol, Project Manager
ESBWR/NGE1 Projects Branch 1
Division of New Reactor Licensing
Office of New Reactors

/RA/

Chris N. Van Wert, Engineer
SRSB
Division of Safety Systems and Risk Assessment
Office of New Reactors

Docket No. 52-010

Enclosures:
As stated

cc w/encls: See next page

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Bruce M. Baval, Project Manager
ESBWR/NGE1 Projects Branch 1
Division of New Reactor Licensing
Office of New Reactors

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SRSB
Division of Safety Systems and Risk Assessment
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ADAMS ACCESSION NO. ML083230072

OFFICE	PM:NGE1	PM:NGE1	BC:SNPB	BC:SRSB	BC:NEG1
NAME	BBaval	ACubbage	AMendiola	JMcKirgan	JCruz
DATE	11/17/08	12/04/08	12/15/08	12/05/08	12/22/08

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SUBJECT: AUDIT REPORT AND SUMMARY (2007 & 2008) FOR GLOBAL NUCLEAR
 FUELS CONTROL BLADE AND FUEL ASSEMBLY DESIGN DATED
 DECEMBER 22, 2008

Hard Copy

NGE1 R/F
BBavol
ACubbage
JCruz

E-Mail

AMendiola
PClifford
JDonoghue
JMcKirgan
GThomas
ACubbage
CVanWert

INTRODUCTION

In support of the DCD Section 4.2 submittal for ESBWR, GEH submitted the following topical reports:

- NEDC-33240, "GE14E Fuel Assembly Mechanical Design Report", January 2006
- NEDC-33242, Rev. 1, "GE14 for ESBWR Fuel Rod Thermal-Mechanical Design Report" March 2007
- NEDE-33243, "ESBWR Control Rod Nuclear Design", May 2006
- NEDE-33244, "ESBWR Control Rod Mechanical Design", June 2006

After initial review of these topical reports and initial requests for additional information, an audit was held July 30 through August 3, 2007 in Wilmington, NC to review the supporting documentation and to resolve remaining open items. During this audit, several RAIs were closed but it was discovered that the latest design of the control blade differed from the design as submitted in the respective topical reports. GEH proposed that they submit a revision to the ESBWR Marathon topical reports that would include the latest design and address the issues which were discussed. As such, additional RAIs for NEDE-33243 Revision 0 and NEDE-33244 Revision 0 were issued.

GEH submitted NEDE-33243 Revision 1 in October 2007 and NEDE-33244 Revision 1 in November 2007. NRC staff, supported by Pacific Northwest National Laboratory (PNNL) staff, conducted a follow-up audit to review the new supporting calculations during August 6 and 7, 2008. Specific areas of review included the finite element analysis calculations, MCNP input/output decks, radiograph of Marathon control blade, and various supporting calculations referenced by the fuel design topical report. This review completed the intended scope of the audit initially conducted July 30 through August 3, 2007. As a result of this audit, various RAIs were closed and a few new RAIs were submitted to GEH as discussed in the Audit results on page 3.

AUDIT CONTACT

Jim Harrison, GEH

AUDIT DATES

July 30-August 3, 2007 and August 6-7, 2008.

AUDIT LOCATION

Wilmington, NC

AUDIT PERSONNEL:

Table 1 provides a comprehensive list of the audit participants from both NRC and GEH. Their attendance at either the July 30 to August 2, 2007 or August 6 – 7, 2008 audit has been noted.

Table 1 – Audit Participants

Last Name	First Name	Affiliation	2007 Audit	2008 Audit
ANDERSEN	JENS	GEH	X	
BAVOL	BRUCE	NRC	X	X
BEYER	CARL	NRC	X	
BROADBENT	GREG	ENTERGY		X
CLIFFORD	PAUL	NRC	X	X
COURY	TOM	GEH		X
CUNNINGHAM	BRANDON	NRC		X
FAWCETT	RUSSELL	GEH	X	
HARRISON	JIM	GEH	X	X
HARRIS	CHARLES	NRC	X	
HINDS	DAVID	GEH	X	
JAHINGIN	NAYEM	GEH	X	
KECK	DAVID	GEH	X	X
KINOSHITA	MIKA	GEH	X	
KINSEY	JIM	GEH	X	
KLYMYSHAN	NICK	NRC	X	X
LIU	STEVE	GEH	X	
LIUCIANO	JERRY	GEH	X	
MILES	BARRY	GEH	X	
MOEN	STEVE	GEH	X	
NELSON	SCOTT	GEH	X	X
NICHOLS	PAUL	GEH	X	X
PATEL	AMRIT	NRC		X
POWERS	MIKE	GEH	X	
RAND	BOB	GEH	X	
SHUAIBI	MOHAMMED	NRC	X	
STACHOWSKI	RUSSELL	GEH	X	
VAN WERT	CHRIS	NRC	X	X
WANG	SYLVIA	GEH		X
WHITE	FROSTIE	GEH	X	

AUDIT RESULTS

SUMMARY OF THE GLOBAL NUCLEAR FUELS (GNF) CONTROL BLADE AND FUEL ASSEMBLY DESIGN (July 30 to August 2, 2007)

NRC staff, along with their consultants from Pacific Northwest National Laboratory (PNNL), conducted an onsite audit at GEH (Wilmington, NC) from July 30 through August 2, 2007. The objectives of this audit dealing with ESBWR related topics were:

1. Review reference documentation and resolve open items related to ESBWR DCD Section 4.2 and GE14E Fuel Assembly Design topical reports NEDC-33240P, "GE14E Fuel Assembly Mechanical Design" and NEDC-33242P, "GE14 for ESBWR Fuel Rod Thermal-Mechanical Design Report."
2. Review reference documentation regarding ESBWR Control Rod Design topical reports NEDE-33243P Rev 0, "ESBWR Control Rod Nuclear Design" and NEDE-33244P Rev 0, "ESBWR Control Rod Mechanical Design Report."
3. Complete audit of ESBWR Marathon rod and GE14E fuel assembly component finite element analyses.

As part of the audit, NRC and PNNL staff inspected the following resources:

- Tour of the control blade fabrication facility
- MCNP input/output files for the ESBWR Marathon topical report
- Finite Element Analysis input/output files for the ESBWR Marathon topical report
- Various calculations referenced by NEDC-33242.

RAI Disposition and Action Items

During the audit, the following requests for additional information (RAIs) were reviewed:

- RAIs 4.2-2, 4.2-4, and 4.8-6 - Revise fuel rod cladding strain Tier 2* requirement, Appendix 4B.
- RAI 4.2-5 - Revise critical power correlation Tier 2* requirement, Appendix 4B, to remove change process description.
- RAI 4.2-6 - Revise fuel temperature Tier 2* requirement, Appendix 4B, to remove "whole core" subset of AOOs.
- RAI 4.2-13 - Tier 1 design requirement related to channel bow.

- RAI 4.2-14 - Revise control rod design Tier 2* requirements, Appendix 4C, to make consistent with Tier 1 requirements.
- RAI 4.8-7 Supplement No. 1 (S01) - GE14E Flow-induced Vibration Testing.
- RAI 4.8-15 and 4.8-16 S01 - GESTR-Mechanical (GSTRM) performance code program fuel calculations.

Audit Exit (2007) Global Nuclear Fuels (GNF) Control Rod and Fuel Assembly Design

Several months after the audit exit the following RAIs were subsequently resolved:

RAIs 4.2-2, 4.2-4, 4.2-5, 4.2-6, 4.2-14, 4.8-6, 4.8-15, and 4.8-16 S01

To address RAI 4.8-7 S01, GEH planned to conduct GE14E Flow-Induced Vibration Testing during 4th quarter of 2007. This RAI remains open – See audit exit 2008 below. RAI 4.2-2 was initially closed and then reopened as RAI 4.2-2 S04 after it was determined that some information still needed to be updated in ESBWR DCD Revision 5. This RAI currently remains open. RAI 4.2-13 was resolved during audit.

During the audit, staff identified that the mechanical design of the ESBWR Control Rod differed from that which was presented in topical reports NEDE-33243P and NEDE-33244P Revision 0. It was determined that RAIs were not going to be issued based on these topical reports and that GEH would document the revised blade design in revisions to the topical reports. In October and November 2007 GEH provided the Revision 1 version of NEDE-33243P and NEDE-33244P. On February 1, 2008, NRC staff transmitted the letter accepting these revisions for detailed review to GEH (Agency-wide Documents Access and Management System (ADAMS) Accession No. ML080090500).

The review of the ESBWR Marathon rod and GE14E fuel assembly component finite element analyses (FEA) was completed with no action items.

SUMMARY OF THE MARATHON CONTROL BLADE TOPICAL REPORTS AUDIT (August 6 and 7, 2008)

NRC staff, along with a consultant from Pacific Northwest National Laboratory (PNNL), conducted an onsite audit at GEH (Wilmington, NC) on August 6 and 7, 2008. The objectives of this audit dealing with ESBWR related topics were:

1. Review reference documentation regarding topical reports ESBWR Control Rod Design topical reports NEDE-33243P Rev 1, “ESBWR Control Rod Nuclear Design” and NEDE-33244P Rev 1, “ESBWR Control Rod Mechanical Design Report.”
2. Resolve open items related to NEDE-33244P Rev1 and NEDE-33243P Rev1.
3. Review related computer analysis files.

As part of the audit, NRC and PNNL staff inspected the following resources:

- Radiograph of discharged control blade
- MCNP input/output files for the ESBWR Marathon topical report
- Finite Element Analysis input/output files for the ESBWR Marathon topical report
- Various calculations referenced by NEDC-33242.

Additionally, computational methods and input files for the ESBWR Marathon topical reports were compared against similar designs for the operational fleet.

RAI Disposition and Action Items

During the audit, the following requests for additional information (RAIs) were reviewed or issued:

- RAI 4.2-16 - MCNP input
- RAI 4.2-17 - ID tolerances
- RAI 4.2-18 - Parametric studies
- RAI 4.2-19 - Dimensional discrepancy
- RAI 4.2-20 - Material degradation mechanism issues
- RAI 4.2-21 - Are connectors, including the rollers exposed to coolant or other corrosive environments?
- RAI 4.2-22 - Austenitic stainless steels have no inherent age hardening capability and lend themselves readily to the welding process.
- RAI 4.2-23 - Basis for the irradiated boron carbide swelling predictions.
- RAI 4.2-24 S01 - Z-axis thickness
- RAI 4.2-25 S01 - Supply capsule impact testing results
- RAI 4.2-26 S01 - ESBWR Control Rod Assembly surveillance program
- RAI 4.2-30 - MCNP confirmatory analyses

- RAI 4.2-31 - ESBWR Marathon control blade structural analyses
- RAI 4.2-32 - Provide mechanical and material properties used in the Marathon design analyses.
- RAI 4.2-33 - From ongoing review of NEDC-33240P, "GE14E Fuel assembly Mechanical Design" - GE14E water rod capable of withstanding design handling loads
- RAI 4.8-7 S03 - From ongoing review of NEDC-33240P, "GE14E Fuel assembly Mechanical Design" - Justification for flow-induced vibration test acceptance criteria

Audit Exit (2008) Marathon Control Blade Topical Reports

RAIs 4.2-16, 4.2-17, 4.2-18, 4.2-19, 4.2-20, 4.2-21, 4.2-22, and 4.2-23 were resolved during the audit.

From both audits, the following RAIs remain open:

4.2-2 S04, 4.2-24 S01, 4.2-25 S01, 4.2-26 S01, 4.2-30, 4.2-31, 4.2-32, 4.2-33, and 4.8-7 S03

To address RAI 4.8-7 S03 and the delay of GE14E Flow-Induced Vibration Testing, GEH proposed the use of Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC). This RAI currently remains open.

The staff's review of related computer analysis files (MCNP confirmatory analyses) resulted in the staff generating RAI 4.2-30.

DC GE - ESBWR Mailing List

(Revised 11/12/2008)

cc:

Ms. Michele Boyd
Legislative Director
Energy Program
Public Citizens Critical Mass Energy
and Environmental Program
215 Pennsylvania Avenue, SE
Washington, DC 20003

Mr. Tom Sliva
Vice President
New Plants Project Management
AREVA, NP, Inc. 3315
Old Forest Road
P.O. Box 10935
Lynchburg, VA 24506-0935

DC GE - ESBWR Mailing List

Email

aec@nrc.gov (Amy Cubbage)
APH@NEI.org (Adrian Heymer)
art.alford@ge.com (Art Alford)
awc@nei.org (Anne W. Cottingham)
bevans@enercon.com (Bob Evans)
bob.brown@ge.com (Robert E. Brown)
BrinkmCB@westinghouse.com (Charles Brinkman)
cberger@energetics.com (Carl Berger)
charles.bagnal@ge.com
charles@blackburncarter.com (Charles Irvine)
chris.maslak@ge.com (Chris Maslak)
CumminWE@Westinghouse.com (Edward W. Cummins)
cwaltman@roe.com (C. Waltman)
dan1.williamson@ge.com (Dan Williamson)
david.hinds@ge.com (David Hinds)
david.lewis@pillsburylaw.com (David Lewis)
David.piepmeyer@ge.com (David Piepmeyer)
dlochbaum@UCSUSA.org (David Lochbaum)
don.lewis@ge.com (Don Lewis)
erg-xl@cox.net (Eddie R. Grant)
Frostie.white@ge.com (Frostie White)
gcesare@enercon.com (Guy Cesare)
GEH-NRC@hse.gsi.gov.uk (Geoff Grint)
george.honma@ge.com (George Honma)
george.wadkins@ge.com (George Wadkins)
GovePA@BV.com (Patrick Gove)
greshaja@westinghouse.com (James Gresham)
gzinke@entergy.com (George Alan Zinke)
hickste@earthlink.net (Thomas Hicks)
james.beard@gene.ge.com (James Beard)
jeff.waal@ge.com (Jeff Waal)
jgutierrez@morganlewis.com (Jay M. Gutierrez)
Jim.Kinsey@inl.gov (James Kinsey)
jim.riccio@wdc.greenpeace.org (James Riccio)
JJNesrsta@cpsenergy.com (James J. Nesrsta)
joel.Friday@ge.com (Joel Friday)
John.O'Neill@pillsburylaw.com (John O'Neill)
john.sorensen@ge.com (John Sorensen)
Joseph_Hegner@dom.com (Joseph Hegner)
junichi_uchiyama@mnes-us.com (Junichi Uchiyama)
kenneth.ainger@exeloncorp.com (Kenneth Ainger)
kimberly.milchuck@ge.com (Kimberly Milchuck)
KSutton@morganlewis.com (Kathryn M. Sutton)
kurt.schaefer@ge.com (Kurt Schaefer)

DC GE - ESBWR Mailing List

kwaugh@impact-net.org (Kenneth O. Waugh)
laura.bello@ge.com (Laura Bello)
lchandler@morganlewis.com (Lawrence J. Chandler)
lee.dougherty@ge.com
lou.lanese@ge.com (Lou Lanese)
Marc.Brooks@dhs.gov (Marc Brooks)
maria.webb@pillsburylaw.com (Maria Webb)
mark.beaumont@wsms.com (Mark Beaumont)
Marvin.Smith@dom.com (Marvin L. Smith)
matias.travieso-diaz@pillsburylaw.com (Matias Travieso-Diaz)
media@nei.org (Scott Peterson)
mike_moran@fpl.com (Mike Moran)
MSF@nei.org (Marvin Fertel)
mwetterhahn@winston.com (M. Wetterhahn)
nirsnet@nirs.org (Michael Mariotte)
PAC2@nrc.gov (Peter Cochran)
pareez.golub@ge.com (Pareez Golub)
patriciaL.campbell@ge.com (Patricia L. Campbell)
paul.gaukler@pillsburylaw.com (Paul Gaukler)
Paul@beyondnuclear.org (Paul Gunter)
peter.jordan@ge.com (Peter Jordan)
phinnen@entergy.com (Paul Hinnenkamp)
pshastings@duke-energy.com (Peter Hastings)
randy.newton@ge.com (Randy Newton)
rick.kingston@ge.com (Rick Kingston)
RJB@NEI.org (Russell Bell)
RKTemple@cpsenergy.com (R.K. Temple)
roberta.swain@ge.com (Roberta Swain)
Russell.Wells@Areva.com (Russell Wells)
sabinski@suddenlink.net (Steve A. Bennett)
sandra.sloan@areva.com (Sandra Sloan)
SauerB@BV.com (Robert C. Sauer)
sfrantz@morganlewis.com (Stephen P. Frantz)
steven.hucik@ge.com (Steven Hucik)
tdurkin@energetics.com (Tim Durkin)
tom.childress@ge.com
tom.miller@hq.doe.gov (Tom Miller)
trsmith@winston.com (Tyson Smith)
Vanessa.quinn@dhs.gov (Vanessa Quinn)
VictorB@bv.com (Bill Victor)
Wanda.K.Marshall@dom.com (Wanda K. Marshall)
wayne.cutright@ge.com (Wayne Cutright)
wayne.marquino@ge.com (Wayne Marquino)
whorin@winston.com (W. Horin)