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Proprietary Notice
This letter forwards GNF proprietary information in accordance with 10CFR2.390. Upon the removal of Enclosure 1, the balance of this letter may be considered non-proprietary.

MFN 06-297, Supplement 3

Docket No. 52-010

January 26, 2007

U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555-0001

Subject: **Response to Portion of NRC Request for Additional Information Letter No. 53 Related to ESBWR Design Certification Application – DCD Chapter 4 and GNF Topical Reports – RAI Numbers 4.2-2S01, 4.2-4S01 and 4.8-16S01 - Supplement**

Enclosure 1 contains GE's response to the subject NRC RAIs transmitted via the Reference 1 letter.

Enclosure 1 contains GNF proprietary information as defined by 10 CFR 2.390. GNF customarily maintains this information in confidence and withholds it from public disclosure. A non-proprietary version is provided in Enclosure 2.

The affidavit contained in Enclosure 3 identifies that the information contained in Enclosure 1 has been handled and classified as proprietary to GNF. GE hereby requests that the information of Enclosure 1 be withheld from public disclosure in accordance with the provisions of 10 CFR 2.390 and 9.17.

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If you have any questions about the information provided here, please let me know.

Sincerely,

James C. Kinsey

James C. Kinsey
Project Manager, ESBWR Licensing

Reference:

1. MFN 06-288, Letter from U. S. Nuclear Regulatory Commission to Mr. David H. Hinds, *Request for Additional Information Letter No. 53 Related to ESBWR Design Certification Application,* August 16, 2006

Enclosures:

1. MFN 06-297, Supplement 3 - Response to Portion of NRC Request for Additional Information Letter No. 53 Related to ESBWR Design Certification Application – DCD Chapter 4 and GNF Topical Reports – RAI Numbers 4.2-2S01, 4.2-4S01, and 4.8-16S01 – Supplement – GNF Proprietary Information
2. MFN 06-297, Supplement 3 - Response to Portion of NRC Request for Additional Information Letter No. 53 Related to ESBWR Design Certification Application – DCD Chapter 4 and GNF Topical Reports – RAI Numbers 4.2-2S01, 4.2-4S01, and 4.8-16S01 – Supplement – Non Proprietary Version
3. Affidavit – Jens G. M. Andersen – dated January 26, 2007

cc: AE Cubbage USNRC (with enclosures)
AA Lingenfelter GNF/Wilmington (w/o enclosures)
GB Stramback GE/San Jose (with enclosures)
eDRFs 0057-1360/R1

Enclosure 2

MFN 06-297, Supplement 3

Response to Portion of NRC Request for Additional Information Letter No. 53 Related to ESBWR Design Certification Application

DCD Chapter 4 and GNF Topical Reports

RAI Numbers 4.2-2 S01, 4.2-4 S01, 4.8-16 S01 Supplement

Non-Proprietary Version

NRC RAI 4.2-2 S01 and 4.2-4 S01:

From Fuels Audit 10/23 - 10/31

Provide:

a. Summary of Japanese data

b. Paragraph as to why the 8X8 cladding and heat treatment is applicable to today's design

c. Explanation of why the hydrogen morphology is the same as in-service reactor

d. Justification limit for oxide with peak nodal

GE Supplemental Response:

On the basis of the analyses and data in Attachment 4.2-2.1, GE/GNF proposes a cladding failure criterion as follows.

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The proposed limit is conservatively based upon currently available data. Should results from ongoing GE/GNF experimental programs support revisions to the limits, the NRC will be notified of the revisions.

Attachment 4.2-2.1

Cladding ductility is a function of fluence and hydrogen content (and thus indirectly a function of corrosion). Because of the uncertainty in hydrogen pickup relative to corrosion layer thickness, measured hydrogen content as a function of exposure is used to characterize the cladding hydrogen content. The available data is shown in Figure 4.2-2.1.

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]] The cladding ductility at operating temperature (taken as 300°C), as indicated by ultimate strain from burst tests, as a function of hydrogen content is shown in Figure 4.2-2.2.

From Figure 4.2-2.1, the upper 95 hydrogen concentration at a local (pellet) exposure of [[ ]] and the concentration at a local exposure of [[ ]] by extrapolation. From Figure 4.2-2.2, the [[ ]]. To account for uncertainties in the extrapolation for hydrogen contents above [[ ]]. Mechanical property test data in addition to the original response at room and reactor operating temperatures for Zircaloy-2 cladding are summarized in Tables 4.2-2.1, 4.2-2.2 and 4.2-2.3.

GE/GNF maintains an ongoing program to characterize the hydrogen content of GNF fuel cladding. However, the current technology limits this program to hot cell PIE measurements, which, due to transport requirements, are both time consuming and resource intensive. GE/GNF also maintains an extensive corrosion surveillance program. Since corrosion and hydrogen are related, this program will be used to indicate changes in corrosion performance and the need for increased hydrogen characterization to confirm that the cladding strain limit remains applicable.

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Figure 4.2-2.1: Hydrogen Content as a Function of Exposure

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Figure A-2: Ultimate Strain vs Hydrogen Content

Table 4.2-2.1: Burst Test Results, Zr-2 Fuel Rod Cladding

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Table 4.2-2.1 (continued): Burst Test Results, Zr-2 Fuel Rod Cladding

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Table 4.2-2.2: Tensile Test Results, Zr-2 Fuel Rod Cladding

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Table 4.2-2.2 (Continued): Tensile Test Results, Zr-2 Fuel Rod Cladding

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Table 4.2-2.3: Burst Test Results, Zr-2 Fuel Rod Cladding (archive samples)

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DCD Impact:

No DCD changes will be made in response to this RAI.

NRC RAI 4.8-16 S01:

Revise response to address the use of LHGR limits in the topical report and TOP/MOP limits for GE14E fuel design. Indicate that the DCD will be revised to reflect that the fuel design will change based upon new improved code "PRIME". In the PRIME submittal letter, include commitment that PRIME will replace GSTRM as the fuel design basis.

From Fuels Audit 10/23 - 10-31

NRC is concerned that today's algorithm does not meet current standards, and that the accumulative effect of fission gas release cannot be conservatively predicted with GSTRM

GE Supplemental Response:

As noted in the original response and subsequent discussion (October 16-20,2006), the GESTR-Mechanical (GSTRM) code is well qualified in the exposure range of interest and predicts prototypical rods very well. [[

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GE/GNF is currently evaluating the potential non-conservatism of GSTRM code and its impact on fuel design and licensing calculation and also on downstream safety analyses. GE/GNF will notify NRC about the outcome of this evaluation and will address any specific comments or concerns NRC staff might have. It is also noted that the GE/GNF plan is to replace GSTRM with the PRIME code as the licensing basis for new fuel designs after approval by the NRC.

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]] this will provide adequate protection against fuel melting and maintain cladding plastic strain less than the limit.

Attachment 4.8-16.1

(Revised GE14E LTR 33242P)

3.2 Fuel Temperature (Melting, Item 2 of Table 3-1)

Numerous irradiation experiments have demonstrated that extended operation with significant fuel pellet central melting does not result in damage to the fuel rod cladding. However, the fuel rod performance is evaluated to ensure that fuel melting will not occur. To achieve this objective, the fuel rod is evaluated to ensure no fuel melting during normal steady-state operation and core wide anticipated operational occurrences. This fuel temperature limit is specified to ensure that sudden shifting of molten fuel in the interior of fuel rods, and subsequent potential cladding damage, can be positively precluded.

4.5 Thermal and Mechanical Overpowers

As discussed in Sections 4.1 and 4.2, analyses are performed to determine the values of the maximum overpower magnitudes that would not exceed the cladding circumferential strain criterion (MOP-Mechanical Overpower) and the incipient fuel center-melting criterion (TOP-Thermal Overpower). Conformance to these MOP and TOP criteria is demonstrated as a part of the normal core design and transient analysis process by comparison of the calculated core transient mechanical and thermal overpowers, as defined schematically in Figure 4-3, to the mechanical and thermal overpower limits determined by the GSTRM analyses.

The concept of TOP and MOP limits as summarized above was developed to provide parameters that are easily evaluated in terms of LHGR or surface heat flux and that can be used as computational limits during the design of a core. TOP and MOP limits are intended to prevent exceedance of actual licensing limits (no fuel melting and cladding plastic strain less than 1%) and to provide an initial screen during the nuclear design of a core or an upcoming cycle. Violation of TOP or MOP limits does not indicate violation of actual licensing limits, only that additional analyses are required to confirm compliance with the actual SAFDLs. The analyses are performed with currently approved methodologies.

Although not explicitly addressed in the licensing analyses, similar overpower analyses are performed to confirm that control blade maneuvers will not result in exceedance of temperature or cladding strain limits.

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Figure 4-3 - Thermal and Mechanical Overpowers (Schematic)

5.2.2 Cladding Strain

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]]. The parameters, which according to their consequences on the result, that were set at the extremes in the manufacturing tolerance bands or operation dependent characterizations include: [[

]]. Evaluations are performed for each fuel rod type over a range of exposures and overpowers to simulate various AOOs. The evaluations reflect continuous operation on the bounding power exposure operating envelope prior to the AOO. Based upon the results of these evaluations, the mechanical overpower limits in Table 5-2 (from Reference 9) are applied to the GE14 fuel design to prevent cladding permanent strain (plastic plus creep) equal to or greater than 1.00% at the limiting exposure for the maximum power envelopes specified in Reference 8.

As in the case of fuel temperature, since the [[

]]. Again, as in the case of fuel temperature, the application is slightly conservative for the limiting rod due to the slightly improved thermal performance resulting from the reduced fuel volume to rod free volume ratio for the GE14E design relative to the GE14 design discussed in Section 5.1. Thus the mechanical overpower limits in Table 5-2 are applied to the GE14E fuel design to [[

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Table 5-2 LFWH, Inadvertent HPCS, HPCI, RCIC Injection, Rod Withdrawal Events

Events	**Maximum Allowable Surface Heat Flux Increase, %**	
	Thermal Overpower (TOP)	Mechanical Overpower (MOP)
Core-Wide Transients and Rod Withdrawal Events	[[ ]]	[[ ]]

The thermal overpower (TOP) and mechanical overpower (MOP) limits in Table 5-2 apply to (core wide) pressurization transients and to bundles impacted by rod withdrawal events. [[

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DCD Impact:

No DCD changes will be made in response to this RAI.

NEDE-33242P Sections 3.2, 4.5, and 5.2.2 will be revised as noted in Attachment 4.18-16.1.

Enclosure 3

MFN 06-297, Supplement 3

Affidavit

Affidavit

I, Jens G. M. Andersen, state as follows:

(1) I am Consulting Engineer, Thermal Hydraulic Methods, Global Nuclear Fuel – Americas, L.L.C. ("GNF-A") and have been delegated the function of reviewing the information described in paragraph (2) which is sought to be withheld, and have been authorized to apply for its withholding.

(2) The information sought to be withheld is contained in Enclosure 1 of GE letter MFN 06-297, Supplement 3, James C. Kinsey to U. S. Nuclear Regulatory Commission, *Response to Portion of NRC Request for Additional Information Letter No. 53 Related to ESBWR Design Certification Application – DCD Chapter 4 and GNF Topical Reports - RAI Numbers 4.2-2S01, 4.2-4S01 and 4.8-16S01 – Supplement* dated January 26, 2007. The proprietary information in Enclosure 1, *MFN 06-297, Supplement 3 Response to Portion of NRC Request for Additional Information Letter No. 53 Related to ESBWR Design Certification Application – DCD Chapter 4 and GNF Topical Reports - RAI Numbers 4.2-2S01, 4.2-4S01 and 4.8-16S01 – Supplement – GNF Proprietary Information,* is delineated by double underlined dark red font text and is enclosed inside double square brackets. Figures and large equation objects are identified with double square brackets before and after the object. The superscript notation $^{\{3\}}$ refers to Paragraph (3) of this affidavit, which provides the basis for the proprietary determination.

(3) In making this application for withholding of proprietary information of which it is the owner or licensee, GNF-A relies upon the exemption from disclosure set forth in the Freedom of Information Act ("FOIA"), 5 USC Sec. 552(b)(4), and the Trade Secrets Act, 18 USC Sec. 1905, and NRC regulations 10 CFR 9.17(a)(4) and 2.390(a)(4) for "trade secrets " (Exemption 4). The material for which exemption from disclosure is here sought also qualify under the narrower definition of "trade secret," within the meanings assigned to those terms for purposes of FOIA Exemption 4 in, respectively, Critical Mass Energy Project v. Nuclear Regulatory Commission, 975F2d871 (DC Cir. 1992), and Public Citizen Health Research Group v. FDA, 704F2d1280 (DC Cir. 1983).

(4) Some examples of categories of information which fit into the definition of proprietary information are:

a. Information that discloses a process, method, or apparatus, including supporting data and analyses, where prevention of its use by GNF-A's competitors without license from GNF-A constitutes a competitive economic advantage over other companies;

b. Information which, if used by a competitor, would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing of a similar product;

c. Information which reveals aspects of past, present, or future GNF-A customer–funded development plans and programs, of potential commercial value to GNF-A;

d. Information which discloses patentable subject matter for which it may be desirable to obtain patent protection.

The information sought to be withheld is considered to be proprietary for the reasons set forth in paragraphs (4)a. and (4)b., above.

(5) To address the 10 CFR 2.390 (b) (4), the information sought to be withheld is being submitted to NRC in confidence. The information is of a sort customarily held in confidence by GNF-A, and is in fact so held. Its initial designation as proprietary information, and the subsequent steps taken to prevent its unauthorized disclosure, are as set forth in (6) and (7) following. The information sought to be withheld has, to the best of my knowledge and belief, consistently been held in confidence by GNF-A, no public disclosure has been made, and it is not available in public sources. All disclosures to third parties including any required transmittals to NRC, have been made, or must be made, pursuant to regulatory provisions or proprietary agreements which provide for maintenance of the information in confidence.

(6) Initial approval of proprietary treatment of a document is made by the manager of the originating component, the person most likely to be acquainted with the value and sensitivity of the information in relation to industry knowledge, or subject to the terms under which it was licensed to GNF-A. Access to such documents within GNF-A is limited on a "need to know" basis.

(7) The procedure for approval of external release of such a document typically requires review by the staff manager, project manager, principal scientist or other equivalent authority, by the manager of the cognizant marketing function (or his delegate), and by the Legal Operation, for technical content, competitive effect, and determination of the accuracy of the proprietary designation. Disclosures outside GNF-A are limited to regulatory bodies, customers, and potential customers, and their agents, suppliers, and licensees, and others with a legitimate need for the information, and then only in accordance with appropriate regulatory provisions or proprietary agreements.

(8) The information identified in paragraph (2) is classified as proprietary because it contains details of GNF-A's fuel design and licensing methodology.

The development of the methods used in these analyses, along with the testing, development and approval of the supporting methodology was achieved at a significant cost, on the order of several million dollars, to GNF-A or its licensor.

(9) Public disclosure of the information sought to be withheld is likely to cause substantial harm to GNF-A's competitive position and foreclose or reduce the availability of profit–making opportunities. The fuel design and licensing methodology is part of GNF-A's comprehensive BWR safety and technology base, and its commercial value extends beyond the original development cost. The value of the technology base goes beyond the

extensive physical database and analytical methodology and includes development of the expertise to determine and apply the appropriate evaluation process. In addition, the technology base includes the value derived from providing analyses done with NRC–approved methods.

The research, development, engineering, analytical, and NRC review costs comprise a substantial investment of time and money by GNF-A or its licensor.

The precise value of the expertise to devise an evaluation process and apply the correct analytical methodology is difficult to quantify, but it clearly is substantial.

GNF-A's competitive advantage will be lost if its competitors are able to use the results of the GNF-A experience to normalize or verify their own process or if they are able to claim an equivalent understanding by demonstrating that they can arrive at the same or similar conclusions.

The value of this information to GNF-A would be lost if the information were disclosed to the public. Making such information available to competitors without their having been required to undertake a similar expenditure of resources would unfairly provide competitors with a windfall, and deprive GNF-A of the opportunity to exercise its competitive advantage to seek an adequate return on its large investment in developing and obtaining these very valuable analytical tools.

I declare under penalty of perjury that the foregoing affidavit and the matters stated therein are true and correct to the best of my knowledge, information, and belief.

Executed at Wilmington, North Carolina this 26th day of January 2007.

Jens G. M. Andersen
Global Nuclear Fuels – Americas, LLC