Global Nuclear Fuel

A Joint Venture of GE, Toshiba, & Hitachi

NEDO-33413
Revision 1
Class I
eDRF 0000-0082-1195
December 2008

FULL SCALE CRITICAL POWER TESTING OF GE14E AND VALIDATION OF GEXL14

Non-PROPRIETARY INFORMATION NOTICE

This is a non-proprietary version of the document NEDC-33413P Revision 1 which has the proprietary information removed. Portions of the document that have been removed are indicated by open and closed double brackets as shown here [[ ]].

IMPORTANT NOTICE REGARDING CONTENTS OF THIS REPORT PLEASE READ CAREFULLY

The information contained in this document is furnished as reference to the NRC Staff for the purpose of obtaining NRC approval of the ESBWR Certification and implementation. The only undertakings of GNF with respect to information in this document are contained in contracts between GNF and participating utilities, and nothing contained in this document shall be construed as changing those contracts. The use of this information by anyone other than that for which it is intended is not authorized; and with respect to any unauthorized use, GNF makes no representation or warranty, and assumes no liability as to the completeness, accuracy, or usefulness of the information contained in this document.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ILLUSTRATIONS

Figure Title Page

Revision Status

Revision Number	Section	Description of Change
0	--	Initial Issue
1	3.2	Updated Table 3-2 and footnote in response to RAI 4.4-74
	5	Added the last paragraph in response to RAI 4.4-70
	6	Updated Reference 2 in response to RAI 4.4-79
	6	Updated References 1 and 3

1. INTRODUCTION

The passive safety features and natural circulation operating strategy employed in the ESBWR require a reactor core design with minimum resistance to two-phase pressure drop, while still providing sufficient density head to maintain natural circulation flow. ESBWR design optimization studies have resulted in a core bundle design, which is for the most part identical to the standard bundle design used in the BWR4/5/6 and ABWR designs except that the overall fuel bundle length has been reduced by about 27 inches and the active fuel length reduced by about 30 inches.

The GE critical quality - boiling length correlation (GEXL) was developed to accurately predict the onset of boiling transition in BWR fuel assemblies during both steady-state and reactor transient conditions. The GEXL critical power correlation for conventional GE14 10x10 fuel (GEXL14) has been developed using data obtained from the ATLAS critical power test facility. GE14 fuel is currently producing power in BWRs worldwide with successful operating performance. The ESBWR version of GE14 (GE14E) is identical to GE14, except for those features related to the axial length of the fuel, i.e., the total fuel axial length, the number and axial location of the fuel rod spacers, and the axial length of the part length rods.

Due to the similarity between the two GE14 versions, GE14 and GE14E, the GEXL14 correlation can be applied to ESBWR applications, provided that the geometry differences between the two versions of GE14, however small these differences are between the two versions, are quantified and properly accounted for.

Reference 1 discussed the application of the GEXL14 critical power correlation to GE14E fuel and the supporting analyses performed to quantify and subsequently account for the effect (on critical power) of the differences between GE14 for the conventional BWRs and GE14E. In Reference 1, the ATLAS critical power data for the conventional BWR version of GE14 was adjusted due to shortening of the heated length and a subchannel analysis model of GE14, previously qualified based on the ATLAS GE14 critical power data, was then used to quantify the effect of the geometry differences between the two GE14 versions on the critical power performance. Based on the ATLAS GE14 data and the subchannel analysis, the statistics of the GEXL14 correlation for GE14E were established and subsequent operating limit and safety limit minimum critical power ratio (MCPR) evaluations were conducted.

Full-scale critical power and pressure drop tests were conducted to collect sufficient data to validate the use of the GEXL14 correlation for the GE14E fuel and demonstrate the adequacy of the established GEXL14 statistics for the GE14E fuel.

GE14E test assembly characteristics, test matrix, and critical power database used in the GEXL14 analysis are provided in Section 2. The GEXL14 analysis and the resulting statistics for the GE14E fuel are discussed in Section 3. An overview of the R-factor calculation method is provided in Section 4. The measure of the capability of a boiling transition prediction correlation is its ability to predict the test data. The GEXL14 correlation is demonstrated to be an accurate predictor of the GE14E test data.

2. GE14E CRITICAL POWER TESTING

2.1 THE GE14E 10X10 STERN TEST ASSEMBLY

The GE14E full-scale critical power and pressure drop testing was performed in the Stern Laboratories test facility in Hamilton, Ontario. The Stern test loop creates pressure, flow, and temperature conditions that accurately simulate the actual operating reactor environment. The GE14E test assembly characteristics are provided in Table 2-1 and Figure 2-1. The tests were performed using [[ ]] axial power profile. The axial power profile, for both the full length and part length rods, used in the Stern tests are shown in Figure 2-2 and a typical bundle power profile is shown in Figure 2-3. In the Stern tests, shims were attached to two adjacent sides of each spacer band so that the most limiting corner of the bundle (highest R-factor rods) had the minimum rod to channel gap. Based on previous test experience, this configuration provides the most conservative critical power and the results are very reproducible.

GE14E fuel uses the GE14 Zircaloy ferrule spacer. From the thermal hydraulic perspective, the only difference between all test assemblies and an actual GE14E fuel assembly was the use of electrically heated rods instead of fuel rods. All simulations included heated part length rods. The spacers for all test assemblies were manufactured at the GNF Wilmington fuel manufacturing facility using the same materials and to the same specifications as reactor quality spacers.

2.2 THE GE14E 10X10 STERN TEST MATRIX

[[

]] All testing was completed in the ATLAS test facility in San Jose, California. This additional data further validates the correlation and confirms the axial power shape sensitivity. Recently, additional test data were obtained from Stern test facility. These tests were obtained for [[ ]], and the primary purpose of these tests was to verify the capability of the of the GEXL14 correlation to predict the trend with axial power shape. The test assembly characteristics and test matrix for the conventional GE14 fuel are provided in Reference 2.

The GE14E 10x10 Stern test matrix for steady-state critical power data is outlined in Table 2-2. This test matrix follows the same test philosophy as previous full-scale tests. A wide range of the operating conditions of pressure, mass flux, inlet subcooling, and R-factor were tested.

The GE14E test matrix used in the validation of the GEXL14 correlation contains the critical power data [[

]] The GEXL14 axial power shape effects were evaluated in Reference 2 using the GE14 [[ ]] data from ATLAS test facility, the GE14 [[ ]] data from Stern test facility, and though trend comparisons of 9x9 and 10x10 fuel designs which had different part length rod designs and spacer locations. The comparison showed that GEXL14 power shape effects were well predicted compared to the GE14 ATLAS and Stern data and consistent with the trend observed in previous fuel designs. It also confirmed that the changes in the part length rod designs and spacer locations did not introduce any new sensitivity into the axial power shape effects.

Table 2-1 STERN GE14E Test Assembly Characteristic

[[	
	]]
Lattice	10x10
[[	
	]]
Number of Full Length Heated Rods	78
[[	]]
Number of Heated Part Length Rods	14
[[	
	]]
Number of Water Rods	2
[[	]]
Number of Spacers on the Heated Length	6
Spacer Type	Zircaloy ferrule
[[	
	]]
[[	
	]]

[[

]]

Figure 2-1 GE14E Test Assembly Rod Numbering System and Thermocouple Location

[[

]]

Figure 2-2 Rod Axial Heat Shape - Stern Critical Power Tests

[[

]]

Figure 2-3 Typical Bundle Axial Heat Shape - Stern Critical Power Tests

Table 2-2 GE14E STERN Test Matrix Critical Power (Steady-state)

Test Type: Number of peaking patterns: Axial Heat Flux Shape: R-factor: Pressure: Mass flux: Inlet subcooling:	[[
Test Type: Number of peaking patterns: Axial Heat Flux Shape: R-factor: Pressure: Mass flux: Inlet subcooling:	
Test Type: Number of peaking patterns: Axial Heat Flux Shape: R-factor: Pressure: Mass flux: Inlet subcooling:	
Test Type: Number of peaking patterns: Axial Heat Flux Shape: R-factor: Pressure: Mass flux: Inlet subcooling:	
Test Type: Number of peaking patterns: Axial Heat Flux Shape: R-factor: Pressure: Mass flux: Inlet subcooling:	]]

Table 2-2 GE14E STERN Test Matrix Critical Power (Steady-state), continued

Test Type: Number of peaking patterns: Axial Heat Flux Shape: R-factor: Pressure: Mass flux: Inlet subcooling:	[[
Test Type: Number of peaking patterns: Axial Heat Flux Shape: R-factor: Pressure: Mass flux: Inlet subcooling:	
Test Type: Number of peaking patterns: Axial Heat Flux Shape: R-factor: Pressure: Mass flux: Inlet subcooling:	
Test Type: Number of peaking patterns: Axial Heat Flux Shape: R-factor: Pressure: Mass flux: Inlet subcooling:	]]

2.3 THE GE14E CRITICAL POWER DATABASE FOR GEXL14 STATISTICAL ANALYSIS

The GE14E critical power database for the statistical analysis of the GEXL14 correlation is summarized in Table 2-3, Table 2-4, and Figure 2-4, which show the number of data points collected for various mass flux, pressure, and inlet subcooling combinations, and the number of points collected when dryout occurred for each unique rod location. The critical power data for the part length rod peaking are not included in the database for the statistical analysis because the GEXL14 correlation is conservative for the part length rod data as discussed in Section 3.4.

Table 2-3 GEXL14 Database for GE14E – Mass Flux vs. Pressure

		Pressure (psia)							
[[									
									]]

Table 2-4 GEXL14 Database for GE14E – Inlet Subcooling vs. Mass Flux

		Mass Flux ($Mlb_m/hr\text{-}ft^2$)									
[[											
											]]

[[

]]

Figure 2-4 GEXL14 Database for GE14E – Collection by Unique Rod Position

3. GEXL14 STATISTICAL ANALYSIS FOR GE14E

3.1 THE GEXL14 CORRELATION

The critical quality versus boiling length plane was chosen as the coordinate system for correlating the boiling transition data. This approach was chosen because it (1) yields good precision, (2) is conceptually simple to apply, and (3) will account for variations in axial heat flux profile. The critical quality - boiling length correlation developed to predict the critical power in BWR fuel assemblies is called GEXL.

The specific GEXL14 correlation developed for GE14 fuel was provided in Reference 2. The GEXL14 correlation coefficients and GEXL input parameters were also discussed in Reference 2.

The R-factor is an input to the GEXL correlations that accounts for the effects of the fuel rod power distributions and the fuel assembly and channel geometry on the fuel assembly critical power. Its formulation for a given fuel rod location depends on the power of that fuel rod, as well as the power of the surrounding fuel rods. An overview of the R-factor calculation method is provided in Section 4. In addition, there is an additive constant applied to each fuel rod location which is dependent on the fuel assembly spacer and channel geometry.

From a thermal hydraulic standpoint, the GE14 and the GE14E fuels differ in three respects:

- The overall heated length of the bundle is shortened from [[ ]]
- The axial position of the spacers relative to one another have changed
- The heated length of the part length rod has changed from [[ ]] and the physical length has changed from [[ ]]

Due to the similarity between the two GE14 versions, GE14 and GE14E, the GEXL14 correlation can be applied to GE14E ESBWR applications. The application of the GEXL14 correlation to GE14E fuel and the supporting analyses were performed in Reference 1. The validity of this methodology for GE14E fuel is confirmed by virtue of the adequacy of the GEXL14 correlation statistics and trend characteristics that are based on Stern test data for GE14E.

For GE14E, the same additive constants used in the GE14 design process are applied except for those of the part length rods. The additive constants for GE14 and GE14E are provided in Table 3-1. [[ ]] (see Figure 3-2).

Table 3-1 GEXL14 Additive Constants for GE14 and GE14E with Ferrule Spacer

Fuel Rod Lattice Position	Fuel Rod Additive Constant	
	GE14	GE14E
[[		
		]]

*Part length fuel rods
**For rods not adjacent to a water rod
***For rods adjacent to a water rod (refer to Figure 3-1)

[[

]]

Figure 3-1 Additive Constant Symmetrical Application

3.2 GEXL14 APPLICATION RANGE

The application range for the GEXL14 correlation is listed Table 3-2. The GE14E estimated range, GE14E database range for the GEXL14 licensing basis statistics, and GE14E Stern critical power database used in the validation of the GEXL14 are also listed in the Table.

Table 3-2 GEXL14 Correlation Application Range and GE14E Ranges

[[

]]

3.3 THE GEXL14 CORRELATION TRENDS AND DATABASE STATISTICS

A statistical analysis was performed for the GE14E Stern database consisting of [[ ]] data points for [[ ]] different rod to rod peaking patterns obtained from the Stern test assembly. The data and analyses cover the range for which the GE14E GEXL14 correlation is considered valid. To facilitate the statistical evaluation of the predictive capability of the GE14E GEXL14 correlation, the concept of an experimental critical power ratio (ECPR) is used. The ECPR is determined from the following relationship:

$$ECPR \equiv \frac{\text{Predicted Critical Power}}{\text{Measured Critical Power}} \quad (3\text{-}1)$$

Figure 3-2 compared the calculated critical power by GEXL14 to the Stern GE14E measured critical power. Figures 3-3 thru 3-5 show the ECPR trends as well as the range of data collection for pressure, mass flux, and inlet subcooling parameters. Figure 3-6 shows the frequency distribution of all ECPRs for GEXL14 versus test data results for GE14E.

[[

]]

Figure 3-2 GE14E Stern Test Data vs. GEXL14 Calculated Critical Power

[[

]]

Figure 3-3 GEXL14 Mass Flux Trends for GE14E

[[

]]

Figure 3-4 GEXL14 Inlet Subcooling Trends for GE14E

[[

]]

Figure 3-5 GEXL14 Pressure Trends for GE14E

[[

]]

Figure 3-6 Frequency versus ECPR Histogram for GE14E Stern Data

A summary of the GEXL14 correlation statistics for the GE14E Stern database is given in Table 3-3. Reference 1 established the GEXL14 statistics for GE14 fuel based on the ATLAS GE14 data and the subchannel analysis. The GE14E licensing basis statistics for the GEXL14 correlation were estimated as a mean ECPR of [[ ]] and a standard deviation of [[ ]] (Reference 1). The GE14E Stern data demonstrated that the established GEXL14 statistics for the GE14E fuel in Reference 1 were conservative. Therefore, the subsequent operation limit and safety limit MCPR evaluations were also conservative.

Table 3-3 GEXL14 Statistics for GE14E Data

[[	
	]]

3.4 THE GEXL14 ANALYSIS FOR PART LENGTH ROD PEAKING DATA

Additive constants for the GE14E part length rods were changed from those for GE14 as indicated in Table 3-1. To demonstrate the adequacy of the GEXL14 correlation for the GE14E part length rods, the GE14E Stern critical power data for the part length rods were analyzed. The GEXL14 correlation predicted [[ ]] part length rod peaking data with a mean ECPR of [[ ]] and a standard deviation of [[ ]]. From this analysis, it is concluded that the GEXL14 correlation conservatively predicts the critical power for the part length rod peaking data.

As mentioned in Section 2.3, the part length rod peaking data are not included in the GEXL14 statistics database for the GE14E fuel because they are conservative.

4. R-FACTOR CALCULATION METHOD

4.1 INTRODUCTION

The R-factor is an input to the GEXL correlations that accounts for the effects of the fuel rod power distributions and the fuel assembly and channel geometry on the fuel assembly critical power. Its formulation for a given fuel rod location depends on the power of that fuel rod, as well as the power of the surrounding fuel rods. In addition, there is an additive constant applied to each fuel rod location that is dependent on the fuel assembly and channel geometry.

The GEXL14 R-factor calculation process is consistent with the methodology submitted to the NRC and accepted as part of the GE reload licensing application (Reference 4). The validity of this methodology for GE14E fuel is confirmed by virtue of the adequacy of the GEXL14 correlation statistics and trend characteristics that are based on GE14E Stern test data.

4.2 R-FACTOR CALCULATIONAL PROCESS

Local two-dimensional fuel rod power distributions vary axially in BWR fuel assemblies due to axial variations in nuclear design, exposure, void fraction, and control state. These factors are considered when calculating the axially integrated powers for individual rods. The two-dimensional distribution of integrated rod powers for a bundle is then used to calculate individual rod R-factors. The bundle R-factor for a particular bundle average exposure and control fraction is the maximum of all of the individual fuel rod R-factors. The steps used in the R-factor calculational process are as follows:

1. Obtain relative 2D rod-by-rod power distributions from TGBLA, which are a function of lattice nuclear design, average exposure, void fraction, and control state.
2. [[

   ]]
3. Calculate an R-factor for each individual fuel rod. [[

   ]]
4. The bundle R-factor is the maximum value of all the individual rod R-factors.
5. Repeat these calculations for each desired bundle average exposure, control fraction, and channel bow.

4.3 BUNDLE AVERAGE AXIAL DISTRIBUTIONS

A 25-node axial shape is used to define a bundle axial relative power shape for the purposes of calculating R-factors. This shape is a function of control fraction. Bundle axial void fraction and bundle axial relative exposure shapes are used to determine two-dimensional radial distributions as a function of axial height.

[[

]]

- The **bundle axial relative exposure shape** is defined as the shape that is uniquely consistent with the uncontrolled axial relative power shape assuming uniform fuel density; and
- The **bundle axial void fraction shape** is defined as a shape that is consistent with the uncontrolled axial relative power shape and gives a prototypical bundle average void fraction.

Figure 4-1 provides a summary of the normalized axial power/exposure shapes and the axial void fraction for the GE14E fuel. The corresponding numbers are listed in Table 4-2.

[[

(4-1)

]]

Figure 4-1 GE14E Axial Shapes for Rod Power Integration

4.4 R-FACTOR DISTRIBUTION

[[

]]

4.5 R-FACTOR CALCULATION EXAMPLES

Using the procedures defined in the previous sections, R-factors are calculated for different lattice locations in a bundle as a function of fuel assembly exposure, control state, and channel bow using Equation 4-1. The following example is for a 10x10 lattice (GE14E).

Consider Equation 4-1 for the various cases as shown in Figure 4-2:

Corner Rod:
Applying Equation 4-1 to a corner rod (as in Figure 4-2a),

[[

]] (4-2)

Side Rod:
Applying Equation 4-1 to a side rod (as in Figure 4-2b),

[[

]] (4-3)

Interior Rod:

Applying Equation 4-1 to an interior rod (as in Figure 4-2c),

[[

]] (4-4)

If there is one unheated lattice position (as in Figure 4-2d),

[[

]] (4-5)

If there are two unheated lattice positions (as in Figure 4-2e),

[[

]] (4-6)

If there are four unheated lattice positions (as in Figure 4-2f),

[[

]] (4-7)

A summary of the R-factor calculational method for each GE14E lattice position (as identified in Figure 4-2) is given in Table 4-1.

4.6 FUEL ASSEMBLY R-FACTOR

The fuel assembly R-factor is determined in accordance with Equation 4-8 for any specified fuel assembly exposure, control state and channel bow.

$$R = \overline{Max}\left[R_i\right] \qquad \text{taken over all } i \qquad (4\text{-}8)$$

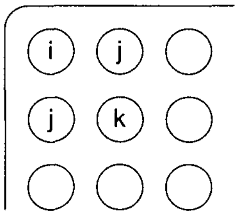

Figure 4-2a

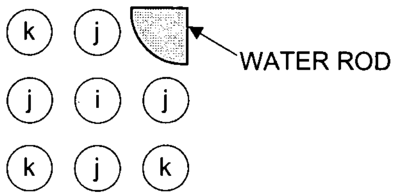

Figure 4-2d

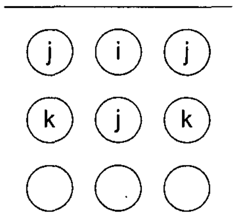

Figure 4-2b

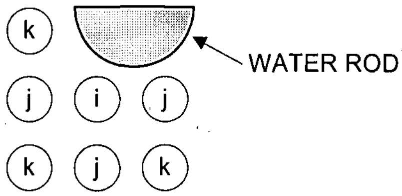

Figure 4-2e

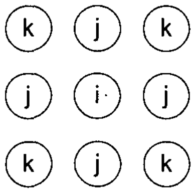

Figure 4-2c

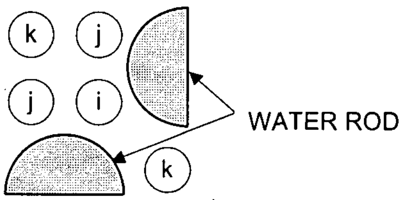

Figure 4-2f

Figure 4-2 Identification of Rods in Positions Adjacent to Rod i

Table 4-1 R-factor Calculation by Lattice Position

Lattice Position	Apply Figure	Use Equation
1,1	4-2a	4-2
1,2	4-2b	4-3
1,3	4-2b	4-3
1,4	4-2b	4-3
1,5	4-2b	4-3
2,2	4-2c	4-4
2,3	4-2c	4-4
2,4	4-2c	4-4
2,5	4-2c	4-4
3,3	4-2c	4-4
3,4	4-2c	4-4
3,5	4-2d	4-5
3,3A	4-2d	4-5
3,4A	4-2e	4-6
3,5A	4-2e	4-6
4,4	4-2c	4-4
4,5	4-2e	4-6
5,5	4-2f	4-7

Table 4-2 GE14E Axial Shapes for Rod Power Integration

[[

]]

5. SUMMARY AND CONCLUSION

The GEXL critical power correlation for conventional GE14 10x10 fuel (GEXL14) was developed using data obtained from the ATLAS critical power test facility. The ESBWR version of GE14 (GE14E) has been developed for ESBWR application. The GE14E fuel is identical to GE14 fuel, except for those features related to the axial length of the fuel, i.e.,

- The total fuel axial length
- The number and axial location of the fuel rod spacers
- The axial length of the part length rods

Due to the similarity between the GE14 and GE14E fuels, the GEXL14 correlation has been applied to GE14E fuel. The statistical evaluation of the GEXL14 for GE14E was performed based on the ATLAS critical power data and the subchannel analyses (Reference 1).

Full-scale critical power and pressure drop tests for a simulated GE14E fuel bundle were conducted to collect sufficient data to validate the use of the GEXL14 correlation and demonstrate the adequacy of the established GEXL14 statistics for the GE14E fuel. The GE14E full-scale testing was performed in the Stern Laboratories test facility in Hamilton, Ontario. A wide range of the operating conditions of pressure, mass flux, and inlet subcooling were tested and a number of rod to rod peaking patterns were simulated with [[
]]

[[
]] As for the specific GEXL14 correlation, the GEXL14 sensitivity to axial power shape was demonstrated from the following facts:

- The original GEXL14 correlation was developed from the GE14 critical power data with [[ ]]
- Additional [[ ]] power distribution GE14 data generated in the ATLAS facility subsequent to the original GEXL14 development validates the axial power shape effects and has demonstrated that the axial power shape effect is well predicted by GEXL14 (Reference 2).
- Additional [[ ]] axial power distribution GE14 data generated in the Stern test facility subsequent to the original GEXL14 development and validation provides further validation that the axial power shape effect is well predicted by GEXL14 (Reference 2).

The statistical evaluation of the GEXL14 is performed for the Stern GE14E critical power data. It has been confirmed that the GEXL14 correlation accurately predicts critical power performance of the GE14E fuel. The R-factor methodology accepted by the NRC (Reference 4) is applied to evaluate the R-factor for the GE14E fuel, and the R-factor methodology is confirmed by virtue of the adequacy of the GEXL14 correlation statistics and trend characteristics for the GE14E critical power database. The established GEXL14 statistics for the GE14E fuel in Reference 1 is confirmed to be conservative.

The qualification of the GEXL14 correlation to transients was accomplished by comparing the predicted change in critical power ratio with full-scale GE14 transient tests (Reference 2). GEXL14 is considered qualified to predict the transient critical power response of GE14E fuel as 1) the original GEXL14 is qualified to transient tests of GE14, 2) the adequacy of the GEXL14 statistics and trend characteristics for the GE14E steady-state database is confirmed, 3) the established GEXL14 licensing basis statistics for the GE14E are conservative, and 4) the limiting transients in the ESBWR such as Inadvertent Isolation Condenser Initiation or Loss of Feedwater Heating events are slow transients, or quasi-steady state events, therefore, the GEXL14 correlation qualified for the GE14 fast transients and confirmed for the GE14E steady-state data is expected to adequately predict the GE14E transients in ESBWR.

6. REFERENCES

1. NEDC-33237P, *GE14 for ESBWR – Critical Power Correlation, Uncertainty, and OLMCPR Development*, Revision 4, July 2008.

2. NEDC-32851P, *GEXL14 Correlation for GE14 Fuel*, Revision 5, January 2008.

3. GE Nuclear Energy, *ESBWR Design Control Document Tier 2 Chapter 15 Safety Analyses*, 26A6642BP Revision 5, May 2008.

4. NEDC-32505P-A, *R-Factor Calculation Method for GE11, GE12, and GE13 Fuel*, Revision 1, July 1999.

Enclosure 3

MFN 08-711 Supplement 1

Submittal of NEDC-33413P Revision 1
and
NEDO-33413 Revision 1

"Full Scale Critical Power Testing of GE14E and Validation of GEXL14E"

Affidavit

Global Nuclear Fuel – Americas, LLC

AFFIDAVIT

I, Andrew A. Lingenfelter, state as follows:

(1) I am Vice President, Fuel Engineering, 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 GEH's letter, MFN 08-711 Supplement 1, Mr. Richard E. Kingston to U.S. Nuclear Energy Commission, entitled *Submittal of NEDC-33413P Revision 1 and NEDO-33413 Revision 1 "Full Scale Critical Power Testing of GE14E and Validation of GEXL14E"* dated December 16, 2008. The proprietary information in Enclosure 1, which is entitled *MFN 08-711 Supplement 1 – Submittal of NEDC-33413P Revision 1 "Full Scale Critical Power Testing of GE14E and Validation of GEXL14E" – GNF Proprietary Information,* is delineated by a [[dotted underline inside double square brackets{3}]]. Figures and large equation objects are identified with double square brackets before and after the object. In each case, 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, resulting in potential products 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 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. 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. Its initial designation as proprietary information, and the subsequent steps taken to prevent its unauthorized disclosure, are as set forth in paragraphs (6) and (7) following.

(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 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 to GNF-A.

(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 information 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.

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 on this 16th day of December 2008.

Andrew A. Lingenfelter

Andrew A. Lingenfelter
Global Nuclear Fuel – Americas, L.L.C