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RS-12-204

November 29, 2012

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555

Clinton Power Station, Unit 1
Facility Operating License No. NPF-62
NRC Docket No. 50-461

Subject: Reports Associated with Results of Post-Irradiation Examination (PIE) of Global Nuclear Fuel (GNF) GE14i Isotope Test Assembly (ITA)

References:

1. Letter from C. S. Goodwin (U. S. NRC) to C. G. Pardee (Exelon Generation Company, LLC), "Clinton Power Station, Unit No.1 -Issuance of Amendment Re: Request to Modify Facility Operating License in Support of the Use of Isotope Test Assemblies (TAC NO. ME1643)," dated January 15, 2010
2. Letter from D. M. Gullott (Exelon Generation Company, LLC) to U. S. NRC, "Reports Associated with Results of Post-Irradiation Examination (PIE) of Global Nuclear Fuel (GNF) GE14i Isotope Test Assembly (ITA)," dated May 14, 2012

This letter completes the reporting requirements associated with the PIE results, of a GNF GE14i ITA bundle, performed by GNF for Clinton Power Station. The reporting of this information is required by the NRC as discussed in Condition 11, of the Conditions and Limitations section, in Reference 1.

Reference 2 reported the results of the poolside visual and poolside combined instrumentation measurement system (COINS) examination requirements. The remaining results, of the poolside gamma scan measurements and segmented rod hot cell destructive examination, are included in attachments 1 through 4 of this letter.

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This submittal is subdivided as follows.

- Attachment 1 provides a proprietary version, including an affidavit from GNF attesting to the proprietary nature of the information, of the results of a hot cell destructive examination of GE14i rod segments.
- Attachment 2 provides a non-proprietary version of the results of a hot cell destructive examination of GE14i rod segments.
- Attachment 3 provides a proprietary version, including an affidavit from GNF attesting to the proprietary nature of the information, of the results for the GE14i Pin-by-Pin gamma scan measurements.
- Attachment 4 provides a non-proprietary version of the results for the GE14i Pin-by-Pin gamma scan measurements.
- Attachment 5 provides the affidavit from GNF attesting to the proprietary nature of NEDC-33787P
- Attachment 6 provides the affidavit from GNF attesting to the proprietary nature of NEDC-33784P.

Portions of the information in Attachments 1 and 3 are proprietary to GNF, and are supported by affidavits signed by GNF, the owner of the information. The affidavits, provided in Attachment 5 and 6, set forth the basis on which the information may be withheld from public disclosure by the NRC and addresses, with specificity, the considerations listed in paragraph (b)(4) of 10 CFR 2.390, "Public inspections, exemptions, requests for withholding." Accordingly, it is respectfully requested that the information be withheld from public disclosure in accordance with 10 CFR 2.390. Non-proprietary versions of the information contained in Attachments 1 and 3 are provided in Attachments 2 and 4, respectively.

There are no regulatory commitments contained in this letter. Should you have any questions concerning this letter, please contact Mr. Thomas J. Griffith at (630) 657-2818.

Respectfully,

Patrick R. Simpson
Manager – Licensing

Attachments:

1. Hot Cell Inspection of Clinton Cycle 13 GE14i Rod Segments – Proprietary
2. Hot Cell Inspection of Clinton Cycle 13 GE14i Rod Segments – Non-Proprietary
3. Clinton GE14i Pin-by-Pin Gamma Scan Report – Proprietary
4. Clinton GE14i Pin-by-Pin Gamma Scan Report – Non-Proprietary
5. Affidavit for NEDC-33787P Revision 0
6. Affidavit for NEDC-33784P Revision 0

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ATTACHMENT 2

Hot Cell Inspection of Clinton Cycle 13 GE14i Rod Segments

Non-Proprietary

Global Nuclear Fuel

A Joint Venture of GE, Toshiba & Hitachi

Global Nuclear Fuel

NEDO-33787
Revision 0
DRF Section 0000-0153-4519 R1
November 2012

NON-PROPRIETARY INFORMATION – CLASS I (PUBLIC)

Hot Cell Inspection of Clinton Cycle 13 GE14i Rod Segments

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ACRONYMS AND ABBREVIATIONS

Term	Definition
BWR	Boiling Water Reactor
GEH	GE Hitachi Nuclear Energy
GNF	Global Nuclear Fuel
GWd/MT	GigaWatt – Day/ Metric Ton
ID	Inside Diameter
ITA	Isotope Test Assembly
OD	Outside Diameter
S/N	Serial Number
VNC	Vallecitos Nuclear Center

ABSTRACT

Nine rod segments from GE14i bundle JYK690 in the [[ ]] pin position were retrieved from Clinton Power Station for non-destructive and destructive post-irradiation examination at the GEH Vallecitos Nuclear Center hot cells in Sunol, California. The [[ ]] segmented isotope rod was irradiated for one full cycle during Cycle 13 in an assembly that achieved a [[ ]] GWd/MT burnup. The examination focused on characterizing the rod segments' mechanical integrity. The examination confirmed that the GE14i segmented isotope rod exhibited excellent mechanical integrity and performed as intended.

1. INTRODUCTION

Segmented isotope rods containing nickel-coated, reactor grade Co-59 isotope targets have been irradiated in a GE14i Isotope Test Assembly (ITA) for one 23-month cycle in Clinton's Cycle 13. A single segmented isotope rod (Serial Number (S/N) 0196CBT) was retrieved from the [[ ]] position in the assembly JYK690 and delivered to the GE Hitachi Nuclear Energy (GEH) Vallecitos Nuclear Center (VNC) located in Sunol, California for post-irradiation examination. The JYK690 bundle achieved an exposure of [[ ]] GWd/MT.

The objectives of the examination were to confirm successful performance of the segmented isotope rod design by verifying that the physical integrity of the segmented isotope rods has been maintained and has not degraded during irradiation and to demonstrate the functionality and process of retrieving and removing cobalt targets from the segmented isotope rods. This report provides a summary of the hot cell work performed to complete these objectives.

The following sections of the report summarize details of the hot cell examination that included visual inspection of all intact rod segments, visual inspection of the three segments that were opened, removal of cobalt targets from the three segments that were opened, and optical microscopy of selected components.

2. GE14I SEGMENTED ISOTOPE ROD DESCRIPTION

The segmented isotope rod is comprised of [[ ]]. The nominal pre-irradiation length of [[ ]] inches and the length of [[ ]] inches, excluding the portion of the male threaded connector beyond the mating shoulder. The threaded male connector beyond the mating shoulder lengthens each segment by [[ ]] inches. After arrival at VNC, the rod segments were assigned identification numbers, with #1 being at the bottom of the bundle and #9 being at the top of the bundle.

Each rod segment consists of an outer Zircaloy-2 barrier tube ("outer tube") that has [[ ]]. There is an inner Zircaloy-2 barrier tube within each outer tube ("inner tube"). And there is a Zircaloy-2 canister within each inner tube ("canister"). The canister has [[ ]]. When the canister is sealed within the inner tube, it is then called an "inner capsule."

3. MECHANICAL INSPECTION

This section contains the results of visual inspection of the outer portion of the nine as-received rod segments, visual inspection of the inner components of the three rod segments that were opened, and optical microscopy of sections of the outer tube and inner tube from Segment 6.

3.1 VISUAL INSPECTION OF INTACT AS-RECEIVED SEGMENTS

The GE14i segmented isotope rod was received in the disassembled condition without its upper or lower endplug extensions. Each of the nine separate segments was visually inspected in the as-received condition. Each segment was placed in a slotted tray adjacent to a ruler that had 1 inch major divisions and 0.1 inch minor divisions. The segment was then viewed through a Kollmorgen periscope from top to bottom in 90 degree increments to identify any visible anomalies. A common set of digital photographs were taken of each segment to document the general condition of the threaded connectors and welds on each end, the serial number on the bottom end, and the cladding outer tube in general.

Figures 1 through 10 show the segments in the as-received condition. In general, all segments are in good condition and exhibit [[

]].

3.2 VISUAL INSPECTION OF INNER SURFACE OF OUTER TUBE

Four inch long blanks of the outer tube from Segments 2, 6, and 9 were clam-shelled so that the inner surface of the outer tube could be examined. The blanks were obtained from approximately the middle of the segment for Segments 6 and 9 and near the top of the segment for Segment 2. Photographic documentation of the inner surface is shown in Figure 11. [[

]].

3.3 VISUAL INSPECTION OF CENTERING PEG FOR INNER CAPSULE

Sectioning of the male threaded connector for Segments 2, 6, and 9 passed through and released a portion of the centering peg that is integral to the outer tube's male and female threaded connectors. [[

]]. The condition of the centering pegs is shown in Figure 12. [[

]].

3.4 VISUAL INSPECTION OF INTACT INNER CAPSULE

The inner capsules from Segments 2, 6, and 9 were released from their rod segments by removing the male threaded connector of each segment. Once the segment was opened and the cut surface deburred, the inner capsules easily slid out by tilting the segment. The outer surfaces of the intact inner capsules were then visually inspected. An arbitrary zero degree reference was established by placing a red paint dot near the top of each inner capsule. Each segment was placed in a slotted tray adjacent to a ruler that had 1 inch major divisions and 0.1 inch minor divisions. The capsule was then viewed through a Kollmorgen periscope from top to bottom in 90 degree increments to identify any visible anomalies. A common set of digital photographs were taken of each capsule in the zero degree orientation to document the general condition of the end caps and welds on each end, and the cladding. Additional photographs were taken of the top and bottom end caps at an angle to view the end cap female threads.

Figures 13 and 14 show the condition of the intact inner capsules. [[

]].

3.5 VISUAL INSPECTION OF INNER SURFACE OF INNER CAPSULE TUBE

Four inch long blanks of the inner capsule tube from Segments 2, 6, and 9 were clam-shelled so that the inner surface of the inner capsule tube could be examined. The blanks were obtained from approximately the middle of the segment for all three segments. Photographic documentation of the inner surface is shown in Figure 15. [[

]]. Numerous fresh scratches exist on the inner surface of the inner tubing, which were caused by twisting and pulling the tightly held canister to remove it from the inner capsule. The inner surface of Segment 9 [[

]]. A small piece of the inner capsule from this segment was examined metallographically to investigate these features and is discussed further in Section 3.7.

3.6 VISUAL INSPECTION OF CANISTER AND COBALT TARGETS

The canisters containing the cobalt targets were removed from the inner capsules from Segments 2, 6, and 9. An example of the Segment 2 canister being pulled from its capsule is shown in Figure 16. In this figure, cobalt targets are visible sitting both upright and on their sides within the canister as designed.

Examples of the condition of batches of targets removed from each of the three canisters are shown in Figure 17. [[
]].

Photographic documentation of the removed canisters is shown in Figure 18. As expected, there were occasional targets that were stuck in each of the three canisters (Figure 19); [[
]].

3.7 OPTICAL MICROSCOPY OF OUTER TUBE AND INNER TUBE SAMPLES

After completing the basic visual inspections and target removal, two samples were prepared for optical microscopy. The first sample (F360) was obtained from the outer tube from Segment 6 and the second (F361) from the inner tube of Segment 9. The outer tube is exposed to the boiling water reactor (BWR) reactor water so the primary purpose of its examination was to evaluate the waterside [[ ]]. The primary purpose of examining the inner tube was to evaluate the [[
]].

Approximately ½ inch long samples were sectioned from their parent tubes. The outer tube sample was a full ring but the inner tube sample was an approximately 180 degree arc of a ring. The samples were mounted, ground and polished with standard metallographic techniques. [[
]]. After polishing, the inner and outer surfaces of both samples were examined at high magnification. Once the polished examination was completed, the samples were [[
]]. Digital images were obtained to document the examination in both polished and etched conditions. [[
]]. Images of the calibration slide scales were placed in the report with the same image size conditions (Figure 20). Feature lengths shown in the micrographs can be obtained by reference to these slide scales. [[ ]] of the inner tube is consistent with as-fabricated levels [[ ]]. [[ ]] of the outer tube is [[ ]].

Figures 21 and 22 show the examination results for the outer tube and Figures 23 through 25 for the inner tube. [[
]]. The waterside

surface of the outer tube has a [[

]]. The outer tube shows no visible signs of interaction with the inner capsule (e.g., wear) and is in excellent condition. There is some [[

]].

[[

]].

[[

]]

Figure 1 Visual Inspection of As-Received Segment 9 (S/N 0166CBT)

[[

]]

Figure 2 Visual Inspection of As-Received Segment 9 (S/N 0166CBT)

[[

]]

Figure 3 Visual Inspection of As-Received Segment 9 (S/N 0166CBT)

[[

]]

Figure 4 Visual Inspection of As-Received Segment 6 (S/N 0327CBT)

[[

]]

Figure 5 Visual Inspection of As-Received Segment 6 (S/N 0327CBT)

[[

]]

Figure 6 Visual Inspection of As-Received Segment 6 (S/N 0327CBT)

[[

]]

Figure 7 Visual Inspection of As-Received Segment 3 (S/N 0315CBT)

[[

]]

Figure 8 Visual Inspection of As-Received Segment 2 (S/N 0436CBT)

[[

]]

Figure 9 Visual Inspection of As-Received Segment 2 (S/N 0436CBT)

[[

]]

Figure 10 Visual Inspection of As-Received Segment 2 (S/N 0436CBT)

[[	Serial Number 0166CBT Segment 9 Vial 65824
	Serial Number 0327CBT Segment 6 Vial 65825
]]	Serial Number 0436CBT Segment 2 Vial 65826

Figure 11 Visual Inspection of Inner Surfaces of Outer Tubes from Segments 2, 6, and 9

[[	Serial Number 0166CBT Segment 9
	Serial Number 0327CBT Segment 6
]]	Serial Number 0436CBT Segment 2

Figure 12 Visual Inspection of Capsule Centering Pegs from Segments 2, 6, and 9

[[			0166CBT Seg. 9
			0327CBT Seg. 6
			0436CBT Seg. 2
		]]	

Figure 13 Visual Inspection of Inner Capsules from Segments 2, 6, and 9

[[		0166CBT Segment 9
		0327CBT Segment 6
		0436CBT Segment 2
	]]	

Figure 14 Visual Inspection of Inner Capsules from Segments 2, 6, and 9

[[	Serial Number 0166CBT Segment 9 Vial 65831
	Serial Number 0327CBT Segment 6 Vial 65834
]]	Serial Number 0436CBT Segment 2 Vial 65828

Figure 15 Visual Inspection of Inner Surfaces of Inner Capsules from Segments 2, 6, and 9

[[

]]

Figure 16 Extraction of Targets Utilizing Canister Extraction Tool

[[	Serial Number 0166CBT Segment 9
	Serial Number 0327CBT Segment 6
]]	Serial Number 0436CBT Segment 2

Figure 17 Visual Inspection of Extracted Targets from Segments 2, 6, and 9

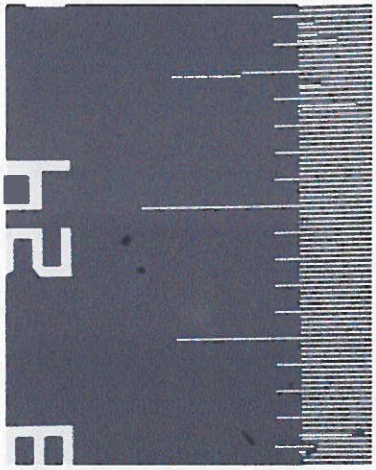
[[		Serial Number 0166CBT Segment 9
		Serial Number 0327CBT Segment 6
	]]	Serial Number 0436CBT Segment 2

Figure 18 Visual Inspection of Canisters from Segments 2, 6, and 9

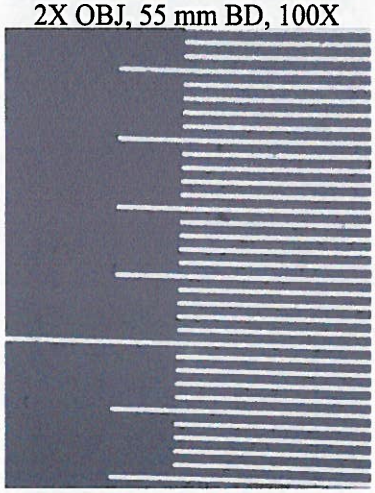
[[

]]

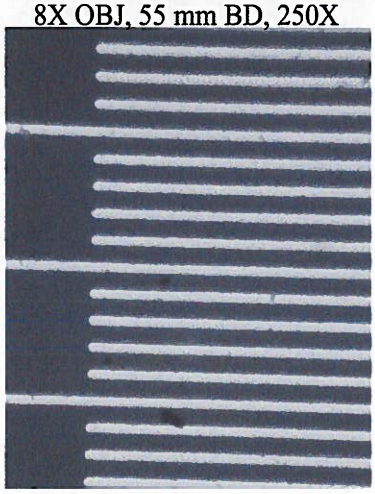
Figure 19 Stuck Target in Canister from Segment 0166CBT



2X OBJ, 55 mm BD, 100X



8X OBJ, 55 mm BD, 250X



13.5X OBJ, 61 mm BD, 500X

Figure 20 Calibration Scale at Original Magnifications of 100, 250, and 500X Magnifications; Smallest Division is 20 Microns

[[		
		]]

Figure 21 Polished Metallographic Cross-Sections from Segment 6 Outer Tube Showing [[ ]]

[[

]]

Figure 22 Etched Metallographic Cross-Section from Segment 6 Outer Tube Showing [[ ]]

[[

]]

Figure 23 Polished Metallographic Cross-Sections from Segment 9 Inner Tube Showing [[ ]]

[[	
	]]

Figure 24 Polished Metallographic Cross-Sections from Segment 9 Inner Tube Showing [[ ]]

[[

]]

Figure 25 Etched Metallographic Cross-Section from Segment 9 Inner Tube Showing [[ ]]

4. SUMMARY AND CONCLUSIONS

The nine segments comprising a single GE14i segmented isotope rod (JYK690 [[ ]]) have been examined in the GEH hot cells to ascertain their integrity and design functionality after one irradiation cycle in the Clinton BWR. The examination confirmed that the GE14i segmented isotope rod exhibited excellent mechanical integrity and performed as intended. Highlights of the examination include the following:

- General waterside Zircaloy cladding corrosion (oxide thickness) was about [[ ]], which is near the detection limit of the measurement technique that was used. The [[ ]]. The presence of the targets did not accelerate corrosion in any manner.
- [[ ]] of the inner tube is consistent with as-fabricated levels [[ ]]. [[ ]] of the outer tube is [[ ]].
- Spacer contact wear marks were observed, which is a normal occurrence. The extent of the contact wear is normal.
- The rod segments maintained their physical integrity as demonstrated by the lustrous, metallic unoxidized appearance on the inside of the three segments that were opened.
- The inner surface of the inner capsule exhibited a [[ ]] and one segment (#9) exhibited [[ ]] on the inner surface. The features were examined by optical microscopy that showed them to be [[ ]].
- As expected, superficial wear was observed between the inner capsule and male threaded connector centering pegs.
- No noticeable wear was observed between the cladding surfaces of the inner capsule and the outer tube or between the cladding surfaces of the inner capsule and canister.
- Overall, the GE14i exhibits fully satisfactory mechanical integrity after one cycle of irradiation; no mechanical design aspects require re-examination after the next cycle or at end of life.

ATTACHMENT 4

Clinton GE14i Pin-by-Pin Gamma Scan Report

Non-Proprietary

Global Nuclear Fuel

A Joint Venture of GE, Toshiba, & Hitachi

Global Nuclear Fuel

NEDO-33784
Revision 0
DRF Section 0000-0153-6562 R0
October 2012

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GE14i Pin-by-Pin Gamma Scan at Clinton December 2011

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Acronyms and Abbreviations

Term	Definition
BAZ	Bottom of the Active Zone
BOC	Beginning of Cycle
BWR	Boiling Water Reactor
CALTIP	Calibrated Traversing In-Core Probe
CYCEXP	Cycle Exposure
DAS	Data Acquisition System
EOC	End of Cycle
GE	General Electric
GEH	GE Hitachi Nuclear Energy
GNF	Global Nuclear Fuel
HPGe	High Purity Germanium
IAT	Bundle Number
LPRM	Local Power Range Monitor
OIEP	Operational Information Exchange Provision
PCTIP	Process Computer Traversing In-Core Probe
PLR	Part Length Rod
RMS	Root Mean Square
RP	Reactor Power
TIP	Traversing In-Core Probe
VABS	Variable Absorber Section
VAD	Variable Aperture Device
WCT	Core Flow in Mlbm/hr
WSGS	Water Submersible Gamma Spectrometer

Abstract

Gamma scanning is a non-destructive method to determine the relative fission product inventory in nuclear fuel. A pin-by-pin gamma scan on a GE14i 10x10 fuel assembly was completed in 2011 at the Clinton Power Station at the end of Cycle 13. Measurements of La^{140} from Gad and UO_2 rods allow comparison of relative predicted and measured pin powers. The agreement between the measurements and predictions using the TGBLA06 lattice physics code and the PANAC11 boiling water reactor (BWR) core simulator is adequate, with a corrected standard deviation of [[ ]] for Ba^{140} / La^{140} using the traditional comparison basis. The data validates the applicability of lattice power distribution uncertainties used for modern BWR core and fuel designs for the GE14i bundle designs.

1. Introduction

1.1 Overview

Power distribution validation data for operating boiling water reactors is routinely taken in the form of traversing in-core probe (TIP) measurements. In this case, the average power of the four bundles surrounding the instrument tube is detected via a neutron sensitive or gamma sensitive detector. For potentially greater resolution and at greater effort and cost, gamma scanning of La^{140} is an independent, non-destructive method to determine the relative power distributions in nuclear fuel. Gamma scan measurements for the purpose of power distribution validation may be made on either bundle average or pin-by-pin measurements. The gamma scanning techniques can also be applied for measuring the relative exposures (Cs^{137}).

The subject of this document is pin-by-pin gamma scan measurements made at the Clinton Power Station in December of 2011 at the end of cycle 13 (EOC13). One bundle was scanned, bundle JYK690. This bundle was a GE14i (Reference 1) once-burnt fuel assembly loaded at beginning of cycle 13 (BOC13). For the gamma scan, the bundle upper tie plate was removed and individual fuel pins transferred to the water submersible gamma spectrometer located in the spent fuel pool for measurement. The fuel assembly was then reassembled, with one segmented isotope rod [[ ]] replaced with a new segmented isotope rod. Subsequently, the once-burnt GE14i bundle was re-loaded into the core during the outage, [[ ]] was shipped to the GE Hitachi Nuclear Energy (GEH) Vallecitos Nuclear Center in California for further examination.

1.2 Gamma Scan Measurements

Gamma scan programs vary by specification of the physical locality of the measurement, time of performing the measurement, measuring time, and number of measurements. For example, the technique for measurements of "power" calls for detection of the 1.6 MeV gamma ray that accompanies beta decay of La^{140} with a half-life of 40.2 hours. La^{140} accumulates in fuel mainly from the beta decay of the fission product Ba^{140} that has a half-life of 12.8 days. After about 10 days following reactor shutdown, La^{140} atom density is proportional to the Ba^{140} atom density and decays with the Ba^{140} half-life. The Ba^{140} distribution in fuel is characteristic of the fission distribution or integrated power history over the last five half-lives, or approximately 60 - 120 days of reactor operation.

Thus, the scan results can be used to determine "recent" core power distribution. The 12.8 day half-life of Ba^{140} also makes it imperative that the gamma scan data be collected as soon as possible after core shutdown, usually during refueling operations, because bundles with powers of interest are normally reinserted for additional use. Reference 2 summarizes the most recent pin-by-pin gamma scan measurements for power distributions (Ba^{140} / La^{140}).

2. Plant Description

2.1 Bundle JYK690

The gamma scanned bundle was a GE14i once-burnt fuel assembly originally loaded at BOC13. Table 2-1 summarizes general information regarding the bundle that was disassembled, gamma scanned, and then reassembled. The once-burnt bundle JYK690 was reinserted into the core at the completion of the gamma scan measurements. The EOC exposures are taken from the official 3DM™ PANAC11 wrap-up from the site.

More information regarding the bundle design and history for this bundle is provided in the following sections. For more detailed information regarding the GE14i bundle design, see Reference 1.

Table 2-1 Gamma Scan Bundle Location in Cycle 13

Bundle ID	IAT (1) Type	Bundle Name	Cycle 13 Location Site Coordinates	Cycle 13 Location PANACEA Coordinates	EOC13 Exposure GWd/ST	EOC13 Exposure GWd/MT
JYK690	[[					]]

Note:

1. IAT: Bundle Number

2.2 Location of Bundle JYK690

Figure 2-1 provides the locations of the TIP strings in Clinton, with each TIP instrument tube identified by the TIP string number. The location of the bundle scanned in Cycle 13 is identified in green in this figure. The TIP string is located at the bottom, right hand corner of the bundle with the TIP string number. The locations of the Sequence A-2 control rods are marked in a red outline. The TIP locations do not change between cycles. Note that JYK690 is adjacent to an instrument tube.

[[

]]

Figure 2-1 TIP Locations for Clinton

3. Fuel Description

The GE14i bundle loaded into Clinton has a 150 inch active fuel length, with [[ ]] inches of natural enrichment at the top and bottom of the UO_2 rods, as seen in Figures 3-1 and 3-2. The Gad rod, however, only has an active length of [[ ]] inches.

[[

]]

Figure 3-1 Description of Bundle 3243 – JYK690

[[

]]

Figure 3-2 Rod Types in GE14i Bundle (Candle Stick)

4. Clinton Cycle 13 Operation

The first official exposure accounting case for Cycle 13 started on February 8, 2010. The last official exposure accounting case ended November 29, 2011. The inventory of fuel in the core at BOC is provided in Table 4-1. The location of bundle JYK690 in Cycle 13 is provided in Figure 2-1. A series of [[ ]] off-line core-tracking cases deplete the core to the cycle average exposure of [[ ]] at EOC13. At the end of the cycle, there were two blades at Notch 10. These control blades were located symmetrically in the core along the center axis. Figures 4-1 and 4-2 summarize the Cycle 13 plant operation, as derived from the official off-line core tracking. From Figure 4-2, it is apparent that there were no outages during this complete operating cycle.

Table 4-1 Bundle Inventory Cycle 13

Bundle Name	IAT	# in Core	# Fresh	AvgWt KG	AvgExp GWd/ST
[[					
					]]

[[

]]

Figure 4-1 Core Power and Notches Inserted Cycle 13 Off-Line Core Tracking vs. Cycle Exposure

[[

]]

Figure 4-2 Total % Rated Core Power and % Rated Flow and Notches Inserted Cycle 13 Off-Line Core Tracking vs. Date

4.1 Off-Line Core Tracking and TIP Comparisons

The normal off-line core tracking used to maintain the Global Nuclear Fuel (GNF) / GEH core models with PANAC11 uses a small sub-set of the on-line 3DM™ cases that are produced in the on-line core monitoring process. In addition, the off-line core tracking is non-adapted, as compared to the on-line core tracking. In the on-line model, the thermal limits are modified via comparisons to measured TIP and local power range monitor (LPRM) readings using "shape adaption."

In the shape adaption process, the radial power calculated by the core simulator is not modified, but the axial shape of the power distribution is modified using the plant TIP and LPRM information. In the on-line system, these modified power distributions are used only for thermal margin evaluations.

4.2 Off-Line TIP Comparisons

This section documents the off-line TIP comparisons derived from the inputs used in the normal off-line core tracking when augmented with retrieval of the measured TIP data. There were sixteen different sets of LPRM calibration data obtained from the site via the Operational Information Exchange Provision (OIEP) data transmittals from Clinton to GNF. Some of these were separated by only a few hours.

4.2.1 TIP Machine Assignments

Figure 2-1 has previously provided the location of the 33 TIP strings. Figure 4-3 provides the assignment of the TIP string to TIP machines. The common channel is at location [[

]]

4.2.2 Off-Line Non-Adapted TIP Comparisons

TIP comparisons based on the normal off-line non-adapted core tracking are summarized in Table 4-2. The radial (or Bundle) root mean square (RMS) is larger than would be expected for a gamma TIP plant, but these values are reasonable for a thermal TIP plant, which is the case for Clinton.

[[

]]

Figure 4-3 TIP Machine Assignments for Clinton

Table 4-2 Summary of TIP Statistics Non-Adapted Offline PANAC11

Case	Qualifier	CYCEXP (1) MWd/ST	RP (1) MW(t)	WCT (1) Mlbm/hr	Bundle RMS	Axial RMS	Nodal RMS	PCTIP (1) Symmetry	CALTIP (1) Symmetry
1	[[								
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									]]
	RMS				[[				
	Mean								
	Standard Deviation								
	Minimum								
	Maximum								]]

Note:

1. CALTIP: Calibrated Traversing In-Core Probe
   CYCEXP: Cycle Exposure
   PCTIP: Process Computer Traversing In-Core Probe
   RP: Reactor Power
   WCT: Core Flow

5. Comparisons of Predicted BA^{140} Distributions

This section contains comparisons of predicted Ba^{140} distributions without comparison to the measured data. Also note that only relative predictions are provided, with no absolute values, as the experimental data will also only be relative measurements, not absolute values.

5.1 Predictions of Pin-by-Pin Ba^{140} with PANAC11 Non-Adapted Core Tracking

Figure 5-1 provides the pin-by-pin Ba^{140} distributions for the [[ ]] rods measured as part of the power gamma scan at Clinton.

[[

]]

Figure 5-1 Predicted Pin-by-Pin Ba^{140} Distributions – Non-Adapted

6. Gamma Scan Equipment and Program Description

The Water Submersible Gamma Spectrometer (WSGS) measures gamma emissions from individual irradiated fuel rods in the plant spent fuel pool. Figure 6-1 identifies the various components of the WSGS.

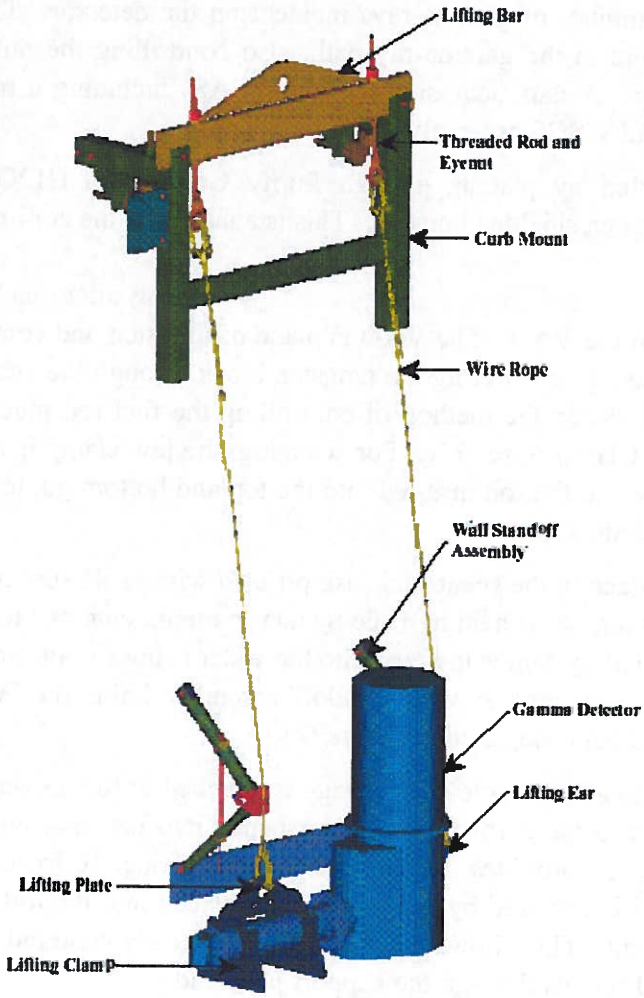

Figure 6-1 Components of the Water Submersible Gamma Spectrometer

6.1 Water Submersible Gamma Spectrometer

The WSGS is comprised of several components. These are a high purity germanium detector, a shielded housing, an attached collimator with an installed collimator slit, a Variable Aperture Device (VAD), and a Variable Absorber Section (VABS). The collimator slit size is selected according to the application and fuel rod activities. The VAD controls the opening between the fuel rod in front of the collimator and the shield block opening at the detector. A larger VAD opening increases the number of gamma-rays incident on the detector. The VABS allows the option to insert absorbers in the gamma-ray path, also controlling the number of gamma-rays incident on the detector. A data acquisition system (DAS) including a motion control unit is joined to the detector and WSGS assembly.

The WSGS is assembled by placing a High Purity Germanium (HPGe) detector into the watertight lead and tungsten shielded housing. This is attached to the collimator as in Figure 6-1. [[ ]] opening along its horizontal axis. The collimator is attached to the VAD. The VAD is made of tungsten and controls the opening size leading to the slit by raising or lowering the tungsten block through the gamma-ray path. At the end of the assembly is placed the method of controlling the fuel rod placement in front of the scanner called the Jaw Clamp Assembly. For scanning, the jaw clamp is attached to the end of the collimator assembly and the rod inserted into the top and bottom guide rollers, which directs the rod through the detection zone.

The system is held in place in the spent fuel cask pit by a wire cable suspension system attached to a lifting bar. The lifting bar is held in place by a curb mount clamped to the curb surrounding the pool and cask pit. The system is lowered into the water using a crane and the lifting bar is set in brackets on the curb mount. A wall standoff assembly holds the WSGS away from the sidewall. This arrangement is depicted in Figure 6-1.

To perform axial scanning, the single rod carriage is attached to the universal carriage rail. The carriage rail is attached to the curb mount and suspends into the cask pit, supported by a wall standoff. The carriage rail provides the path for the rod carriage to travel up and down during scanning. The fuel rod is captured by the grapple and placed into the rod carriage and clamped in place for measurement. This allows the rod to be completely captured by the grapple during measurement. The rod travels through the support jaws and [[ ]]. The data collection electronics, liquid nitrogen lines, and air circulation tubing connect through an umbilical attached to the top of the detector housing.

6.2 Scope of Measurements

During the gamma scan measurements, [[ ]] fuel rods were measured. This report describes the measurements and analysis for the [[ ]] fuel rods.

6.2.1 Measured Rods

A total of [[ ]] fuel rods were gamma scanned, as described in Figure 6-2.

[[

]]

[[

]]

Figure 6-2 Locations of Gamma Scanned Rods

The La^{140} measurements started on [[ ]] and were finished on [[ ]] local time.

6.3 Power Rod Measurements (BA^{140} / LA^{140})

The GE14i bundle loaded into Clinton has a 150 inch active fuel length, with [[ ]] inches of natural enrichment at the top and bottom of the UO_2 rods, as seen in Figures 3-1 and 3-2. The Gad rod, however, only has an active length of [[ ]] inches. Measurements are made at different axial heights along the length of these rods. There are [[ ]] measured as part of this campaign. The first rod measured was the [[ ]] rod. This full length rod was chosen as the reference rod. This rod was measured multiple times at the beginning of the gamma scan campaign, and then re-measured periodically during the subsequent rod measurements to ensure consistency of the multi-day measurement process. The data for this reference rod is used to assess the experimental uncertainty of the power gamma scan measurements, and also as a check on the accuracy of the decay correction process. The rod [[ ]] inches, [[ ]] the bottom of the active fuel zone.

[[ ]] segmented isotope rods) was measured at [[ ]] inch [[ ]] the bottom of the active fuel zone, so as to obtain experimental confirmation of the analytic evaluations of the effect of the segmented isotope rod connectors on the axial power shape of [[ ]]. [[ ]]) were measured every [[ ]] inches, [[ ]] the bottom of the active fuel zone. [[ ]] have axial measurements every [[ ]] inches. Measurements of the following [[ ]] full length rods were made every [[ ]] inches starting [[ ]] inches above the bottom of the active fuel zone: [[ ]]. Measurements of the Gad rod ([[ ]]) were made every [[ ]] inches. Measurements for the following [[ ]] full length rods were made every [[ ]] inches: [[ ]].

6.4 LA^{140} Reference Rod Measurements

The measured data for this reference rod is shown in Figure 6-3.

[[

]]

Figure 6-3 Reference Rod Measurements Rod [[ ]]

6.4.1 Analysis of Reference Rod Measurements

The reference rod measurements provide insight as to the uncertainties in the experimental measurement campaign. There are two important items that contribute to the uncertainties in the measurements. The first item is the axial positioning of the slice of the rod presented to the collimator and detector. The second item is the uncertainty in the actual count rates.

To quantify these uncertainties, the average value of the [[ ]] measurements at each of the [[ ]] axial positions is first computed. This is shown in Figure 6-4, which also shows the standard deviation of the measurements made at each axial level. The data for the "measurement reproducibility" is provided in Table 8-2. The uncertainty is highest (exceeds [[ ]]) in Nodes [[ ]], where the signal is the lowest, the flux curvature is the largest, and relatively small differences in the axial position contribute to larger measurement uncertainties. For this reason, these bottom and top nodes are generally not considered in statistical comparisons.

[[

]]

Figure 6-4 Average Axial Values for Reference Rod [[ ]]

6.4.2 [[ ]] Inch Measurements on Rod [[ ]]

[[ ]] segmented isotope rods) was measured at [[ ]] inch [[ ]] the bottom of the active fuel zone, so as to obtain experimental confirmation of the analytic evaluations of the effect of the segmented isotope rod connectors on the axial power shape of [[ ]]. Figure 6-5 plots the [[ ]], including identification of the bottom and top of each segment in the adjacent segmented isotope rod, as well as the spacer in the fuel assembly. It is not clear that there is a significant effect on the measured La^{140} distribution due to the connectors in the adjacent segmented isotope rod.

[[

]]

Figure 6-5 [[ ]] Inch La^{140} Measurements for Rod [[ ]]

The gamma scan measurements are done at the end of the first full cycle of residence of the GE14i bundle. If there had been power spiking in the adjacent fuel rods early in the residence of this bundle, the incremental pin exposures for these power spiking locations would be higher than non-connector axial location. As the pins are exposed throughout the cycle, these higher power locations would have higher cumulative exposures than axially adjacent positions, which could eventually reduce the power spiking propensity for the fuel pins immediately adjacent to the connectors. [[

]]

7. Types of Comparisons

This section provides summaries of types of comparisons of design calculations of Ba^{140} with measured La^{140} as a means of demonstrating the GNF capability for calculating nodal pin powers for the GE14i fuel assembly.

There are two types of statistical comparisons. The first, described in Section 8, retains the traditional statistical approach used by GE in the 1960 – 1985 period for all gamma scan comparisons, where the measured uncertainty at each axial level is used to provide a corrected standard deviation at each axial level. In this traditional approach, the corrected standard deviation is calculated by taking the square root of the sum of the differences between the square of the measured uncertainty and the square of the measurement uncertainty (for each axial level independently).

The second approach, described in Section 9, uses an approach similar to the statistical approach used in making TIP comparisons, where the radial, axial and nodal components are presented without any correction for experimental uncertainties.

Both approaches are described in more detail in Reference 2.

8. Traditional Basis for Gamma Scan Comparisons

In previous GE pin-by-pin gamma scans, repeat measurements on a reference rod during the course of the experiment were used as a statistical approach to include an evaluation of the uncertainty in the measurements to correct the measured standard deviation. This section provides comparisons of the Clinton measurements to design calculations using this traditional approach.

8.1 Summary – Bundle JYK690 – Traditional Basis

For the once-burnt GE14i bundle JYK690, measurements at [[ ]] axial elevations for [[ ]] different fuel rods were made. Multiple measurements were made on the reference rod. Pin-by-pin measurements of La^{140} at multiple axial heights are made. The design tools are then used to predict the Ba^{140} distribution, and the measured and predicted distributions are compared. The first set of comparisons use the PANAC11 and post-processing programs to predict the pin-by-pin Ba^{140} distributions.

These pin-by-pin comparison statistics are organized by treating (i.e., normalizing) each X-Y plane of the fuel assembly individually (similar to the calculation of local peaking in the infinite lattice TGBLA06 calculation). In the summary tables in this section, the standard deviation of the quantity {(Predicted Ba^{140} / Measured La^{140}) –1} is reported, corrected for the measurement reproducibility of the reference rod. For all [[ ]] nodes, the average measurement reproducibility is [[ ]]; if the comparison is limited to Nodes [[ ]] (eliminating the [[ ]] nodes where the experimental uncertainty is above [[ ]]), the average measurement reproducibility of the reference rod is [[ ]].

Comparisons for bundle JYK690 are summarized in the following tables. Note that BAZ is the Bottom of the Active Zone.

The detailed PANAC11 traditional comparisons for bundle JYK690 are provided in Table 8-2. The statistical results are summarized in Table 8-1 for axial Nodes [[ ]]. As can be seen, the corrected standard deviation is [[ ]]. While slightly larger than the [[ ]] uncertainty from the Duane Arnold Gamma Scan documented in Section 10.1, [[ ]].

Table 8-1 Statistical Comparisons Using the Traditional Basis Non-Adapted Off-Line

Case	Standard Deviation	Measurement Reproducibility	Corrected Standard Deviation
Results for Non-Adapted Off-Line (Nodes [[ ]])	[[		]]

Table 8-2 Results for Non-Adapted Off-Line

Height from BAZ (in)	Node	Standard Deviation	Measurement Reproducibility	Corrected Standard Deviation
[[				
				]]

9. BA^{140} / LA^{140} Pin Nodal, Rod, and Axial Average Root Mean Square Comparisons

The traditional comparison process provides insights as to the comparison of pin-by-pin power distribution within an X-Y plane, but the axial shape of the comparison is eliminated from consideration by the normalization process. This section provides a different view of the comparison process, analogous to the techniques common to the TIP comparison process. Similar to the TIP comparison process, the following three quantities are evaluated and compared:

- Pin Nodal RMS
- Rod Average RMS
- Axial Average RMS

In each case, the RMS is formed from calculation of (Predicted – Measured)/Measured values.

9.1 Pin Nodal, Rod, and Axial Average Statistical Summary

The pin nodal, rod, and axial average statistics for the analytical comparisons for the bundle gamma scanned at Clinton are provided below. The off-line non-adapted TIP comparisons (off-line non-adapted calculated TIPs compared to measured TIPs) documented in Table 4-1 show a cycle average of [[ ]] nodal RMS value when the statistics are taken over Nodes [[ ]]. This TIP value is a measure of the results of averaging over the four bundles surrounding the TIP string. This compares to the gamma scan values of [[ ]] for the pin nodal RMS when the statistics are also computed over the range from [[ ]] (of [[ ]] nodes). Table 9-1 summarizes the pin nodal RMS, the rod average RMS, and the axial average RMS. Note, however, that the experimental uncertainty for Nodes [[ ]] is greater than [[ ]], which explains the rather dramatic increase in the RMS values in Table 9-1 for Nodes [[ ]] compared to Nodes [[ ]].

Table 9-1 Pin Nodal, Rod and Axial Averaged RMS Comparisons

Case	Pin Nodal RMS	Rod Average RMS	Axial Average RMS
Non-Adapted Off-Line ([[ ]])	[[		
Non-Adapted Off-Line ([[ ]])			]]

9.2 Summary Plot of Pin Nodal RMS

This comparison provides a summary of the off-line non-adapted results with the gamma scan measurements. Figure 9-1 compares the predicted Ba^{140} and measured La^{140} on a pin-by-pin basis for the range of Nodes [[ ]] (RMS is [[ ]]). Again, both predicted and measured values are normalized to an average value of 1.000. A clear indication of a difference at both high and low relative measured values seems to indicate a challenge to the axial power shape in PANAC11 for the non-adapted core tracking. However, these differences are eliminated in the on-line 3DM™ shape adapted approach.

[[

]]

Figure 9-1 Pin Nodal Comparisons for Non-Adapted Case – Nodes [[ ]]

10. Conclusions

This section includes conclusions regarding the gamma scan measurements of a GE14i bundle at Clinton in December of 2011.

This document has presented the results of measurements of La^{140} and the comparisons of predicted Ba^{140} for the purpose of confirmation of the power distribution calculations in the design process using the traditional statistical approach. In this approach, the measured standard deviation is corrected for the measurement uncertainty at each axial level. In addition, the traditional approach first normalizes the data to each axial plane, so the effect of axial shape differences is eliminated in this approach.

Table 10-1 provides a summary of the corrected standard deviations of various gamma scan measurements. As can be seen, the Clinton results are [[ ]] to the FitzPatrick pin-by-pin gamma scans previously submitted to the NRC. The value for the corrected standard deviation for Clinton is [[ ]] than for FitzPatrick, as the [[ ]] for Clinton was approximately [[ ]] of that measured for FitzPatrick. Also note that the measurement reproducibility for the Clinton campaign is comparable to the FitzPatrick campaign. Thus, the results for the Clinton campaign are statistically equivalent to previous gamma scan campaigns, because of the [[ ]] of measured fuel rods. The Duane Arnold and FitzPatrick results provided in Table 10-1 are obtained from Reference 2.

Table 10-1 Comparison of Traditional Statistics for Gamma Scan Measurements

Case	Number of [[ ]] Inch Axial Nodes	Bundle	Measurement Reproducibility	Corrected Standard Deviation
[[				
				]]

11. References

1. GE Hitachi Nuclear Energy, "Safety Analysis Report to Support Introduction of GE14i Isotope Test Assemblies (ITAs) in Clinton Power Station," NEDC-33505P, Revision 0, June 2009.

2. GE Hitachi Nuclear Energy, "Applicability of GE Methods to Expanded Operating Domains – Pin-by-Pin Gamma Scan at FitzPatrick October 2006," NEDC-33173 Supplement 2 Part 2P-A, Revision 1, April 2012.

ATTACHMENT 5

Affidavit for NEDC-33787P Revision 0

Global Nuclear Fuel – Americas
AFFIDAVIT

I, Lukas Trosman, state as follows:

(1) I am Engineering Manager, Reload Design and Analysis, Global Nuclear Fuel – Americas, LLC (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 GNF-A proprietary report, NEDC-33787P, "Hot Cell Inspection of Clinton Cycle 13 GE14i Rod Segments," Revision 0 dated November, 2012. GNF-A proprietary information in NEDC-33787P is identified by a dotted underline inside double square brackets. [[This sentence is an example.{3}]] Figures and large equation objects containing GNF proprietary information are identified with double square brackets before and after the object. In all cases, 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, 975 F2d 871 (DC Cir. 1992), and Public Citizen Health Research Group v. FDA, 704 F2d 1280 (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, 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), above, is classified as proprietary because it contains detailed results regarding the in-reactor performance of the GE14i Lead Use Assembly. The development, evaluation, design details and performance, as they relate to the GE14i Lead Use Assembly, was achieved at a significant cost to GNF-A.

The development of the GE14i Lead Use Assembly is derived from the extensive experience database that constitutes a major GNF-A asset.

(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 12th day of November 2012.

Lukas Trosman
Engineering Manager, Reload Design and Analysis
Global Nuclear Fuel – Americas, LLC

ATTACHMENT 6

Affidavit for NEDC-33784P Revision 0

Global Nuclear Fuel – Americas
AFFIDAVIT

I, Atul A. Karve, state as follows:

(1) I am Engineering Manager, Methods, Global Nuclear Fuel – Americas, LLC (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 NEDC-33784P, *GE14i Pin-by-Pin Gamma Scan at Clinton December 2011*, Revision 0, dated October 2012. GNF-A proprietary information within the text and tables is identified by a dotted underline placed within double square brackets. [[This sentence is an example.{3}]] GNF-A proprietary information in figures is identified with double square brackets before and after the object. In all cases, 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, 975 F2d 871 (DC Cir. 1992), and Public Citizen Health Research Group v. FDA, 704 F2d 1280 (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, 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 detailed results including the process and methodology for the design and analysis of the GE14i Isotope Test Assembly. The GE14i Isotope Test Assembly has been developed at a significant cost to GNF-A.

The development of the GE14i Isotope Test Assembly is derived from the extensive experience database that constitutes a major GNF-A asset.

(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 9th day of October 2012.

Atul A. Karve
Engineering Manager, Methods
Global Nuclear Fuel – Americas, LLC