**This letter forwards proprietary information in accordance with 10 CFR 2.390. The balance of this letter may be considered non-proprietary upon removal of Attachments 5 and 6.**

Sam Belcher
Vice President-Nine Mile Point

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CENG[SM]
a joint venture of
Constellation Energy
eDF

NINE MILE POINT
NUCLEAR STATION

December 13, 2010

U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

**ATTENTION:** Document Control Desk

**SUBJECT:** Nine Mile Point Nuclear Station
Unit No. 2; Docket No. 50-410

Response to Request for Additional Information Regarding Nine Mile Point Nuclear Station, Unit No. 2 – Re: The License Amendment Request for Extended Power Uprate Operation (TAC No. ME1476) – Spent Fuel Pool Criticality Analysis

**REFERENCES:**
(a) Letter from K. J. Polson (NMPNS) to Document Control Desk (NRC), dated May 27, 2009, License Amendment Request (LAR) Pursuant to 10 CFR 50.90: Extended Power Uprate

(b) Letter from R. Guzman (NRC) to S. L. Belcher (NMPNS), dated November 12, 2010, Request for Additional Information Regarding Nine Mile Point Nuclear Station, Unit No. 2 – Re: The Licensing Amendment Request for Extended Power Uprate Operation – Reactor Systems Review (TAC No. ME1476)

Nine Mile Point Nuclear Station, LLC (NMPNS) hereby transmits revised and supplemental information in support of a previously submitted request for amendment to Nine Mile Point Unit 2 (NMP2) Renewed Operating License (OL) NPF-69. The request, dated May 27, 2009 (Reference a), proposed an amendment to increase the power level authorized by OL Section 2.C.(1), Maximum Power Level, from 3467 megawatts-thermal (MWt) to 3988 MWt.

By letter dated November 12, 2010 (Reference b), the NRC staff requested additional information (RAI) regarding the spent fuel pool criticality analysis. Attachment 1 (non-proprietary) and Attachment 5 (proprietary) provide the response to this RAI. Attachment 2 (non-proprietary) and Attachment 6 (proprietary) provide Holtec Report No. HI-2012621.

A001
NRR

**This letter forwards proprietary information in accordance with 10 CFR 2.390. The balance of this letter may be considered non-proprietary upon removal of Attachments 5 and 6.**

Attachments 5 and 6 are considered to contain proprietary information exempt from disclosure pursuant to 10 CFR 2.390. Therefore, on behalf of Holtec and Global Nuclear Fuel (GNF), NMPNS hereby makes application to withhold these attachments from public disclosure in accordance with 10 CFR 2.390(b)(1). The affidavits from Holtec and GNF detailing the reasons for the requests to withhold the proprietary information are provided in Attachments 3 and 4.

There are no new regulatory commitments in this submittal.

Should you have any questions regarding the information in this submittal, please contact J. J. Dosa, Director Licensing, at (315) 349-5219.

Very truly yours,

**STATE OF NEW YORK** :
: **TO WIT:**
**COUNTY OF OSWEGO** :

I, Sam Belcher, being duly sworn, state that I am Vice President – Nine Mile Point, and that I am duly authorized to execute and file this response on behalf of Nine Mile Point Nuclear Station, LLC. To the best of my knowledge and belief, the statements contained in this document are true and correct. To the extent that these statements are not based on my personal knowledge, they are based upon information provided by other Nine Mile Point employees and/or consultants. Such information has been reviewed in accordance with company practice and I believe it to be reliable.

Subscribed and sworn before me, a Notary Public in and for the State of New York and County of Oswego, this 13 day of December, 2010.

**WITNESS** my Hand and Notarial Seal:

Lisa M. Doran
Notary Public

My Commission Expires:

9/12/2013
Date

**Lisa M. Doran**
**Notary Public in the State of New York**
**Oswego County Reg. No. 01DO6029220**
**My Commission Expires 9/12/2013**

SB/STD

Attachments:

1. Response to Request for Additional Information Regarding License Amendment Request for Extended Power Uprate Operation (NON-PROPRIETARY)

2. Holtec Report No. HI-2012621 (NON-PROPRIETARY)

3. Affidavit from Holtec Justifying Withholding Proprietary Information

4. Affidavit from Global Nuclear Fuel Justifying Withholding Proprietary Information

5. Revised Response to Request for Additional Information Regarding License Amendment Request for Extended Power Uprate Operation (PROPRIETARY)

6. Holtec Report No. HI-2012621 (PROPRIETARY)

cc: NRC Regional Administrator, Region I
NRC Resident Inspector
NRC Project Manager
A. L. Peterson, NYSERDA (w/o Attachments 5 and 6)

# ATTACHMENT 1

# RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION REGARDING LICENSE AMENDMENT REQUEST FOR EXTENDED POWER UPRATE OPERATION (NON-PROPRIETARY)

Certain information, considered proprietary by Holtec has been deleted from this Attachment. The deletions are identified by double square brackets.

**Nine Mile Point Nuclear Station, LLC**
**December 13, 2010**

**ATTACHMENT 1**
**RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION REGARDING LICENSE AMENDMENT REQUEST FOR EXTENDED POWER UPRATE OPERATION**
**(NON-PROPRIETARY)**

By letter dated May 27, 2009, as supplemented on August 28, 2009, December 23, 2009, February 19, 2010, April 16, 2010, May 7, 2010, June 3, 2010, June 30, 2010, July 9, 2010, July 30, 2010, October 8, 2010, October 28, 2010, November 5, 2010, and December 10, 2010, Nine Mile Point Nuclear Station, LLC (NMPNS) submitted for Nuclear Regulatory Commission (NRC) review and approval, a proposed license amendment requesting an increase in the maximum steady-state power level from 3467 megawatts thermal (MWt) to 3988 MWt for Nine Mile Point Unit 2 (NMP2).

By letter dated November 12, 2010, the NRC staff requested additional information (RAI) regarding the spent fuel pool criticality analysis. This attachment provides the response to this RAI.

The NRC request is repeated (in italics), followed by the NMPNS response.

**Request for Additional Information – Reactor Systems Branch – November 12, 2010**

*By letter dated May 27, 2009 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML091610103), Nine Mile Point Nuclear Station, LLC (NMPNS or the licensee) submitted a license amendment request (LAR) for Nine Mile Point, Unit No.2 (NMP2). The proposed amendment requests an increase in the maximum steady-state power level at NMP2 from 3467 megawatts thermal (MWt) to 3988 MWt. This represents a 15-percent increase over the current licensed thermal power (CLTP).*

*Based on its review of the LAR and the supplemental information provided by the NMPNS in letters dated February 19, 2010 (ML100550599), June 3, 2010 (ML101610168), and July 30, 2010 (ML102170184), the NRC staff has determined that additional information requested below will be needed to support its review.*

*In its letter dated June 3, 2010, the licensee stated that,*

> *General Electric/Global Nuclear Fuel (GE/GNF) performed the depletion and criticality analyses in 2004 as reflected in Section 2.8.6 of NEDC-33351 P, Attachment 11 of the May 27, 2009 License Amendment Request.*

*In its letter dated July 30, 2010, the licensee stated that,*

> *However, the GEH criticality evaluation is not part of the current licensing basis for the NMP2 spent fuel pool. The Holtec criticality analysis referenced in Section 9.1.2 of the NMP2 Updated Safety Analysis Report (USAR) is the current analysis of record. The Holtec criticality analysis was retained as the analysis of record, because, at the transition to GE14 fuel, the Holtec criticality analysis already addressed GE14 fuel types (as well as earlier fuel types utilized at NMPNS, which were shown to be bounded by GE14 fuel).*

*In an e-mail dated September 16, 2010 (ML103050187), the licensee indicated that, NMP2 has never submitted a criticality analysis to the NRC staff for review.*

*Based on above, the NRC staff is unable to make a reasonable assurance finding for regulatory compliance, since the NRC staff has not reviewed the licensee's analysis of record. The NRC staff review of an EPU application per Review Standard (RS)-001 assumes that an acceptable starting point (i.e., an analysis of record) is available. The licensee submitted its latest USAR update by letter dated October 27, 2008 (ML083080129). The USAR reflects the Holtec analysis and states that,*

> *The criticality analysis for GE6/6B, GE9B, GE11, GE13, and GE14 fuel limits the maximum average planar enrichment to 5.0 w/o [weight percent] U-235 and the in-core K∞ [K-infinity] ≤1.32, or a maximum average planar enrichment of 5.0 w/o U-235, as long as there is a minimum of 6 $Gd_2O_3$ [gadolinium oxide] rods at a minimum of 4.2 w/o $Gd_2O_3$.*

*The NRC staff understands that NMPNS intends to retain this technical basis following EPU implementation. The NRC staff has not reviewed this information. Therefore, to allow the NRC staff to continue its review, provide the Holtec analysis report that forms the licensee's analysis of record. In* *addition, provide the quantitative information that shows that the most limiting GE14 lattice design analyzed for the EPU submittal bounds all fuel stored at NMP2. This information may include the comparisons of keff vs. burnup curves for the applicable lattice designs and the actual burnup values for the fuel bundles stored at NMP2. The NRC staff needs this information to make a reasonable assurance determination that NMP2 fuel storage racks complies with NMP2 Technical Specification Section 4.3, "Fuel Storage".*

**NMNPS Response**

Spent Fuel Storage

The current design basis criticality analysis for the NMP2 Spent Fuel Pool (SFP) racks is Holtec Report No. HI-2012621, which is included as Attachment 2 (non-proprietary) and Attachment 6 (proprietary). The Holtec criticality analysis used the CASMO4 and MCNP4A codes. A two-dimensional CASMO4 model was used to perform in-core burnup calculations and then to restart the burned fuel in the standard cold core geometry and in the SFP storage rack. CASMO4 was also used to calculate the reactivity effect of manufacturing tolerances. MCNP4A was used to perform certain calculations requiring a three dimensional model such as eccentric fuel positioning or abnormal fuel locations, and to provide a means of benchmarking CASMO4 against critical experiments. This analysis was incorporated into the current design basis in June 2001 via a 10 CFR 50.59 Evaluation, as part of the Phase I re-rack to add ten new Holtec Boral high density spent fuel storage racks in the NMP2 SFP. Note: The SFP storage capacity remained in compliance with the Technical Specifications, since the spent fuel storage capacity was maintained at no more than 4049 assemblies. This criticality analysis and associated 10 CFR 50.59 Evaluation was again referenced in the Phase II re-rack which replaced the 16 original Boraflex spent fuel racks with Holtec Boral racks of the same design as installed under Phase I. The NRC reviewed 10 CFR 50.59 Evaluation 2001-066, as noted in an Integrated Inspection Report issued on November 7, 2007 (Reference 1). It states:

> "The selected [Safety Evaluations] SEs were reviewed to verify that changes to the facility or procedures as described in the Updated Final Safety Analysis Reports (UFSAR) were reviewed and documented in accordance with 10 CFR 50.59, and that the safety issues pertinent to the changes were properly resolved or adequately addressed. The reviews also included the verification that NMPNS had appropriately concluded that the changes and tests could be accomplished without obtaining license amendments... This review was performed to verify that NMPNS' threshold for performing SEs was consistent with 10 CFR 50.59...No findings of significance were identified."

As indicated in the NMPNS letter dated July 30, 2010, the design basis criticality analysis for GE14 fuel in the NMP2 SFP will change to the GE-Hitachi Nuclear Energy Americas LLC (GEH) analysis discussed in previous RAI responses following approval of the Extended Power Uprate (EPU) license amendment request. The Holtec criticality analysis will be retained only for the purpose of demonstrating that the earlier fuel types (GE6/6B, GE9B, and GE11) are bounded by the GE14 assembly design (note that the Holtec analysis also addresses GE13 fuel type, which has not been used at NMP2). Table 2 on page 19 of the Holtec report provides the summary information used to conclude that GE14 fuel design has a higher reactivity than the older fuel types. All fuel assembly types were analyzed using CASMO4 at 4.95% enrichment (including the manufacturing tolerance of ± 0.05% enrichment which is equivalent to the 5.0% enrichment discussed in NMP2 Updated Safety Analysis Report Section 9.1.2.2) and no credit for Gadolinium (Gd) to determine the k-infinity ($k_{inf}$) in both the standard cold core geometry and the rack configuration for burnups ranging from 0 to 40 GWd/MTU (summarized in Figure SFP-1). Since GE11 and GE14 assemblies have partial length rods, they were evaluated both with and without a fuel rod in those locations. The GE14 assembly (with water in the part length rod location) was chosen as the bounding assembly on the basis that it had the highest rack $k_{inf}$ at the burnup which yielded a $k_{inf}$ of 1.32 in the standard cold core geometry (see Worksheet C.2 on page C-4 of the report). A depletion uncertainty equal to 5% of the largest reactivity decrement for any fuel type from fresh fuel to the above mentioned burnup was also determined and used for all assemblies. The bounding GE14 assembly was then used as the reference assembly in subsequent calculations to determine uncertainties from manufacturing tolerances (Boral B-10 loading uncertainty, 0.05 wt% enrichment uncertainty, etc), as well as the effects of various Gd loadings, moderator temperature changes, channel removal or bulging, eccentric fuel positions, abnormal fuel locations and accident conditions. The acceptance criteria used in the Holtec report was the Technical Specification 4.3.1.1.a requirement that k-effective ($k_{eff}$) remain less than or equal to 0.95, including allowance for uncertainties, with the racks fully loaded with the most reactive fuel (GE14) in unborated water at the Technical Specification 4.3.1.1.b spent fuel storage rack cell pitch of 6.18 inches.

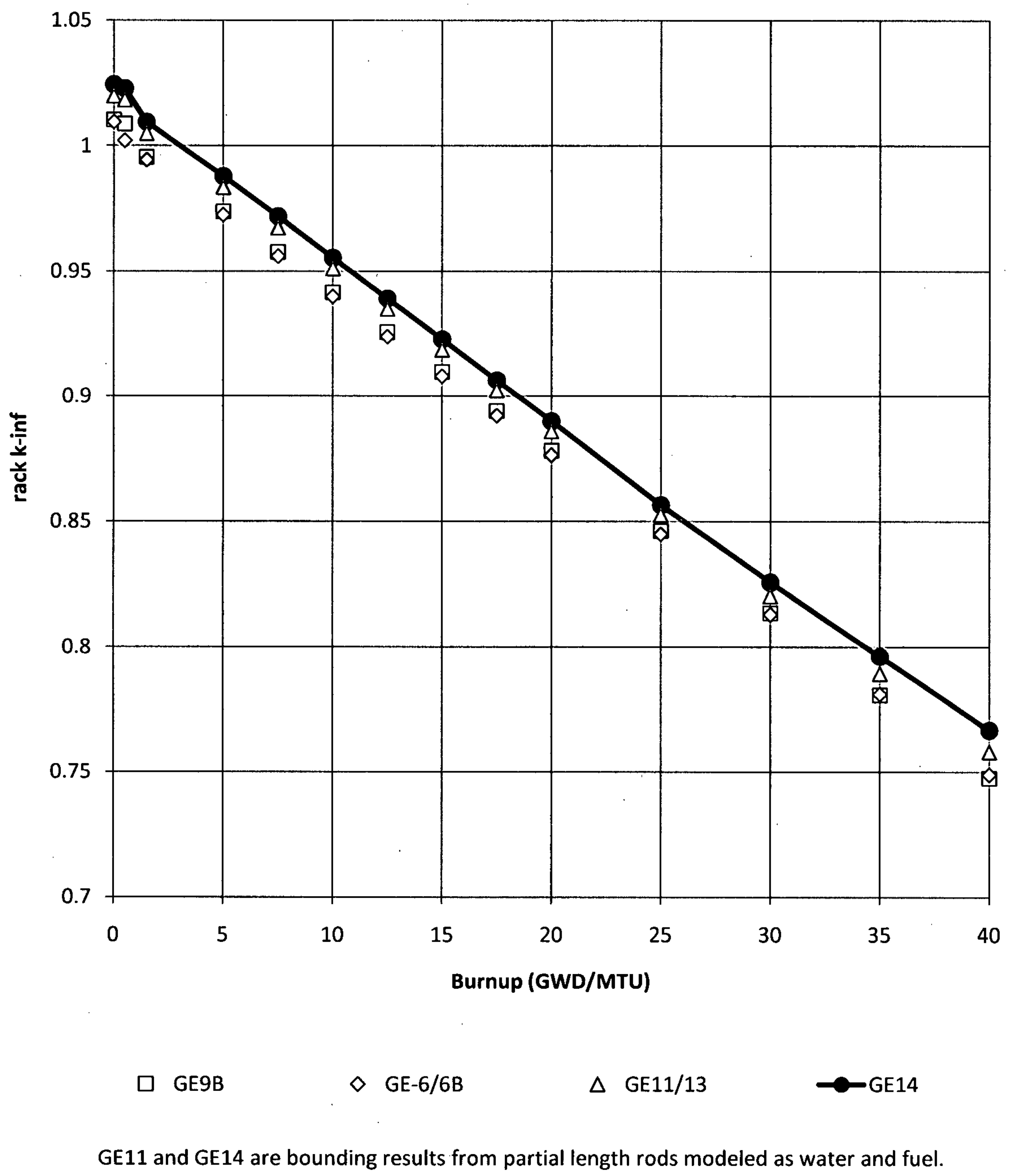


Figure SFP-1 – Rack $k_{inf}$ Versus Burnup for All Fuel Types in the NMP2 SFP at 4.95% Enrichment with No Credit for Gd

Given that the population of older fuel types (GE6/6B, GE9B, and GE11) is fixed and has known characteristics (i.e., no new fuel of this type will be ordered nor will any of these assemblies be reinserted in the core), there are additional sources of margin not credited in the Holtec report that can be considered to provide additional assurance that this population of fuel in the NMP2 SFP will continue to be bounded by GE14 fuel. Estimates of the amount of margin in delta-k (Δk) provided by each of these sources are discussed further below.

1. <u>Burnup</u>

   Figure SFP-2 provides a scatter plot showing the distribution of assembly average burnup and enrichment for each of the old fuel designs in the NMP2 SFP. Based on Worksheet C.2 in the Holtec report, all of the GE9B and GE11 assemblies and most of the GE6/6B assemblies are well above the burnup (~15 GWd/MTU) used for the CASMO $k_{inf}$ value cited in Table 2 of the Holtec report for those assembly types. In the case of the GE9B and GE11, the least burned assemblies show at least an additional -0.09 and -0.06 Δk margin to the reference $k_{inf}$ value, respectively based on Worksheet C.2 when only their burnup is considered. All of the GE6/6B fuel with enrichment above 2% shows at least an additional -0.03 Δk margin based only on consideration of the lowest burnup. All of the above estimates include a 5% reduction to account for the additional depletion uncertainty.

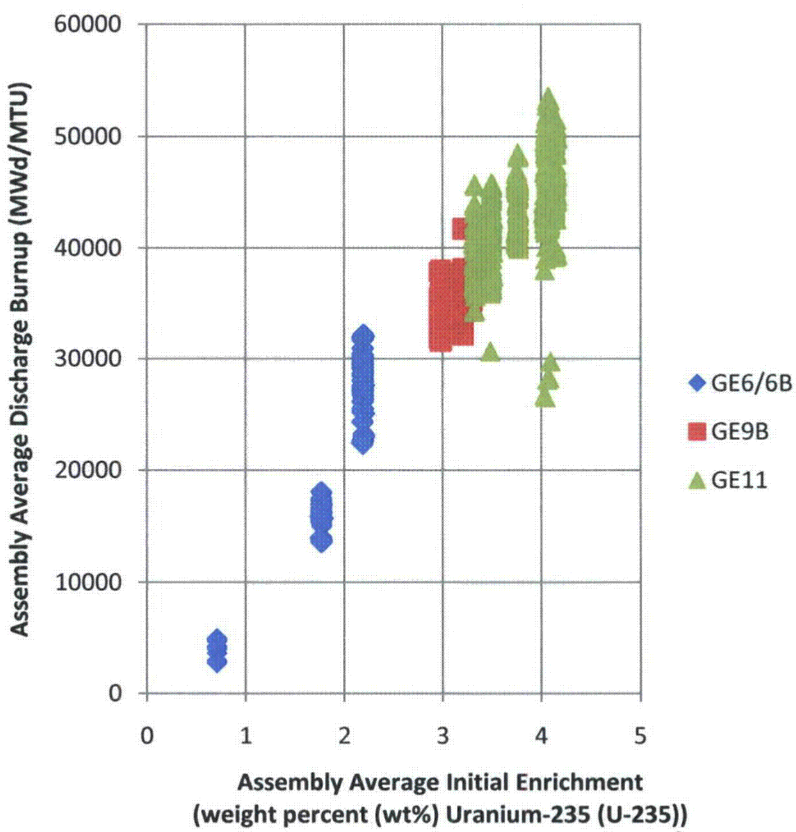


Figure SFP-2 – Burnup/Enrichment Distribution of Older Fuel Types in NMP2 SFP

Any discussion of credit for burnup should address assemblies containing failed rods which were subjected to power suppression just prior to discharge. This not only decreases the U-235 depletion, but the harder spectrum also results in higher production of fissile plutonium isotopes. Consequently, the reduction in reactivity associated with a given burnup for such an assembly will not be as great as for an assembly not subjected to power suppression. Table SFP-1 summarizes the four assemblies in the population of older fuel types (all GE11) in the NMP2 SFP which experienced failed rods and were subjected to power suppression prior to discharge. In all cases, the burnup prior to power suppression was greater than the reference burnup used to generate the $k_{inf}$ listed for the GE11 in Table 2 of the Holtec report. Non-failed assemblies in the suppressed cell are not discussed since they achieved the same or higher burnup than the failed assemblies, which were discharged at the end of the cycle.

| GE11 ASSEMBLY | ASSEMBLY AVERAGE ENRICHMENT | INITIAL CYCLE | FAILED CYCLE | DISCH. DATE | BURNUP AT DISCHARGE (GWD/MTU) | BURNUP PRIOR TO SUPRESSION (GWD/MTU) | OPERATING TIME SUPPRESSED (MONTHS) |
|---|---|---|---|---|---|---|---|
| YJ5573 | 3.32 | 4 | 6 | 5/1/1998 | 42.00 | 40.02 | 3.2 |
| YJV565 | 4.08 | 8 | 9 | 3/12/2004 | 28.16 | 23.35 | 16.6 |
| YJM296 | 4.15 | 7 | 9 | 3/12/2004 | 45.71 | 42.59 | 9.7 |
| JLA408 | 4.09 | 9 | 10 | 3/20/2006 | 29.21 | 24.75 | 15.5 |

Table SFP-1 – Summary of Older Fuel Type Failures in NMP2 SFP

2. Enrichment

Additional margin is also available from the lower enrichments used for the older fuel types versus that assumed in the Holtec report. As discussed previously, the Holtec report evaluated all fuel types at an enrichment of 4.95%. As can be seen from Figure SFP-2, all of the older fuel types have initial enrichments well below 4.95%. In the case of the low enriched and natural uranium GE6/6B assemblies in Figure SFP-1, the lower enrichment can be used to compensate for the fact that the burnup is below the reference value used to determine the rack $k_{inf}$ for GE6/6B fuel in Table 2 of the Holtec report. To characterize the trend in reactivity with lower enrichment, NMPNS developed a SCALE4.4 CSAS\KENO Va model of a fresh GE6/6B assembly in the NMP2 SFP Holtec rack with no credit for Gd (see Enclosure SFP-1 to this response). The model was axially and radially reflected for consistency with the CASMO4 model. Inputs for this model were obtained from Tables 1 and 2, Figure 1 and Appendix B of the Holtec report, and the model was verified to yield results similar to those indicated for the reference 4.95% enriched assembly at zero burnup in Worksheet C.2. The results of running this model at different initial enrichments are summarized in Figure SFP-3 below. They indicate that even without credit for burnup, the lower enriched GE6/6B assemblies would have an additional $\Delta k$ margin of -0.10 to -0.15 compared to the reference CASMO4 rack $k_{inf}$ value listed in Table 2 of the Holtec report for this fuel type.

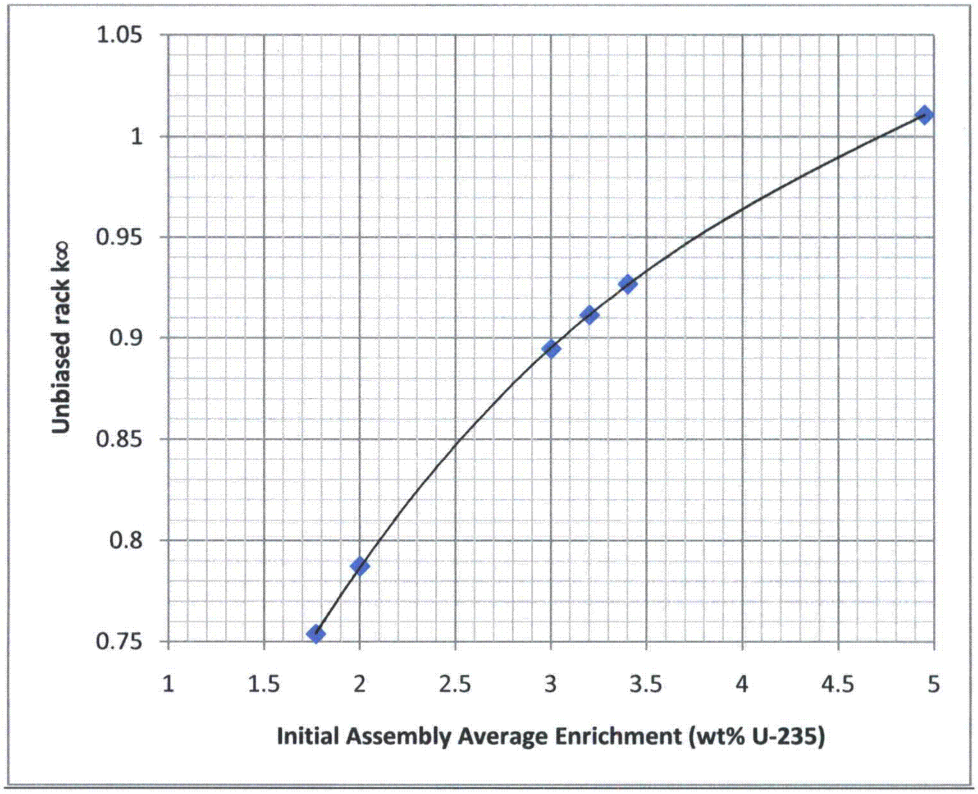


Figure SFP-3 – NMP2 SFP Rack $k_{inf}$ Trend with GE6/6B Assembly Enrichment (no Gd, no Burnup)

3. Cooling Time

It has been shown in numerous studies that spent fuel discharged from a reactor will decrease in reactivity from 100 hours to ~100 years. This effect is driven by the decay of the Plutonium-241 (Pu-241) fissile nuclide (with a half-life of 14.4 years) and the buildup of the neutron absorbers Americium-241 (Am-241) (from decay of Pu-241) and Gd-155 (from Europium-155 (Eu-155) which decays with a half-life of 4.7 years). Section 7.9 of the Holtec report provides a brief discussion of this effect, but since no credit is taken for cooling time in that analysis, no attempt was made to quantify the amount of additional margin available. However, an estimate of the available margin introduced by consideration of cooling time for the older fuel types that were used at NMPNS can be developed from information available in the general literature. Reference 2 calculated $k_{inf}$ for an 8x8 Boiling Water Reactor (BWR) assembly with various enrichments, burnups, and cooling times from 5 to 40 years. Reference 2 provides the calculated $k_{inf}$ results in Table 5 and a plot of the negative reactivity effect with cooling time is provided in Figure 6. The results indicate the $\Delta k_{inf}$ is substantial for decay beyond 5 years. It is estimated from Reference 2, and the range of discharge times for the old fuel types in Table SFP-2, that the additional $\Delta k_{inf}$ margin in transitioning from 5 years to ~20 years is -0.04. This margin provides added confidence that older NMPNS fuel is bounded by more recently discharged GE14 fuel.

| ASSEMBLY TYPE | FIRST USED | FIRST DISCHARGED | LAST USED | LAST DISCHARGED | COOLING TIMES (YEARS) |
|---|---|---|---|---|---|
| GE6/6B | Cycle 1 | 9/8/1990 | Cycle 5 | 9/28/1996 | 14.1 to 20.2 |
| GE9 | Cycle 2 | 4/9/1995 | Cycle 6 | 5/1/1998 | 12.6 to 15.6 |
| GE11 | Cycle 4 | 5/1/1998 | Cycle 11 | 3/23/2008 | 2.7 to 12.6 |

Table SFP-2 – Range of Cooling Times for Each Old Fuel Type

New Fuel Storage

The current GE14 fuel lattice design satisfies the NMP2 new fuel vault storage criteria outlined in Technical Specification (TS) Section 4.3 provided that the peak, in-core eigenvalue of any constituent fuel lattice, as computed by either the GNF lattice physics codes TGBLA04A or TGBLA06A, does not exceed 1.29. This limit provides significant conservatism with respect to the fuel licensing acceptance criteria outlined in NEDE-24011-P-A-17, Section 1.1.3 Item G. Note that the need to satisfy the optimum moderation criteria specified in requirement (b) of Technical Specification 4.3.1.2 is obviated by implementing Service Information Letter (SIL) No. 152, Criticality Margins for Storage of New Fuel.

The fresh, Beginning-of-Life (BOL), GE14 fuel bundle lattice compositions following EPU implementation may change as a result of the need for higher core power levels, higher fuel burn-up and larger total cycle energy output. These BOL fuel composition changes will not result in a change in the effective fresh fuel in-rack subcritical reactivity of the fuel bundle/lattices because the GNF fuel design process manages the lattice average uranium (U-235) enrichment and gadolinium oxide fuel composition and placement to meet EPU fuel cycle requirements such that subcritical reactivity remains essentially constant.

Provided the peak, in-core eigenvalue of any constituent fuel lattice, as computed by either TGBLA04A or TGBLA06A, does not exceed 1.29, the post-EPU GE14 fuel bundles/lattices will also meet the new fuel vault rack storage criticality requirements outlined in TS Section 4.3. Management of the GE14 in-core eigenvalue is inherent in the GNF fuel design process as described in NEDC-32868P, Rev. 3, "GE14 Compliance with Amendment 22 of NEDE-24011-P-A (GESTAR-II)", April 2009.

Summary

Quantitative information has been provided that shows the most limiting GE14 lattice design analyzed for the EPU submittal bounds all fuel stored at NMP2. The Holtec report provides the detailed evaluation and results summarizing the determination of the GE14 lattice as the most reactive fuel for SFP storage. To supplement this determination NMPNS has provided the characteristics of the fuel bundle types stored at NMP2. These characteristics, in conjunction with the $k_{inf}$ dependency on burnup, enrichment and cooling time, provides added confidence older lattice types stored at NMP2, such as the GE-6/6B, GE9B and GE11, are bounded by GE14. The Holtec evaluation results reveal that a $\Delta k_{inf}$ margin exists for GE9B and GE11 with only consideration of the actual minimum burnups for these assemblies. For the GE-6/6B, a $\Delta k_{inf}$ margin exists by considering minimum burnups and the lower enrichments. In summary, although the Holtec evaluation by itself provides the justification that the GE14 lattice type is bounding, margin due to burnup, enrichment and cooling time further strengthens this conclusion.

The Holtec report provides the means of demonstrating compliance with NMP2 Technical Specifications 4.3.1.1.a and 4.3.1.1.b.

Compliance with the Technical Specification 4.3.1.2 requirements for new fuel storage racks is ensured by the GNF fuel design process.

Technical Specification 4.3.2 was not impacted by the Holtec re-rack since neither the spent fuel pool drainage system nor interconnecting systems were modified. Similarly, Technical Specification 4.3.3 was not impacted by the Holtec re-rack as the spent fuel storage capacity was maintained at no more than 4049 assemblies. This was documented in the associated 10 CFR 50.59 Evaluation and NMPNS design change documentation.

**References**

1. NRC Integrated Inspection Report 05000220-07-004 and 05000410-07-004, on 07/01/2007 – 09/30/2007, Nine Mile Point Nuclear Station, Units 1 and 2; Event Followup, ADAMS Accession Number ML073110044.

2. Broadhead, B.L., K-infinite Trends with Burnup, Enrichment, and Cooling Time for BWR Fuel Assemblies, ORNL/M-6155, August 1998.

   http://www.ornl.gov/~webworks/cppr/y2002/rpt/94484.pdf

**Enclosure SFP-1 – Scoping CSAS/KENO Va Model for GE6/6B Assembly in NMP2 Rack**

```
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   H2O      3 1.000             277.15      END
   SS304     4 1.000             277.15      END
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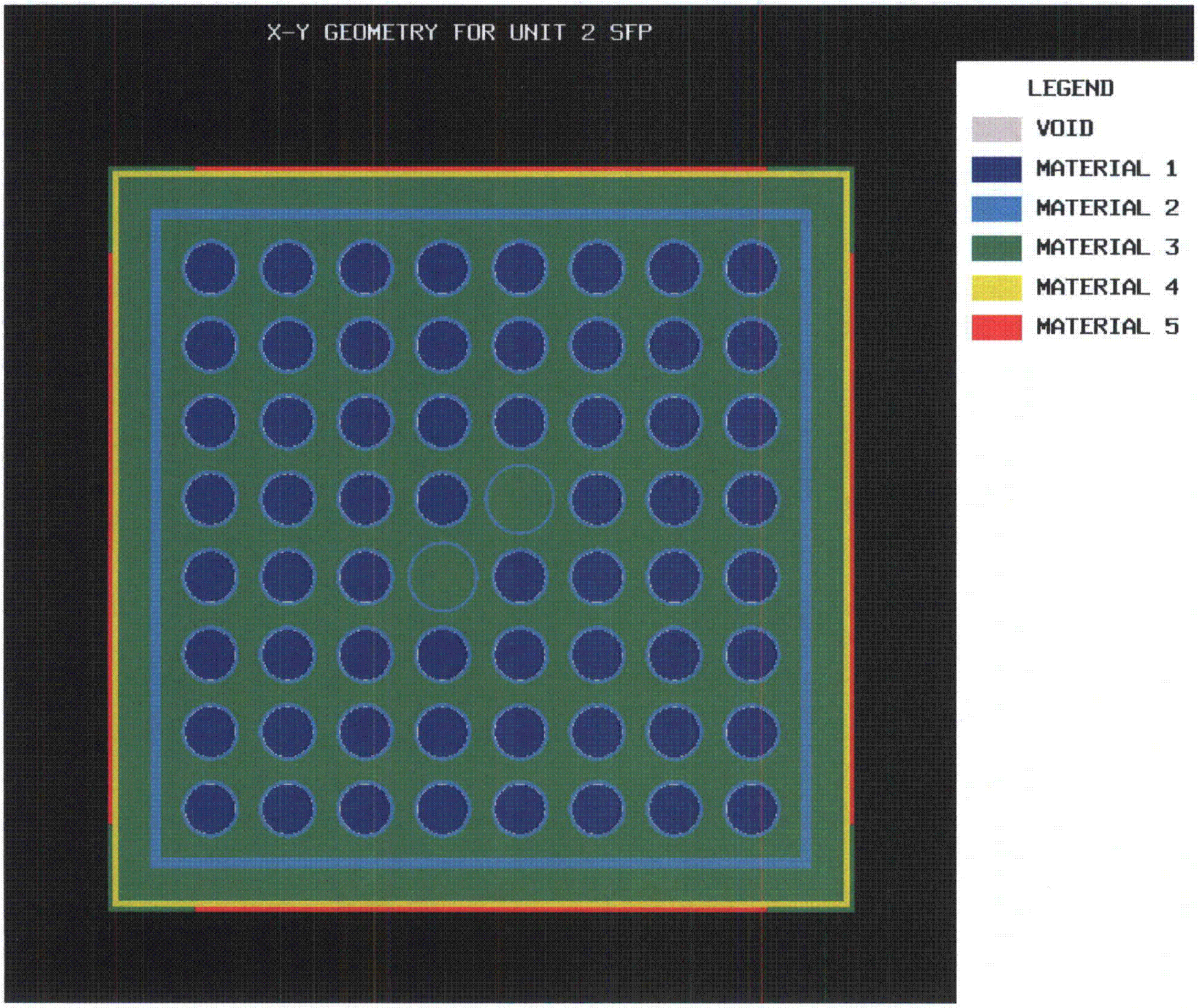
X-Y GEOMETRY FOR UNIT 2 SFP
LEGEND
VOID
MATERIAL 1
MATERIAL 2
MATERIAL 3
MATERIAL 4
MATERIAL 5