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Constellation Energy
Nine Mile Point Nuclear Station

June 27, 2008

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

ATTENTION: Document Control Desk

SUBJECT: Nine Mile Point Nuclear Station
Units No. 1; Docket No. 50-220

Response to Acceptance Review Comments Re: License Amendment Request for Removal of Boraflex Credit (TAC No. MD8434)

REFERENCES:

(a) Letter from K. J. Polson (NMPNS) to Document Control Desk (NRC), dated April 3, 2008, License Amendment Request Pursuant to 10 CFR 50.90: Elimination of Credit for Boraflex in Spent Fuel Pool Criticality Analyses – Technical Specification 5.5, Storage of Unirradiated and Spent Fuel

(b) Letter from R. V. Guzman (NRC) to K. J. Polson (NMPNS), dated June 16, 2008, Nine Mile Point Nuclear Station, Unit No. 1 – Acceptance Review of Requested Licensing Action Re: Removal of Boraflex Credit (TAC. No. MD8434)

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 1 (NMP1) Renewed Operating License DPR-63. The request, dated April 3, 2008 (Reference a), proposed to revise the NMP1 Technical Specifications (TS) to reflect the current spent fuel storage rack configuration and to eliminate reliance on Boraflex™ as a neutron absorber in the two remaining Boraflex storage racks located in the spent fuel storage pool. By letter dated June 16, 2008 (Reference b), the NRC forwarded comments required to be addressed prior to the staff's completion of the acceptance review for the amendment request. Revisions and supplemental information provided to address the NRC comments are discussed below.

Section 3.1 of the Enclosure to Reference (a) provided a summary of the criticality analyses performed to support the license amendment request. An input used for the analyses was spent fuel pool water at a density of 1.0 gm/cm^3. As a result of the NRC comments, NMPNS has revised the water density used in the analyses to 0.98 gm/cm^3, corresponding to a water temperature of 150°F.

Attachment 1 to the Enclosure of Reference (a) is replaced with Attachment 1 to this letter. This attachment contains TS 5.5 marked up to show the changes made by the license amendment request. The attachment is a duplicate of the one included in Reference (a), except for changes made to k-infinity. The k-infinity limit for the north non-poison rack is revised to 1.2441, while the k-infinity limit for the south non-poison rack is revised to 1.2254. These revisions are a result of the increased moderator temperature used in the analyses (discussed above).

Attachment 2 to the Enclosure of Reference (a) is replaced with Attachment 2 to this letter. Attachment 2 contains Revision 2 to Report NET-290-01, "Evaluation of the Nine Mile Point 1 Boraflex Spent fuel Racks with 7x7, 8x8, and 9x9 Fuel Assemblies Taking No Credit for Boraflex Reactivity Control." This revised report addresses the NRC's comments in Reference (b). Appendix 2 to the revised report lists each NRC comment from Reference (b), a response to the comment, and a reference to modifications made to the body of the report as a result of the comment, if any.

The revised and supplemental information contained in this submittal does not affect the No Significant Hazards Determination analysis provided by NMPNS in Reference (a). Pursuant to 10 CFR 50.91(b)(1), NMPNS has provided a copy of this letter to the appropriate state representative. This letter contains no new regulatory commitments.

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

Very truly yours,

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

I, Sam L. Belcher, being duly sworn, state that I am Plant General Manager, 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 27th day of June, 2008.

WITNESS my Hand and Notarial Seal:

Notary Public

My Commission Expires:

11/12/2010
Date

TONYA L. JONES
Notary Public in the State of New York
Oswego County Reg. No. 01JO6083354
My Commission Expires 11/12/2010

SLB/JJD

Attachments:
1. Proposed Technical Specification Changes (Mark-up)
2. Report No. NET-290-01, Revision 2, Evaluation of the Nine Mile Point 1 Boraflex Spent fuel Racks with 7x7, 8x8, and 9x9 Fuel Assemblies Taking No Credit for Boraflex Reactivity Control

cc: S. J. Collins, NRC
R. V. Guzman, NRC
Resident Inspector, NRC
J. P. Spath, NYSERDA

ATTACHMENT 1

PROPOSED TECHNICAL SPECIFICATION CHANGES (MARK-UP)

The current version of Technical Specification Page 346 has been marked-up by hand to reflect the proposed changes.

Insert A

5.5 Storage of Unirradiated and Spent Fuel

5.5.2 Unirradiated Fuel Storage

Unirradiated fuel assemblies will normally be stored in critically safe new fuel storage racks in the reactor building storage vault. Even when flooded with water, the resultant k_{eff} is less than 0.95. Fresh fuel may also be stored in shipping containers. The unirradiated fuel storage vault is designed and shall be maintained with a storage capacity limited to no more than 200 fuel assemblies.

~~1066 spent fuel assemblies with up to 15.6 grams (3.0 weight percent) of Uranium-235 per axial centimeters of assembly can be stored in non-poison flux trap racks in the north half of the spent fuel pool. 1710 spent fuel assemblies with up to 18.13 grams (3.75 weight percent) of Uranium-235 per axial centimeters of assembly can be stored in Boraflex racks in the south half of the pool. These racks have been designed to maintain a k_{eff} less than 0.95 under conditions of optimum water moderation. The north and south half of the pool are analyzed to store 1840 and 2246 fuel assemblies, respectively, using racks containing the neutron absorber material Boral. The Boral racks will maintain a k_{eff} of less than 0.95 under abnormal and accident conditions. The spent fuel stored in the Boral racks must have a peak lattice enrichment of 4.6 % or less and the k-inf in the standard cold core geometry must be less than or equal to 1.31.~~

5.6 (Deleted)

INSERT A (for TS Page 346)

5.5.1 Spent Fuel Storage

The spent fuel storage racks are designed to maintain a $k_{eff} \leq 0.95$ when fully flooded with unborated water, which includes an allowance for uncertainties as described in Section X-J.2.1 of the UFSAR.

The spent fuel pool is analyzed to store 4086 spent fuel assemblies using storage racks containing the neutron absorber material Boral. The spent fuel assemblies stored in the Boral storage racks must have a peak lattice enrichment of 4.6% or less, and the k-infinity in the standard cold core geometry must be ≤ 1.31.

The spent fuel pool is also analyzed to store 3496 spent fuel assemblies in Boral storage racks and 414 spent fuel assemblies in the two non-poison storage racks (3910 assemblies total). The spent fuel assemblies stored in the Boral storage racks must have a peak lattice enrichment of 4.6% or less, and the k-infinity in the standard cold core geometry must be ≤ 1.31.The spent fuel assemblies stored in the non-poison storage racks must satisfy the following criteria:

a. The north non-poison rack (storage cells 2B37 to 2M54 - 198 cells total) can be loaded with any of the existing 7x7 or 8x8 fuel types that are stored in the spent fuel pool, or with 9x9 fuel with a k-infinity in the standard cold core geometry of ≤ ~~1.2676.~~ 1.2441

b. The south non-poison rack (storage cells 2A55 to 2M72 - 216 cells total) can be loaded with 8x8 fuel with a k-infinity in the standard cold core geometry of ≤ 1.2164, except that storage cells 2A71, 2A72, 2D71 to 2F71 (3 cells), 2D72 to 2F72 (3 cells), 2K55, 2L55, and 2M59 to 2M72 (14 cells) can be loaded with 8x8 fuel with a k-infinity in the standard cold core geometry of ≤ ~~1.2258.~~ 1.2254

ATTACHMENT 2

REPORT NO. NET-290-01, REVISION 2
EVALUATION OF THE NINE MILE POINT 1 BORAFLEX SPENT FUEL RACKS WITH 7X7, 8X8, AND 9X9 FUEL ASSEMBLIES TAKING NO CREDIT FOR BORAFLEX FOR REACTIVITY CONTROL

Nine Mile Point Nuclear Station, LLC
June 27, 2008

Report No. NET-290-01

Evaluation of the Nine Mile Point 1 Boraflex Spent Fuel Racks with 7x7, 8x8 and 9x9 Fuel Assemblies Taking No Credit for Boraflex for Reactivity Control

October 2007

Prepared for

Constellation Nuclear Corporation, LLC

Prepared by:

Northeast Technology Corp.
108 North Front Street, 3rd Floor
UPO Box 4178
Kingston, New York 12401

Under Purchase Order: 7706697

Rev.	Date	Prepared by:	Reviewed by:	Approved (QA):
Ø	10/30/07	Matthew C. Harris	[illegible]	L. P. Mariani
1	3/4/08	Matthew C. Harris	[illegible]	L. P. Mariani
2	6/23/08	Matthew C. Harris	[illegible]	L. P. Mariani

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1.0 INTRODUCTION

The Nine Mile Point Unit No. 1 (NMP1) spent fuel pool contains two types of spent fuel storage racks. One type, the majority of racks, utilizes the neutron absorber material BORAL for reactivity control; the other type utilizes Boraflex (only two modules). The Boraflex racks were originally licensed for unirradiated fuel assemblies with a peak lattice enrichment of 3.75 w/o U-235[1]. The Boraflex racks were subsequently analyzed for un-irradiated fuel assemblies with initial enrichments up to 4.65 w/o U-235 with a minimum of 7 Gd_2O_3 rods at 4.0 w/o Gd_2O_3[2]. The BORAL racks were installed in late 2004 replacing all but two of the Boraflex modules with new BORAL rack modules [3, 4].

These two Boraflex modules are located in the southwest corner of the NMP1 spent fuel pool. There is unrestricted access to all 198 storage cells in the "North" module. The "South" Boraflex module contains 216 storage cells with cell access restricted by a tooling table. The tooling table is supported by four pedestals seated in four empty cells within the module[4]. This table precludes access to a significant portion of the storage cells beneath it. 2

This report documents criticality analyses of the two remaining Boraflex modules based on: 1) the actual inventory of assemblies loaded in the South module that are inaccessible due to the presence of the tooling table and; 2) loading of the North module with any 7x7 or 8x8 assembly at peak reactivity or any 9x9 assembly with a specified combination of maximum enrichment and minimum number of gadolinia rods. The analyses are based on the assumption that the adjacent BORAL racks are filled with maximum reactivity 10x10 fuel assemblies with a peak lattice enrichment of 4.6 or less. This corresponds to a 10x10 bundle with a $k_\infty \leq 1.31$ in standard cold core geometry (SCCG)[5]. The analysis provides maximum flexibility with respect to future fuel storage utilization of the Boraflex modules and possible removal of fuel assemblies for dry cask storage. 2

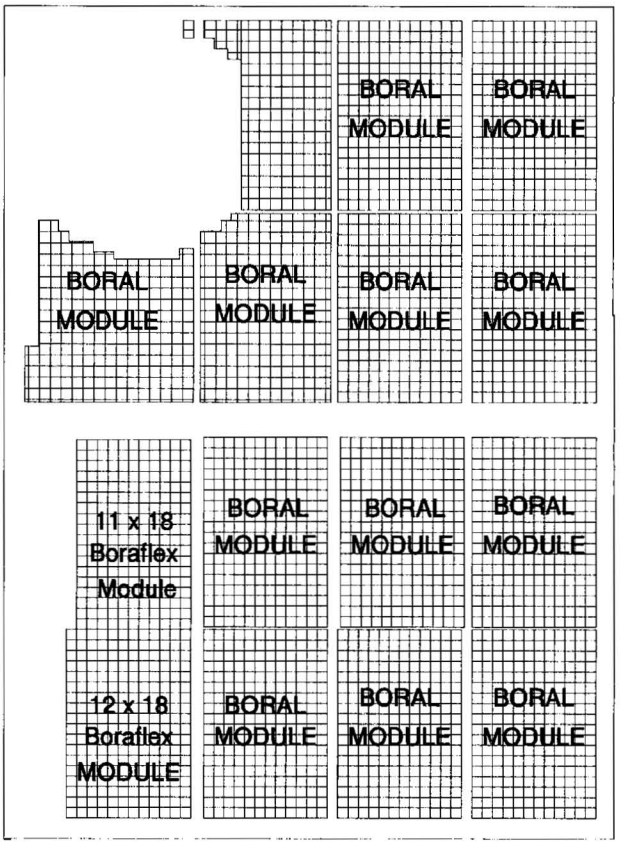
From the analyses the maximum allowable enrichment and minimum required gadolinia rod combination such that $k_{eff} \leq 0.95$ are determined. The maximum calculated k_{eff} includes fuel and rack allowances for as-built tolerances, model bias and calculational uncertainties, which when statistically combined, ensure that the true $k_{eff} \leq 0.95$ at a 95% probability and at a 95% confidence level.

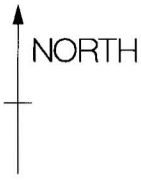
1.1 Fuel and Fuel Rack Design Description

The remaining two Boraflex spent fuel rack modules include a "North" module consisting of an 11x18 array of cells and a "South" module consisting of a 12x18 array of storage cells located in the southwest corner of the NMP1 spent fuel pool as shown in Figure 1[3,4]. The individual storage cells utilize Boraflex in a flux trap configuration as shown in Figure 2. The rack structural components are made from 304L stainless steel. The storage cells are asymmetric with two sheets of Boraflex forming a flux trap between assemblies in the E-W direction. In the N-S direction, the fuel assemblies are separated by the stainless steel rack structure.

Nominally, the Boraflex sheets are 134 inches long, beginning 10.79 inches above the base plate of the rack module and extending to 144.79" above the base plate. The active fuel region extends from elevation 7.22 inches to elevation 152.46 inches for all fuel 1
assemblies. For these assemblies, the top and bottom six inches of the active fuel length are natural uranium. For the current analysis, Boraflex sheets were replaced with water. 1
All fuel is 145.24 inches long.

The fuel design parameters for the 7x7, 8x8 and 9x9 fuel types are shown in Table1.





TOTAL SPENT FUEL POOL STORAGE = 3910 CELLS
BORAL STORAGE = 3496 CELLS
BORAFLEX STORAGE = 414 CELLS

Figure 1: The Spent Fuel Storage Pool at the Nine Mile Point 1 Station

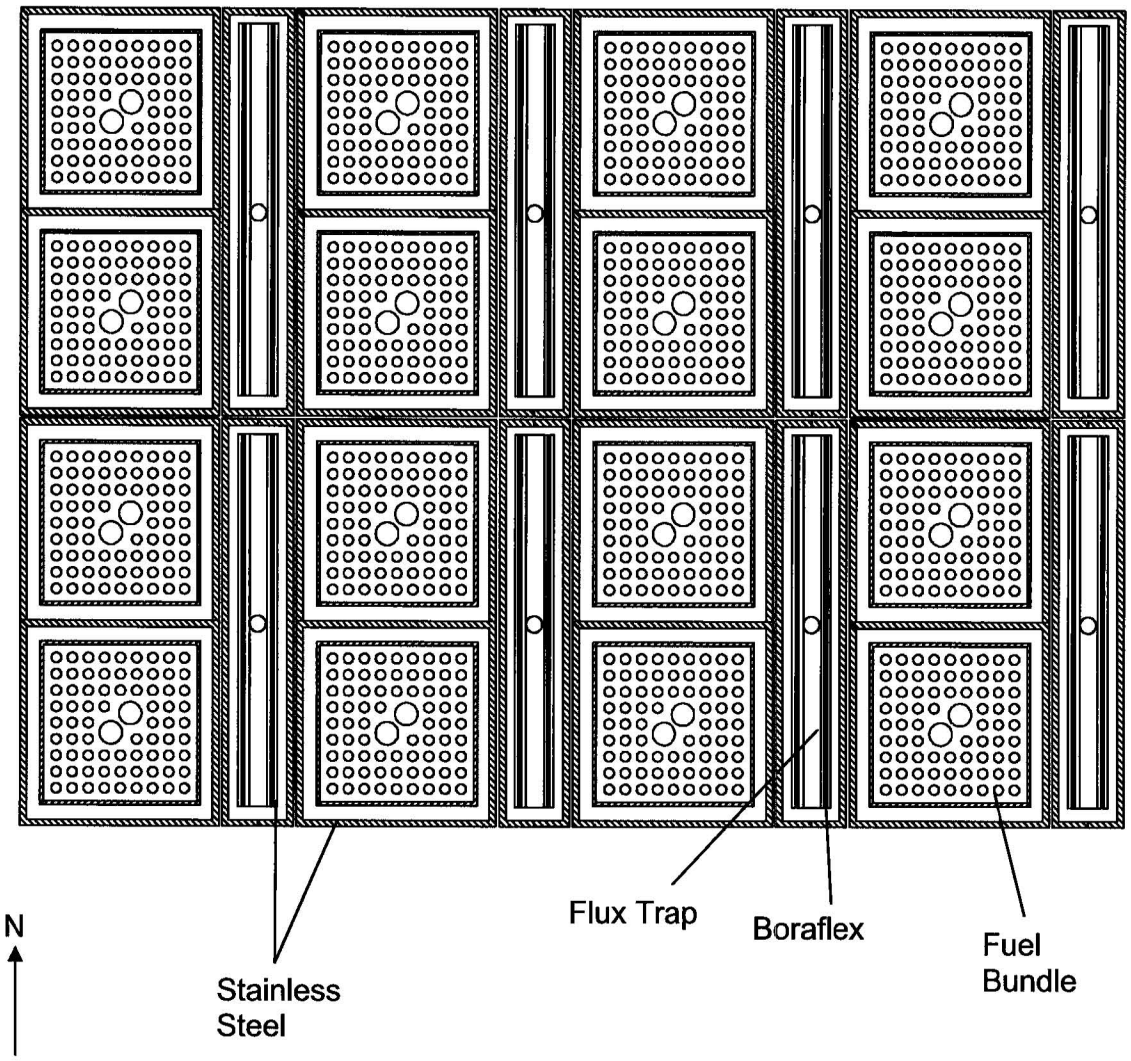


Figure 2: A 4x4 Array of Fuel Storage Cells (shown with Boraflex)
Filled with 9X9 Fuel Assemblies

Table 1

Fuel Assembly Description
Nine Mile Point 1 Nuclear Power Station

FUEL RODS	7x7	8x8 (GE7)	8x8 (GE8x8/R)	9x9	10x10
Cladding Material	Zircaloy	Zircaloy	Zircaloy	Zircaloy	Zircaloy
Cladding Tube OD, in.	0.563	0.483	0.483	0.440	0.404
Cladding Tube Wall Thickness, in.	0.032	0.032	0.032	0.028	0.026
Pellet Material	Sintered UO_2	Sintered UO_2	Sintered UO_2	Sintered UO_2	Sintered UO_2
Pellet OD, in.	0.487	0.410	0.410	0.376	0.345
Pellet Density, gm/cm^3 (% theoretical)	10.412 (95%)	10.412 (95%)	10.5764 (96.5%)	10.631 (97%)	10.631 (97%)
Pellet-to-Clad Diametral Gap, in.	0.012	0.009	0.009	0.008	0.007
FUEL ASSEMBLIES					
Number of Rods (# of water rods)	49 (0)	62 (2)	60 (4)	74 (2 large)	92 (2 large)
Rod Array	7x7	8x8	8x8	9x9	10x10
Rod-to-Rod Pitch, in.	0.738	0.640	0.640	0.566	0.510
Assembly Dimensions (without fuel channel), in.	5.166 x 5.166	5.26 x 5.26	5.26 x 5.26	5.094 x 5.094	5.10 x 5.10
Maximum Assembly Planer Average Enrichment, w/o ^{235}U, in Boraflex Modules	2.5	3.20	3.60	4.60	4.60
Axial Fuel Loading (gms U-235/cm-assembly)	13.511	17.15	17.15	22.85	23.92

1

1.2 Design Basis and Design Criteria

The analyses and evaluations described in this report demonstrate for the NMP1 Boraflex spent fuel racks $k_{eff} \leq 0.95$ when completely loaded with the most reactive limiting fuel type under the most reactive conditions. The maximum calculated reactivity (k_{eff}) when adjusted for code biases, fuel and rack manufacturing tolerances and methodology/calculational uncertainties (combined in a root-mean-square sense) will be less than or equal to 0.95 with a 95% probability at a 95% confidence level.

All analyses and evaluations have been conducted in accordance with the following codes, standards and regulations as applicable to spent fuel storage facilities:

- American Nuclear Society, American National Standard Design Requirements for Light Water Reactor Spent Fuel Storage Facilities at *Nuclear Power Plants*, ANSI/ANS-57.2-1983. October 7, 1983.

- Nuclear Regulatory Commission, Letter to All Power Reactor Licensees from B. K. Grimes. *OT Position for Review and Acceptance of Spent Fuel Storage and Handling Applications.* April 14, 1978, as amended by letter dated January 18, 1979.

- USNRC Standard Review Plan, NUREG-0800, Section 9.1.1, New Fuel Storage, and Section 9.1.2, Spent Fuel Storage.

- USNRC Regulatory Guide 1.13, Spent Fuel Storage Facility Design Basis, Rev. 2, December 1981.

- General Design Criterion 62, Prevention of Criticality in Fuel Storage and Handling. | 1

- ANS/ANSI 8.12-1987, Nuclear Criticality Control and Safety of Plutonium - Uranium Fuel Mixtures Outside Reactor.
- Memorandum from L. Kopp, SRE, to Timothy Collins, Chief, Reactor Systems Branch, Division of Systems Safety and Analysis, "Guidance on the Regulatory Requirements for Criticality Safety Analysis of Fuel Storage at Light Water Reactor Power Plants", August 19, 1998. 2

It is noted that the above USNRC and ANS/ANSI documents refer to the requirement that the maximum effective neutron multiplication factor (k_{eff}) be less than or equal to 0.95. The analyses of the reference case fuel/rack configurations are based on an infinite repeating array, which is infinite in the lateral extent and finite in the z-direction. 2

2.0 ANALYTICAL METHODS AND ASSUMPTIONS

The reactivity state of the NMP1 spent fuel racks has been analyzed using KENO V.a from the SCALE-PC[6] package and CASMO-4[7]. These computer codes have been validated and verified for spent fuel rack evaluations by benchmarking calculations of LWR critical experiments as described in the Appendix to this report. The computer codes (or their predecessors) have been previously reviewed and approved by the USNRC for spent fuel rack criticality evaluations[8].

To identify a most reactive fuel type that can be stored in the "North" Boraflex rack module the following approach was adopted. The current fuel loading configuration in the "South" Boraflex rack module has been assumed and the most reactive 9x9 bundle that can be stored in the "North" Boraflex module has been determined. The most reactive fuel lattice is defined for each fuel type, including the maximum planar average enrichment (w/o U-235) and minimum number of Gd_2O_3 rods, each rod containing the minimum w/o Gd_2O_3 loading. The depletion characteristics for this fuel assembly (k_∞ versus burnup) both for the standard cold-core geometry (SCCG) and for fuel rack geometry were assessed with CASMO-4 to determine the burnup resulting in peak assembly reactivity (k_∞). In these calculations, the fuel assembly is depleted at hot full power conditions in core geometry using CASMO-4. At specified burnup levels, the assembly is brought to the cold zero power condition (no Xenon) and modeled in the rack geometry. Subsequently, the assembly is subjected to additional burnup in the hot full power condition in core geometry and the iterative process repeated. The depletion characteristics of a fuel assembly with gadolinia are shown in Figure 3 as well as the depletion characteristics of an assembly without gadolinia burnable poisons.

The base-case reference value of k_{eff} of the fuel and rack configuration has been determined with KENO V.a. The effect of depletion on storage rack reactivity has been determined using CASMO-4. The KENO V.a model of the NMP1 fuel and storage rack is an exact rendering of the fuel and rack geometry as shown in Figure 4. Due to asymmetries in the NMP1 rack, the CASMO-4 model contains some approximations. For this reason, the CASMO-4 results are applied on a relative and not absolute basis (relative to the KENO V.a model). Further, the CASMO-4 model approximations have been verified using Keno V.a | 2

models. One model replicated the CASMO geometry and a recent model was an exact representation. The difference in the calculated eigenvalues between the Keno V.a exact geometry and the Keno V.a approximate models is less than 0.006 Δk_∞, calculated assuming that the most reactive bundles are stored in the racks. 2

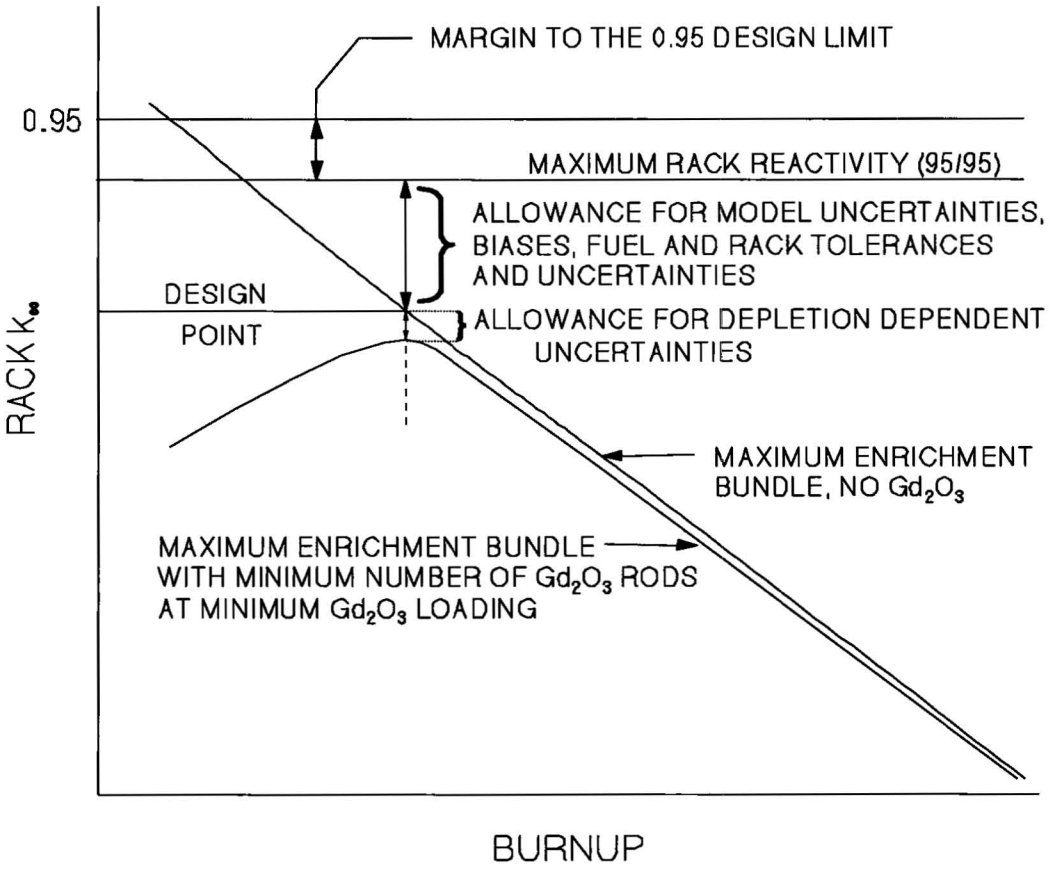


Figure 3: Depletion Characteristics of the Advanced Fuel Types

To assure that the actual fuel/rack reactivity is always less than the calculated maximum reactivity, the following conservative assumptions have been applied to the analyses:

1. The fuel assembly design parameters for these analyses are based on the most reactive lattice for a given fuel type.

2. The maximum fuel enrichment is uniform throughout the assembly. The assumption of uniform enrichment results in a higher reactivity than the distributed enrichments in the actual assemblies[8].

3. The fuel assembly is channeled in the rack as this condition results in the highest reactivity.

4. For the standard cold-core geometry (SCCG) calculations, the moderator is assumed to be demineralized water at full water density (1.0 gm/cm^3). For the in-rack calculations, the moderator is at a temperature of 150°F (density 0.98 gm/cm^3), which bounds the maximum normal condition of a full core offload. 2

5. All available storage locations are loaded with assemblies of maximum reactivity. This is conservative since four locations in the "South" module contain the tooling table feet and cannot be loaded with fuel.

6. No credit is taken for neutron absorption in the fuel assembly grid spacers or upper and lower end fittings.

7. No credit is taken for any natural uranium or reduced enrichment axial blankets (fuel is assumed to be at maximum average planar enrichment).

8. The number of gadolinia rods is taken as the minimum number contained in any region of the fuel assembly (vanished regions typically contain one less gadolinia rod than dominant regions).

9. Gadolinia loading (w/o Gd_2O_3) is assumed to be the minimum loading for assemblies with split gadolinia loadings.

10. BORAL racks contain 10x10 fuel at the reactivity equivalent fresh fuel enrichment (REFFE) that yield k_∞ = 1.31 in the standard cold core geometry (SCCG). The BORAL boron loading is at the minimum certified areal density of 0.0150 gms b-10/cm^2. [6]

11. All fuel is assumed to have an active length of 145.2 inches.

Based on the analyses described subsequently the maximum k_∞ at a 95% probability with a 95% confidence level of the fuel/rack configuration is calculated as:

$$k_\infty = k_{ref} + \Delta k_{bias} + \sqrt{\sum_{n=1}^{13} \Delta k_n^2}$$

where

k_{ref}	=	Nominal KENO V.a k_∞ adjusted for depletion effects
Δk_{bias}	=	Model bias

Tolerances and Uncertainties:

Δk_1	=	UO_2 enrichment tolerance
Δk_2	=	UO_2 pellet density tolerance
Δk_3	=	Gd_2O_3 loading tolerance
Δk_4	=	Rack cell inner width tolerance
Δk_5	=	Rack cell wall thickness tolerance
Δk_6	=	Flux trap width tolerance
Δk_7	=	Pellet diameter tolerance
Δk_8	=	Cladding inside diameter tolerance
Δk_9	=	Cladding outside diameter tolerance
Δk_{10}	=	Cladding wall thickness tolerance
Δk_{11}	=	Asymmetric assembly position tolerance
Δk_{12}	=	Methodology bias uncertainty (95 x 95)
Δk_{13}	=	Calculational uncertainty (95 x 95)
Δk_{14}	=	Burnup uncertainty

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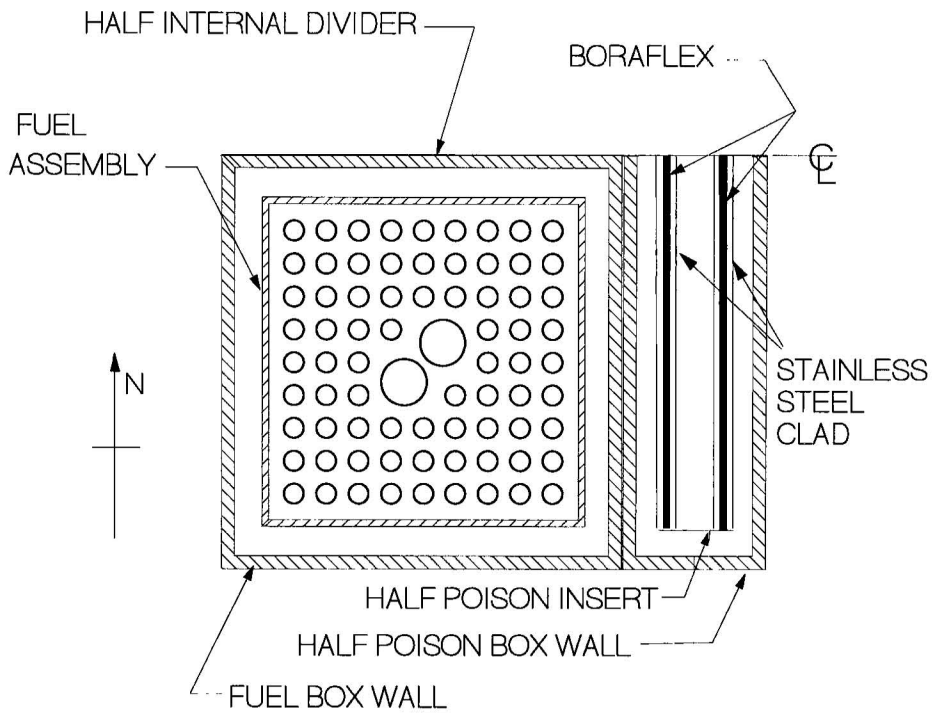

Figure 4: KENO V.a Model of NMP1 Racks with 9x9 Fuel
(All boundaries of the cell assume spectral reflection of neutrons)