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A Joint Venture of GE, Toshiba, & Hitachi

Global Nuclear Fuel

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Non-Proprietary Information – Class I (Public)

**Fuel Bundle Information Report
for
Limerick Unit 2
Reload 12 Cycle 13**

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Limerick Unit 2

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1. Introduction and Summary

This report, which supplements the *Supplemental Reload Licensing Report*, contains thermal-mechanical linear heat generation rate (LHGR) limits for the GNF-A fuel designs to be loaded into Limerick Unit 2 for Cycle 13. These LHGR limits are obtained from thermal-mechanical considerations only. Approved GNF-A calculation models documented in Reference 1 were used in performing this analysis.

LHGR limits as a function of exposure for each bundle of the core design are given in Appendix A. The LHGR values provided in Appendix A provide upper and lower exposure dependent LHGR boundaries which envelope the actual gadolinia dependent LHGR limits. The LHGRs reported have been rounded to two places past the decimal.

Appendix B contains a description of the fuel bundles. Table B-1 contains a summary of bundle-specific information, and the figures provide the enrichment distribution and gadolinium distribution for the fuel bundles included in this appendix. These bundles have been approved for use under the fuel licensing acceptance criteria of Reference 1.

2. References

1. *General Electric Standard Application for Reactor Fuel*, NEDE-24011-P-A-19, May 2012; and the U.S. Supplement, NEDE-24011-P-A-19-US, May 2012.

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Appendix A

UO₂/Gd Thermal-Mechanical LHGR Limits

Bundle Type: GNF2-P10CG2B386-2G8.0/13G7.0-120T2-150-T6-3644 (GNF2)

Bundle Number: 3644

Peak Pellet Exposure	UO ₂ LHGR Limit
GWd/MT (GWd/ST)	kW/ft
[[
]]

Peak Pellet Exposure	Most Limiting Gadolinia LHGR Limit ¹
GWd/MT (GWd/ST)	kW/ft
[[
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¹ Bounding gadolinia LHGR limit for all gadolinium concentrations occurring in this bundle design
[[]].

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UO₂/Gd Thermal-Mechanical LHGR Limits

Bundle Type: GE14-P10CNAB389-14GZ-120T-150-T6-3157 (GE14C)

Bundle Number: 3157

Peak Pellet Exposure	UO ₂ LHGR Limit
GWd/MT (GWd/ST)	kW/ft
0.00 (0.00)	13.40
16.00 (14.51)	13.40
63.50 (57.61)	8.00
70.00 (63.50)	5.00

Peak Pellet Exposure	Most Limiting Gadolinia LHGR Limit ²
GWd/MT (GWd/ST)	kW/ft
0.00 (0.00)	12.00
13.42 (12.17)	12.00
60.17 (54.59)	7.16
66.57 (60.39)	4.48

² Bounding gadolinia LHGR limit for all gadolinium concentrations occurring in this bundle design (7.0% Gd).

UO₂/Gd Thermal-Mechanical LHGR Limits

Bundle Type: GE14-P10CNAB389-15GZ-120T-150-T6-3158 (GE14C)

Bundle Number: 3158

Peak Pellet Exposure	UO ₂ LHGR Limit
GWd/MT (GWd/ST)	kW/ft
0.00 (0.00)	13.40
16.00 (14.51)	13.40
63.50 (57.61)	8.00
70.00 (63.50)	5.00

Peak Pellet Exposure	Most Limiting Gadolinia LHGR Limit ³
GWd/MT (GWd/ST)	kW/ft
0.00 (0.00)	12.00
13.42 (12.17)	12.00
60.17 (54.59)	7.16
66.57 (60.39)	4.48

³ Bounding gadolinia LHGR limit for all gadolinium concentrations occurring in this bundle design (7.0% Gd).

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UO₂/Gd Thermal-Mechanical LHGR Limits

Bundle Type: GE14-P10CNAB391-13GZ-120T-150-T6-3159 (GE14C)

Bundle Number: 3159

Peak Pellet Exposure	UO ₂ LHGR Limit
GWd/MT (GWd/ST)	kW/ft
0.00 (0.00)	13.40
16.00 (14.51)	13.40
63.50 (57.61)	8.00
70.00 (63.50)	5.00

Peak Pellet Exposure	Most Limiting Gadolinia LHGR Limit ⁴
GWd/MT (GWd/ST)	kW/ft
0.00 (0.00)	11.76
13.31 (12.08)	11.76
59.76 (54.21)	7.02
66.12 (59.98)	4.39

⁴ Bounding gadolinia LHGR limit for all gadolinium concentrations occurring in this bundle design (8.0% Gd).

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UO₂/Gd Thermal-Mechanical LHGR Limits

Bundle Type: GE14-P10CNAB391-13G8.0-120T-150-T6-3160 (GE14C)

Bundle Number: 3160

Peak Pellet Exposure	UO ₂ LHGR Limit
GWd/MT (GWd/ST)	kW/ft
0.00 (0.00)	13.40
16.00 (14.51)	13.40
63.50 (57.61)	8.00
70.00 (63.50)	5.00

Peak Pellet Exposure	Most Limiting Gadolinia LHGR Limit ⁵
GWd/MT (GWd/ST)	kW/ft
0.00 (0.00)	11.76
13.31 (12.08)	11.76
59.76 (54.21)	7.02
66.12 (59.98)	4.39

⁵ Bounding gadolinia LHGR limit for all gadolinium concentrations occurring in this bundle design (8.0% Gd).

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UO₂/Gd Thermal-Mechanical LHGR Limits

Bundle Type: GE14-P10CNAB390-12GZ-120T-150-T6-3161 (GE14C)

Bundle Number: 3161

Peak Pellet Exposure	UO ₂ LHGR Limit
GWd/MT (GWd/ST)	kW/ft
0.00 (0.00)	13.40
16.00 (14.51)	13.40
63.50 (57.61)	8.00
70.00 (63.50)	5.00

Peak Pellet Exposure	Most Limiting Gadolinia LHGR Limit ⁶
GWd/MT (GWd/ST)	kW/ft
0.00 (0.00)	11.76
13.31 (12.08)	11.76
59.76 (54.21)	7.02
66.12 (59.98)	4.39

⁶ Bounding gadolinia LHGR limit for all gadolinium concentrations occurring in this bundle design (8.0% Gd).

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UO₂/Gd Thermal-Mechanical LHGR Limits

Bundle Type: GNF2-P10CG2B396-6G7.0/6G6.0-120T2-150-T6-3648 (GNF2)

Bundle Number: 3648

Peak Pellet Exposure	UO ₂ LHGR Limit
GWd/MT (GWd/ST)	kW/ft
[[
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Peak Pellet Exposure	Most Limiting Gadolinia LHGR Limit ⁷
GWd/MT (GWd/ST)	kW/ft
[[
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⁷ Bounding gadolinia LHGR limit for all gadolinium concentrations occurring in this bundle design
[[]].

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UO₂/Gd Thermal-Mechanical LHGR Limits

Bundle Type: GNF2-P10CG2B404-12G6.0-120T2-150-T6-3643 (GNF2)

Bundle Number: 3643

Peak Pellet Exposure	UO ₂ LHGR Limit
GWd/MT (GWd/ST)	kW/ft
[[
]]

Peak Pellet Exposure	Most Limiting Gadolinia LHGR Limit ⁸
GWd/MT (GWd/ST)	kW/ft
[[
]]

⁸ Bounding gadolinia LHGR limit for all gadolinium concentrations occurring in this bundle design
[[]].

UO₂/Gd Thermal-Mechanical LHGR Limits

Bundle Type: GNF2-P10CG2B389-14GZ-120T2-150-T6-3645 (GNF2)

Bundle Number: 3645

Peak Pellet Exposure	UO ₂ LHGR Limit
GWd/MT (GWd/ST)	kW/ft
[[
]]

Peak Pellet Exposure	Most Limiting Gadolinia LHGR Limit ⁹
GWd/MT (GWd/ST)	kW/ft
[[
]]

⁹ Bounding gadolinia LHGR limit for all gadolinium concentrations occurring in this bundle design
[[]].

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UO₂/Gd Thermal-Mechanical LHGR Limits

Bundle Type: GNF2-P10CG2B391-15GZ-120T2-150-T6-3646 (GNF2)

Bundle Number: 3646

Peak Pellet Exposure	UO ₂ LHGR Limit
GWd/MT (GWd/ST)	kW/ft
[[
]]

Peak Pellet Exposure	Most Limiting Gadolinia LHGR Limit ¹⁰
GWd/MT (GWd/ST)	kW/ft
[[
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¹⁰ Bounding gadolinia LHGR limit for all gadolinium concentrations occurring in this bundle design
[[]].

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UO₂/Gd Thermal-Mechanical LHGR Limits

Bundle Type: GNF2-P10CG2B392-14GZ-120T2-150-T6-3647 (GNF2)

Bundle Number: 3647

Peak Pellet Exposure	UO ₂ LHGR Limit
GWd/MT (GWd/ST)	kW/ft
[[
]]

Peak Pellet Exposure	Most Limiting Gadolinia LHGR Limit ¹¹
GWd/MT (GWd/ST)	kW/ft
[[
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¹¹ Bounding gadolinia LHGR limit for all gadolinium concentrations occurring in this bundle design
[[]].

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UO₂/Gd Thermal-Mechanical LHGR Limits

Bundle Type: GNF2-P10CG2B391-14GZ-120T2-150-T6-3725 (GNF2)

Bundle Number: 3725

Peak Pellet Exposure	UO ₂ LHGR Limit
GWd/MT (GWd/ST)	kW/ft
[[
]]

Peak Pellet Exposure	Most Limiting Gadolinia LHGR Limit ¹²
GWd/MT (GWd/ST)	kW/ft
[[
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¹² Bounding gadolinia LHGR limit for all gadolinium concentrations occurring in this bundle design
[[]].

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UO₂/Gd Thermal-Mechanical LHGR Limits

Bundle Type: GNF2-P10CG2B388-2G8.0/8G7.0/2G6.0-120T2-150-T6-4218 (GNF2)

Bundle Number: 4218

Peak Pellet Exposure	UO ₂ LHGR Limit
GWd/MT (GWd/ST)	kW/ft
[[
]]

Peak Pellet Exposure	Most Limiting Gadolinia LHGR Limit ¹³
GWd/MT (GWd/ST)	kW/ft
[[
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¹³ Bounding gadolinia LHGR limit for all gadolinium concentrations occurring in this bundle design
[[]].

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UO₂/Gd Thermal-Mechanical LHGR Limits

Bundle Type: GNF2-P10CG2B386-14GZ-120T2-150-T6-4221 (GNF2)

Bundle Number: 4221

Peak Pellet Exposure	UO ₂ LHGR Limit
GWd/MT (GWd/ST)	kW/ft
[[
]]

Peak Pellet Exposure	Most Limiting Gadolinia LHGR Limit ¹⁴
GWd/MT (GWd/ST)	kW/ft
[[
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¹⁴ Bounding gadolinia LHGR limit for all gadolinium concentrations occurring in this bundle design
[[]].

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UO₂/Gd Thermal-Mechanical LHGR Limits

Bundle Type: GNF2-P10CG2B388-14GZ-120T2-150-T6-4220 (GNF2)

Bundle Number: 4220

Peak Pellet Exposure	UO ₂ LHGR Limit
GWd/MT (GWd/ST)	kW/ft
[[
]]

Peak Pellet Exposure	Most Limiting Gadolinia LHGR Limit ¹⁵
GWd/MT (GWd/ST)	kW/ft
[[
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¹⁵ Bounding gadolinia LHGR limit for all gadolinium concentrations occurring in this bundle design
[[]].

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UO₂/Gd Thermal-Mechanical LHGR Limits

Bundle Type: GNF2-P10CG2B396-2G7.0/10G6.0-120T2-150-T6-4217 (GNF2)

Bundle Number: 4217

Peak Pellet Exposure	UO ₂ LHGR Limit
GWd/MT (GWd/ST)	kW/ft
[[
]]

Peak Pellet Exposure	Most Limiting Gadolinia LHGR Limit ¹⁶
GWd/MT (GWd/ST)	kW/ft
[[
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¹⁶ Bounding gadolinia LHGR limit for all gadolinium concentrations occurring in this bundle design
[[]].

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Appendix B

Fuel Bundle Information

Table B-1 Bundle Specific Information						
Fuel Bundle	Bundle Number	Enrichment (wt% U-235)	Weight of UO ₂ (kg)	Weight of U (kg)	Max k _∞ at 20°C ¹⁷	Exposure at Max k _∞ GWd/MT (GWd/ST)
GNF2-P10CG2B386-2G8.0/13G7.0-120T2-150-T6-3644 (GNF2)	3644	[[
GE14-P10CNAB389-14GZ-120T-150-T6-3157 (GE14C)	3157					
GE14-P10CNAB389-15GZ-120T-150-T6-3158 (GE14C)	3158					
GE14-P10CNAB391-13GZ-120T-150-T6-3159 (GE14C)	3159					
GE14-P10CNAB391-13G8.0-120T-150-T6-3160 (GE14C)	3160					
GE14-P10CNAB390-12GZ-120T-150-T6-3161 (GE14C)	3161					
GNF2-P10CG2B396-6G7.0/6G6.0-120T2-150-T6-3648 (GNF2)	3648					
GNF2-P10CG2B404-12G6.0-120T2-150-T6-3643 (GNF2)	3643					
GNF2-P10CG2B389-14GZ-120T2-150-T6-3645 (GNF2)	3645					
GNF2-P10CG2B391-15GZ-120T2-150-T6-3646 (GNF2)	3646					
GNF2-P10CG2B392-14GZ-120T2-150-T6-3647 (GNF2)	3647					
GNF2-P10CG2B391-14GZ-120T2-150-T6-3725 (GNF2)	3725					

¹⁷ Maximum lattice k_∞ for the most reactive uncontrolled state plus a [[]] adder for uncertainties.

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GNF2-P10CG2B388- 2G8.0/8G7.0/2G6.0-120T2-150- T6-4218 (GNF2)	4218					
GNF2-P10CG2B386-14GZ- 120T2-150-T6-4221 (GNF2)	4221					
GNF2-P10CG2B388-14GZ- 120T2-150-T6-4220 (GNF2)	4220					
GNF2-P10CG2B396- 2G7.0/10G6.0-120T2-150-T6- 4217 (GNF2)	4217]]

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**Figure B-1 Enrichment and Gadolinium Distribution for EDB No. 3644
Fuel Bundle GNF2-P10CG2B386-2G8.0/13G7.0-120T2-150-T6-3644 (GNF2)**

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**Figure B-2 Enrichment and Gadolinium Distribution for EDB No. 3157
Fuel Bundle GE14-P10CNAB389-14GZ-120T-150-T6-3157 (GE14C)**

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**Figure B-3 Enrichment and Gadolinium Distribution for EDB No. 3158
Fuel Bundle GE14-P10CNAB389-15GZ-120T-150-T6-3158 (GE14C)**

[[

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**Figure B-4 Enrichment and Gadolinium Distribution for EDB No. 3159
Fuel Bundle GE14-P10CNAB391-13GZ-120T-150-T6-3159 (GE14C)**

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**Figure B-5 Enrichment and Gadolinium Distribution for EDB No. 3160
Fuel Bundle GE14-P10CNAB391-13G8.0-120T-150-T6-3160 (GE14C)**

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**Figure B-6 Enrichment and Gadolinium Distribution for EDB No. 3161
Fuel Bundle GE14-P10CNAB390-12GZ-120T-150-T6-3161 (GE14C)**

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Figure B-7 Enrichment and Gadolinium Distribution for EDB No. 3648
Fuel Bundle GNF2-P10CG2B396-6G7.0/6G6.0-120T2-150-T6-3648 (GNF2)

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**Figure B-8 Enrichment and Gadolinium Distribution for EDB No. 3643
Fuel Bundle GNF2-P10CG2B404-12G6.0-120T2-150-T6-3643 (GNF2)**

[[

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**Figure B-9 Enrichment and Gadolinium Distribution for EDB No. 3645
Fuel Bundle GNF2-P10CG2B389-14GZ-120T2-150-T6-3645 (GNF2)**

[[

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**Figure B-10 Enrichment and Gadolinium Distribution for EDB No. 3646
Fuel Bundle GNF2-P10CG2B391-15GZ-120T2-150-T6-3646 (GNF2)**

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**Figure B-11 Enrichment and Gadolinium Distribution for EDB No. 3647
Fuel Bundle GNF2-P10CG2B392-14GZ-120T2-150-T6-3647 (GNF2)**

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Figure B-12 Enrichment and Gadolinium Distribution for EDB No. 3725
Fuel Bundle GNF2-P10CG2B391-14GZ-120T2-150-T6-3725 (GNF2)

[[

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Figure B-13 Enrichment and Gadolinium Distribution for EDB No. 4218
Fuel Bundle GNF2-P10CG2B388-2G8.0/8G7.0/2G6.0-120T2-150-T6-4218 (GNF2)

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Figure B-14 Enrichment and Gadolinium Distribution for EDB No. 4221
Fuel Bundle GNF2-P10CG2B386-14GZ-120T2-150-T6-4221 (GNF2)

[[

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**Figure B-15 Enrichment and Gadolinium Distribution for EDB No. 4220
Fuel Bundle GNF2-P10CG2B388-14GZ-120T2-150-T6-4220 (GNF2)**

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**Figure B-16 Enrichment and Gadolinium Distribution for EDB No. 4217
Fuel Bundle GNF2-P10CG2B396-2G7.0/10G6.0-120T2-150-T6-4217 (GNF2)**