ENCLOSURE 2

MFN 14-058

Response to Request for Additional Information Re: GEH Licensing Topical Report NEDE-33766P, "GEH Simplified Stability Solution (GS3)"

Non-Proprietary Information – Class I (Public)

IMPORTANT NOTICE

This is a non-proprietary version of Enclosure 1, from which the proprietary information has been removed. Portions of the enclosure that have been removed are indicated by an open and closed bracket as shown here [[ ]].

NRC RAI-1

Provide any changes to the submitted LTR by topic. Include the revised envelope in Table 9-1, mixed core procedures, a definition of legacy fuel, removal of "BWR/3" in Table 9-5, and inclusion of [[ ]] in Section 9.4 of the cycle-specific application.

GEH Response

All changes to the submitted licensing topical report (LTR) (Reference 1) are included as Attachment 1 to this request for additional information (RAI) response. All sections and pages affected by the changes are included in the attachment with Revisions On so the changes can be easily identified. In order to provide contiguous sections some pages will have no changes. These changes will be included in the approval ("–A") version of the GS3 licensing topical report. As shown in the attachment the following items have been addressed:

1) A revised envelope in Table 9-1. The revised table [[

]]
2) The definition of mixed core and associated procedure is included in Section 10.1.
3) The definition of legacy fuel is added in Section 10.1.
4) A note was added to clearly specify that Table 9-5 is not applicable to the BWR/3.
5) The inclusion of [[ ]] in Section 9.4 of the cycle-specific application and the process to describe its application. Section 9.4 was modified to include the discussion of [[

]] Figure 9-1 was also modified to include the step "8a", i.e., the step that [[ ]]

References:

1) GE Hitachi Nuclear Energy, "GEH Simplified Stability Solution (GS3)," NEDE-33766P, Revision 0, September 2013.

NRC RAI – 2

Provide a chart of example calculations for cycle-specific GS3 application of GE/GNF fuel in the US BWR fleet. Include BWR type, cycle, fuel, initial minimum critical power ratio (MCPR), final MCPR, and margin to safety limit MCPR. For each plant provide the worst case scenarios when the hot channel is assumed to operate at the anticipated operational occurrence operating limit MCPR limit and at the GS3 OLMCPR limit.

GEH Response

Tables 1, 2, and 3 provide the results for example calculations performed for cycle-specific GS3 application of GEH/GNF fuel in [[

]].

Table 1 includes BWR type, cycle, limiting fuel type, Initial Minimum Critical Power Ratio (IMCPR), Final MCPR (FMCPR), and margin to the Safety Limit Minimum Critical Power Ratio (SLMCPR) for the [[

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References:

1) GE Hitachi Nuclear Energy, "GEH Simplified Stability Solution (GS3)," NEDE-33766P, Revision 0, September 2013.

Table 1: Cycle-specific GS3 application results for realistic case scenarios.

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Table 2: Cycle-specific GS3 application results for worst case scenario (IMCPR limit set by transient AOO OLMCPR).

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Table 3: Cycle-specific GS3 application results for beyond worst case scenario (IMCPR limit set by GS3 LTR OLMCPR).
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NRC RAI - 3

Provide results of a GS3 sensitivity study for [[
]] for a representative plant. Provide the best estimate and worst case initial condition scenarios.

GEH Response

The best-estimate results of GS3 sensitivity studies for [[

]].

References:

1) GE Hitachi Nuclear Energy, "GEH Simplified Stability Solution (GS3)," NEDE-33766P, Revision 0, September 2013.
2) GE Hitachi Nuclear Energy, "DSS-CD TRACG Application," NEDE-33147P-A, Revision 4, August 2013.

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NRC RAI - 4

Provide an analysis of a sample transition from GE14 to GNF2 fuel over three cycles for a representative plant. Provide radial peaking factors for the two transition cycles identifying the fuel types and amount of each fuel that is present.

GEH Response

Analyses of a sample transition from GE14 to GNF2 fuel over three cycles have been provided for a representative [[

]] Radial peaking factors for the two transition cycles identifying the fuel types and amount of each fuel that is present are also provided in Tables 1 and 2.

[[

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References:

1) GE Hitachi Nuclear Energy, "GEH Simplified Stability Solution (GS3)," NEDE-33766P, Revision 0, September 2013.
2) Global Nuclear Fuel, "GEXL17 Correlation for GNF2 Fuel," NEDC-33292P, Revision 3, April 2009.
3) Global Nuclear Fuel, "GEXL14 Correlation for GE14 Fuel," NEDC-32851P-A, Revision 5, April 2011.

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NRC RAI - 5

Provide results of a sensitivity analysis for the impact of lower power range monitor failures on GS3 results.

GEH Response

A sensitivity analysis for the impact of Local Power Range Monitor (LPRM) failures on GS3 results was conducted in support of NEDE-33766P Revision 0 (Reference 1). Two series of LPRM failure sensitivities were conducted, consistent with Reference 2, [[

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These two sensitivity analyses were conducted with a [[

]] This assignment is illustrated in Figure 1. The limiting TRACG thermal-hydraulic channel (2802) in the vicinity of [[

]] This representative mapping is used for [[

]]

Because single LPRM cells tend to be more sensitive than four LPRM cells, the LPRM failures make an OPRM cell more sensitive than that with its original 4-LPRM cells (Reference 2).

[[

]] Four (4) LPRMs are feeding into this cell: A5, B8, C4 and D2. LPRMs C4, B8 and D2 are [[

]]

The OPRM cell trip time decreases as the number of LPRM failures increases. The cell trip times are outlined in Table 1. Because the LPRM signals feeding into an OPRM cell are averaged, decreasing the number of LPRM inputs to an OPRM cell makes this cell more responsive. This is consistent with Reference 2 Section 4.3.3.3. As the cell becomes more responsive, the OPRM amplitude setpoint is reached earlier, resulting in a reduced trip time. [[

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Table 1: OPRM Cell Trip Times for Successive LPRM failures.

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References:

1) GE Hitachi Nuclear Energy, "GEH Simplified Stability Solution (GS3)," NEDE-33766P, Revision 0, September 2013.
2) GE Nuclear Energy, "Reactor Stability Detect and Suppress Solutions Licensing Basis Methodology for Reload Applications," NEDO-32465-A, August 1996.

ATTACHMENT 1
TO
RAI-1
MFN 14-058 ENCLOSURE 2

Modified Sections of NEDE-33766P, "GEH Simplified Stability Solution (GS3)"

Non-Proprietary Information – Class I (Public)

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9.4 FUEL RELOAD ANALYSIS APPLICATION

This section describes the application of the GS3 methodology for plants that fall within the generic licensing basis envelope of this LTR for fuel reload analyses, which corresponds to Step 8 **and Step 8a** of the overall GS3 process illustrated in Figure 9-1. Applications that fall outside the generic licensing basis envelope are discussed in Section 10, which corresponds to Step 9 of the overall GS3 process illustrated in Figure 9-1.

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]] This approach is consistent with the approved DSS-CD process in NEDC-33075P (Reference 8). Once the OPRM amplitude setpoint(s) are selected from Table 9-5, Table 9-6, or Table 9-7, each corresponding SCC setpoint is selected per Table 9-10, which is obtained from the approved Table E-1 in Reference 2. Table 9-10 is duplicated in this LTR for convenience in referencing both PBDA OPRM setpoints (i.e., amplitude and SCC) from the same source. There is no change introduced between the SCC versus OPRM amplitude setpoint relationship approved in Reference 2.

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9.4.1 Demonstration of Fuel Reload Analysis for a GS3 Option III Plant

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9.5 EXTENSION OF GENERIC ENVELOPE

The generic GS3 licensing basis allows the implementation of the GS3 methodology for GE BWR/2-6 product lines and existing GEH/GNF fuel designs. GS3 provides SLMCPR protection during anticipated instability events. The generic GS3 licensing basis is applicable when [[

]] the GS3 plant-specific procedure defined in Table 10-2 will be performed to demonstrate adequate SLMCPR protection.

Any extension of the GS3 applicability envelope requires confirmation analysis based on the procedure defined in Table 10-2, which is based on the methodology outlined in Section 9.3. The plant-specific application is described in Section 10.1. [[

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Table 9-1 [[

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Table 9-2 GS3 [[ ]] TRACG Analysis Event Matrix

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Table 9-3 GS3 [[ ]] TRACG Analysis Event Matrix

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Table 9-4 GS3 [[ ]] TRACG Analysis Event Matrix

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Table 9-5 [[ ]]

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Table 9-6 [[ ]]

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Table 9-7 [[ ]]

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Table 9-8 [[ ]]

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Table 9-9 [[ ]]

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Table 9-10 Relationship Between OPRM Successive Confirmation Count Setpoint and OPRM Amplitude Setpoint

Successive Confirmation Count Setpoint	OPRM Amplitude Setpoint[1, 2]
8	≥1.05
9	≥1.06
10	≥1.07
11	≥1.08
12	≥1.09
13	≥1.10
14	≥1.11
15	≥1.13
16	≥1.14

Notes:

1. The relationship between the OPRM SCC setpoint and the OPRM amplitude setpoint is obtained from Table E-1 of Reference 2.
2. Once the OPRM amplitude setpoint(s) are selected from Table 9-5, Table 9-6, and Table 9-7, each corresponding SCC setpoint is selected from this table.

Table 9-11 Conservatisms Included in GS3 Methodology

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Table 9-12 [[ ]]

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Figure 9-1 Flow Chart of the Overall GS3 Process

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Figure 9-2 OPRM Channel Configuration for BWR/6 TRACG Instability Events

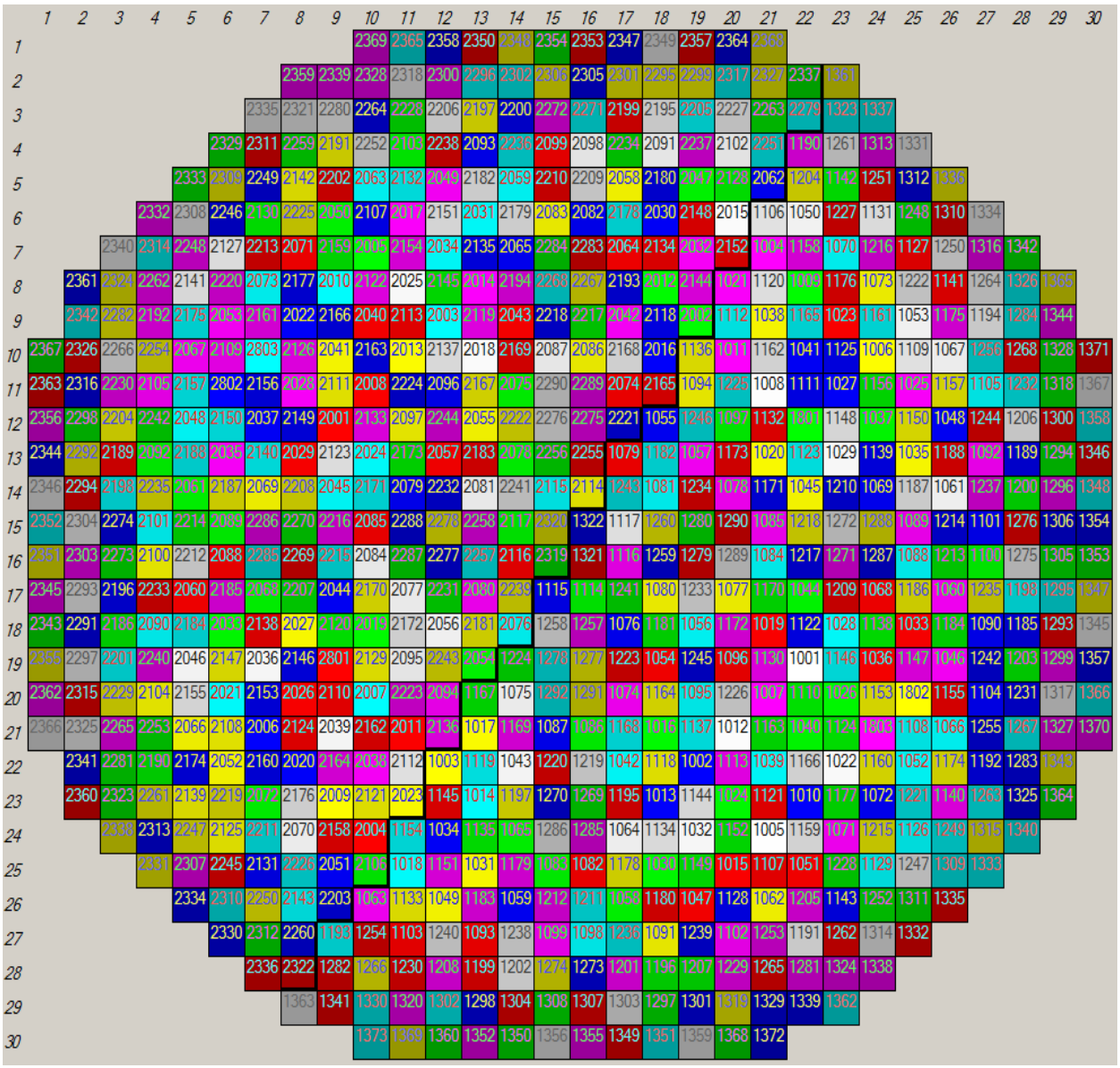

Figure 9-3 Full Core Individual Bundle Model for BWR/6 TRACG 2RPT Instability Event

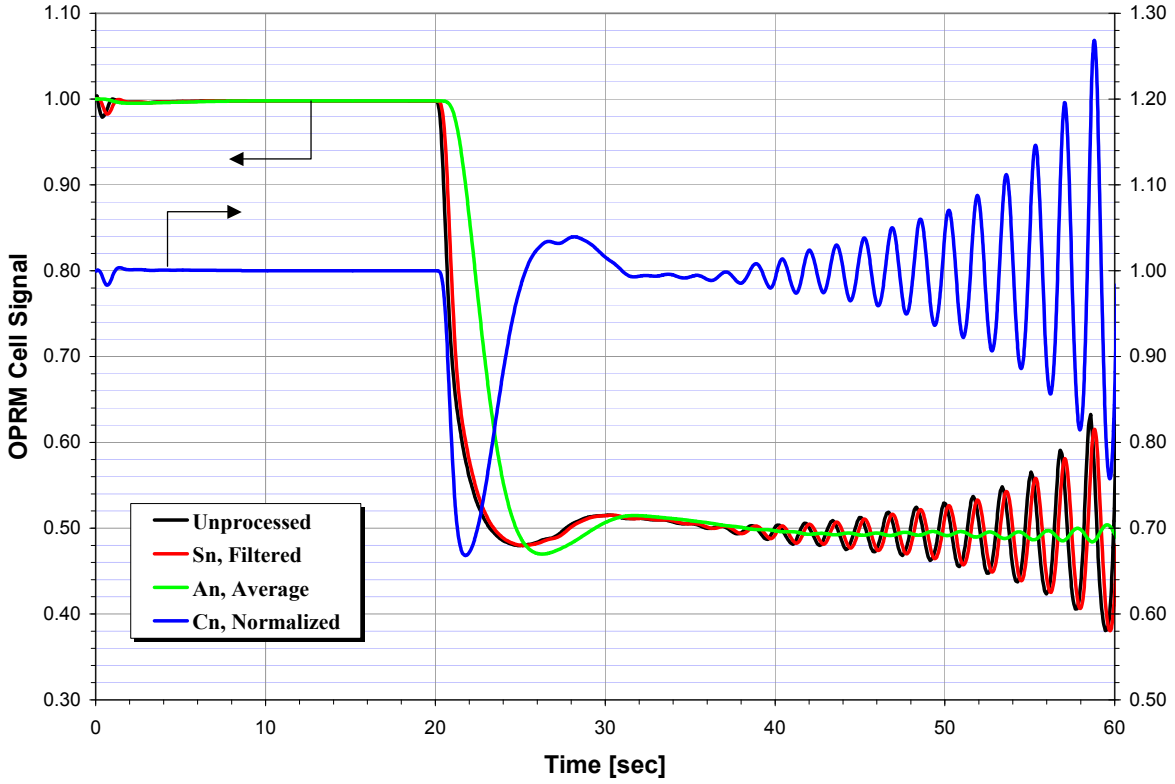

Figure 9-4 OPRM Cell Signal Processing

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Figure 9-5 MCPR Determination

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Figure 9-6 Simulation of an APRM Scram Line Logic for an Option I-D Plant

10. PLANT-SPECIFIC APPLICATIONS

A plant-specific review procedure is established to confirm that the generic GS3 licensing basis is applicable to plant-specific designs, including reload designs, thereby demonstrating SLMCPR protection by the GS3 methodology for anticipated stability-related oscillations. If the generic GS3 licensing basis is not applicable to a plant-specific design, additional analyses are necessary to demonstrate applicability. The process described in this section corresponds to Step 9 of the overall GS3 process illustrated in Figure 9-1.

10.1 PLANT-SPECIFIC REVIEW PROCESS

The generic GS3 licensing basis allows the implementation for GE BWR/2-6 product lines and existing GEH/GNF fuel designs. The solution provides for SLMCPR protection during anticipated instability events. The calculated MCPR Margin criteria documented in Table 9-5 through Table 9-9 are expected to accommodate future evolution in fuel cycle designs and operating flexibility features that may affect stability performance.

The standard plant-specific review process, which also applies to the reload process, consists of an applicability checklist confirming that the generic applicability envelope, as defined in Sections 9.2 and 9.3, is not exceeded. The plant-specific applicability checklist is provided in Table 10-1.

If any checklist criterion is not met as a result of a plant-specific design change that may affect reactor stability performance, then the GS3 plant-specific procedure defined in Table 10-2 will be performed to demonstrate adequate SLMCPR protection. If the design change is either within the GS3 plant-specific applicability checklist envelope or does not affect the reactor stability performance, then [[

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[[

]] The GS3 procedure uncertainty (or equivalent), documented in Sections 7 and 9, is then applied to confirm the protection of the

SLMCPR for any applicable OPRM/APRM setpoint(s). The GS3 applicability extension procedure is documented in Table 10-2.

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If the GS3 applicability extension involves a new GEH/GNF fuel design beyond GNF2 or non-GEH/GNF fuel designs, then the procedure documented in Table 10-3 is applied. This table lists the possible fuel design transitions among approved and unapproved GEH/GNF and non-GEH/GNF fuel designs for GS3 applications. [[

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Table 10-3 specifies the required [[

]] This process would apply to both cases where a new fuel design product line (e.g., GNF3) loaded core is implementing GS3 and where a GS3 licensed plant has a core introducing a new fuel design product line such as GNF3 fuel. Both of these scenarios are consistent with the DSS-CD approved methodology as documented in Reference 8 [[

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10.2 LEAD USE ASSEMBLY

The introduction of lead use assemblies (LUAs) in a reload core that is implementing the GS3 methodology should follow the process required by the implemented stability LTS Option I-D, II, or III.

10.3 TECHNICAL SPECIFICATIONS

No Technical Specification (TS) or TS Bases revisions are required with the implementation of the TRACG GS3 methodology for plants licensed for operation with Option I-D, II, or III stability LTS if the GS3 LTR, or GESTAR II, including the approved GS3 LTR, is referenced in in the TS section for methods.

Table 10-1 GS3 Plant-Specific Applicability Checklist

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