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U.S. Nuclear Regulatory Commission
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Subject: **Response to Portion of NRC Request for Additional Information Letter No. 106 - Related to ESBWR Design Certification Application – RAI Number 21.6-82 Supplement 1**

The purpose of this letter is to submit the GE Hitachi Nuclear Energy (GEH) response to the U.S. Nuclear Regulatory Commission (NRC) Request for Additional Information (RAI) sent by the Reference 1 NRC letter. GEH response to RAI Number 21.6-82 Supplement 1 is addressed in Enclosure 1.

If you have any questions or require additional information, please contact me.

Sincerely,

Richard E. Kingston

Richard E. Kingston
Vice President, ESBWR Licensing

Received on
2/26/10

D068
NRO

Reference:

1. MFN 07-497, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, GEH, *Request For Additional Information Letter No. 106 Related To ESBWR Design Certification Application*, dated September 6, 2007

Enclosure:

1. MFN 08-457 – Response to Portion of NRC Request for Additional Information Letter No. 106 - Related to ESBWR Design Certification Application – RAI Number 21.6-82 S01

cc:	AE Cubbage	USNRC (with enclosure)
	GB Stramback	GEH/San Jose (with enclosure)
	RE Brown	GEH/Wilmington (with enclosure)
	DH Hinds	GEH/Wilmington (with enclosure)
	eDRF	0000-0083-5843/1

Enclosure 1

MFN 08-457

Response to Portion of NRC Request for Additional Information Letter No. 106 Related to ESBWR Design Certification Application RAI Number 21.6-82 S01

NRC RAI 21.6-82 S01

The original RAI requested details of the transient xenon capability in TRACG. GEH responded that xenon concentration remains constant and is not updated during TRACG transients. The staff agrees with GEH that actual xenon concentrations would have insignificant impact on anticipated operational occurrences (AOO) and anticipated transients without a scram (ATWS) calculations. However during start-up, which takes place over the course of hours, the staff believes that xenon will have an impact on calculations. The staff is concerned about stability during start-up. A condition put upon the approval of TRACG for predicting stability margins for ESBWR (see Reference) was: "The ascension to full power, as with all other transient xenon conditions, will be analyzed using the PANACEA transient xenon option and reviewed at the design certification stage." Since TRACG does not have transient xenon capability, please provide additional information to address the effects of xenon on ESBWR start-up.

Reference: Safety Evaluation Report Regarding the Application of General Electric's Topical Report, TRACG Application for ESBWR Stability Analysis, NEDE-33083P, Supplement 1 (TAC MC3288) (ADAMS Accession Nos. ML0608900750 and ML061000463)

GEH Response

GEH has performed a series of PANACEA/TRACG integral analysis to address the concern regarding the impact of xenon on ESBWR start-up, especially with respect to the stability margin. As stated in the original response to RAI 21.6-82, the PANACEA code has the capability to track the distribution of Xe in reactor core and perform transient calculations while TRACG does not have such feature. However, in terms of stability impact, the effect of Xe concentration variation across the core region is identified as a variation of power peaking, which can be accurately and conservatively evaluated through TRACG. Therefore, a methodology was developed and employed by integrating PANACEA and TRACG calculations for Xe effect. The details of this method are discussed below in the order of analysis flow.

1. PANACEA analyses were performed at multiple temperature conditions to determine the maximum Radial Peaking Factor (RPF) during a startup when the burnup of transient Xe is considered. It was determined that the reduction in RPF by control rod withdrawal (reducing the control rod density) is more significant than the change in power caused by a local Xe transient.

2. TRACG then simulated startup transient at a given heatup rate until the rated steam pressure is reached. Before the TRACG transient execution, the radial peaking factor of the hot channel (a single fuel bundle or a group of 4x4 bundles in hot region of the core) was increased so that the maximum RPF observed throughout the TRACG startup is larger than the maximum RPF established in the PANACEA cases. Thus, the TRACG calculation bounds the possible maximum RPF caused by Xe effect. Please note that the RPF improves during startup to full power, beyond the power level when rated pressure is attained, as the control rod density further decreases. Furthermore, large power/flow

oscillations due to TYPE-I instability are only observed before rated pressure is reached as documented in DCD Tier 2 Chapter 4, Revision 5, Appendix 4D.2. Therefore, TRACG startup simulation is performed only up to rated steam pressure.

3. Stability related parameters, including maximum rate of flow variation, min CPR, maximum power and RPF for hot bundle, were then evaluated based on TRACG results together with plots of interest to show the margin to the acceptable stability limit.

GEH believes that the above methodology assures that the limiting Xe effect is conservatively evaluated in TRACG for startup stability. Detail of the analysis and results by following this method for Xe effect during startup are reported in GEH's response to RAI 4.4-60.

Unlike TYPE-I instability, TYPE-II instability (Density wave-induced oscillation) is not limiting at lower power levels during startup. As stated in NEDE-33083P, Supplement 1, Section 8.1 and DCD Tier 2 Subsection 4D.1.3.1 stability (TYPE-II) is limiting at full power because it is the point of highest power/flow ratio. Thus, TYPE-II instability is not of concern during startup and sufficient margins to instability are maintained based on the Decay Ratio (DR) values for TYPE-II oscillations at rated conditions documented in DCD Tier 2 Chapter 4, Revision 5, Appendix 4D.1.

DCD Impact

No DCD changes will be made in response to this RAI.

No changes to the subject LTR (NEDE-33083P) will be made in response to this RAI.