



**HITACHI**

**GE Hitachi Nuclear Energy**

September 27, 2012  
MFN 12-111 R0

U.S. Nuclear Regulatory Commission  
Attn: Document Control Desk  
Washington, DC 20555-0001

**Dale E. Porter**

GE-Hitachi Nuclear Energy Americas LLC  
Safety Evaluation Program Manager

3901 Castle Hayne Rd.,  
Wilmington, NC 28401  
USA

T 910 819-4491  
Dale.Porter@GE.Com

**Subject: Part 21 60-Day Interim Report Notification:  
Error in Main Steam Line High Flow Computational Methodology**

This letter provides information concerning an evaluation being performed by GE Hitachi Nuclear Energy (GEH) regarding a potential non-conservatism in calculation of Main Steam Line (MSL) choked flow rates. As stated herein, GEH has not concluded that this is a reportable condition in accordance with the requirements of 10CFR 21.21(d), and continued evaluation is required to determine whether this question about calculation methods and inputs is a reportable condition and what impact and extent of this condition may exist.

The information required for a 60-Day Interim Report Notification per §21.21(a)(2) is provided in Attachment 3. The commitment for follow-on actions is provided in Attachment 3, item (vii).

If you have any questions, please call me at (910) 819-4491.

Sincerely,

Dale E. Porter  
Safety Evaluation Program Manager  
GE-Hitachi Nuclear Energy Americas LLC

Attachments:

1. Description of Evaluation
2. US Plants Potentially Affected
3. 60-Day Interim Report Notification Information per §21.21(a)(2)

MFN 12-111 R0

Page 2 of 2

cc: S. S. Philpott, USNRC  
S. J. Pannier, USNRC  
O. Tabatabai-Yazdi, USNRC  
D. C. Crawford, GEH  
J. F. Harrison, GEH  
J. G. Head, GEH  
G. A. Watford, GEH  
P. L. Campbell, GEH Washington  
PRC File  
DRF Section No. 0000-0153-0033

## Summary

GEH has recently discovered that calculations of choked flow rate in the Main Steam Line (MSL) of GEH BWRs may not be conservative, with the potential impacts to be evaluated for existing MSL high-flow setpoints and Analytical Limits (ALs).

GEH has not completed the evaluation of this condition to determine reportability under 10 CFR Part 21 and is therefore issuing this 60-day Interim Notification. GEH will close or issue an update on this matter on or before December 12, 2012. Given the early status of the evaluation, GEH has no recommended actions at this time. This 60-day Interim Notification is issued in accordance with 10CFR Part 21.21(a)(2), and will be sent to all GE BWR/2-6 plants and ABWR plants.

## Introduction

GEH has recently discovered that calculations of the choked flow rate in the Main Steam Line (MSL) of GEH BWRs may not be conservative, with potential impacts to be evaluated for existing MSL high-flow setpoints and Analytical Limits (ALs). The choked flow rate (or critical flow) in this application is the maximum flow rate in the MSL that would result from a postulated steam line break downstream of each set of Main Steam Isolation Valves (MSIVs). This maximum flow rate is determined in part by the geometry of the in-line MSL flow restrictor (which also serves as a venturi flow meter by design) and the stagnation pressure of the flow at the inlet to the flow restrictor. Establishing this choked flow rate is important for proper determination of the MSL high-flow Analytical Limits and setpoints because the MSL high-flow trip ensures that an MSIV isolation is activated (specifically, Group 1 valves) when high MSL flow is detected. If the actual choked flow rate is lower than that used for establishing the MSL high-flow AL, then the MSL high-flow instrumentation could possibly be set to trip at a flow rate greater than would occur, and the MSL high-flow trip would not be activated to initiate MSIV isolation. Diverse methods are incorporated into the reactor design-basis instrumentation to provide high confidence that a reactor scram and MSIV isolation will occur during design basis events, and GEH is evaluating this condition to ensure isolation occurs and to determine the time required to complete isolation initiated by other such trips in the absence of a MSL high-flow trip.

Margins between choked flow rate and the MSL high-flow AL at the original licensed thermal power are relatively large (often greater than 50% of rated flow), with calculated choked flow rates comfortably greater than the AL values typically used. Increases in MSL flow rate at uprated power decrease those original MSL flow margins for plants. This trend of decreasing margin motivates prior and current efforts to ensure that choked-flow-to-high-

flow-AL margins and choked-flow-to-high-flow-setpoint margins remain sufficient to ensure reliable high-flow trip functionality.

### **Description of Discovery**

Non-conservatism potentially present in GEH calculations of choked flow rate are attributed primarily to choice of flow pressure used in the calculation and, to a lesser extent, choice of flow model.

#### ***Choice of Flow Pressure***

In many cases, GEH calculations have not explicitly considered MSL pressure losses between the reactor pressure vessel and the inlet to the MSL flow restrictor. These calculations have typically used pressure values at or near reactor dome pressure, rather than the (lower) pressure values associated with the flow restrictor inlet, which is the pressure that drives choked flow phenomena in the restrictor. This choice of pressure results in a higher calculated choked flow rate than would result if calculated using the pressure at the flow restrictor inlet. This non-conservatively high value of choked flow rate may result in a non-conservative calculation of margin between choked flow rate and the high-flow setpoint and AL. At original licensed thermal power with relatively large margins (discussed above), choice of pressure input for the calculations did not appreciably affect the results, but reduced flow margins motivate use of the most representative input values.

#### ***Choice of Flow Model***

GEH notes that multiple models (or equations) for calculating choked flow rate are available, and differences in results for the various methods can be significant for cases with lower MSL choked-flow-to-high-flow-AL margin (though choice of flow model has less effect than the input value of pressure). Flow models differ primarily in treatment of two-phase flow phenomena, which is challenging, with the simpler models assuming ideal gas behavior. Simplifications applied in previous years were appropriate for cases with relatively large margin between choked flow rate and the MSL high-flow AL. But reduction of that margin reduces the ability to accommodate flow uncertainties. That fact and this recent discovery have motivated the current effort to re-evaluate which flow model is most appropriate for applications with reduced MSL flow margins.

After the most appropriate flow equation is established, GEH will re-evaluate choked flow rates using pressure values at, or representative of, flow restrictor inlets, to the extent necessary to determine the reportability of this condition under 10 CFR Part 21.

**Extent of Condition**

GEH is currently accumulating information that will allow calculation of selected choked flow rates as necessary to identify specific plant cases with noticeably reduced choked-flow-to-high-flow-AL margin. The extent of condition will be determined from that evaluation, which will identify any values of AL that should be considered for decrease to a lower value.

**Evaluation of Setpoint Margin to Choked Flow Rate**

After determining which, if any, values of AL might be lowered to re-establish margin to choked flow rate, the adequacy of current MSL high-flow setpoint values should be evaluated to determine whether conservatism in the setpoint methodology provides sufficient margin to choked flow to ensure trip function. At this stage, whether GEH has all the information necessary to evaluate adequacy of current setpoints is uncertain. Evaluation of reportability under 10 CFR Part 21 may require either a Transfer of Information from GEH to owners of potentially-affected plants for evaluation by plant staff, or may require that plant owners supply GEH with necessary information, in accordance with established procedures for transmittal of data. The appropriate path to resolution will become apparent as the evaluation of extent of condition is completed.

**ABWR and ESBWR Design Certification Documentation Applicability**

The issue described above has been reviewed for applicability to documentation associated with 10 CFR 52, and determined to have no effect on the technical information contained in either the ABWR certified design or the ESBWR design in certification. This is true because the Technical Specifications submitted with the Design Certification Documentation do not include specific or suggested values of MSL high-flow values, and because details of specific components, such as dimensions of the MSL flow restrictor are not available at the time of design certification to allow calculations of choked flow rate. Therefore, these details are addressed on a plant-by-plant basis.

**Recommendation**

GEH has no recommendations at this time.

**Corrective/Preventive Actions**

GEH intends to complete the ongoing evaluations by December 12, 2012.

Refer to Attachment 3, Item (vii) for corrective actions.

**Attachment 2**  
**US Plants Potentially Affected**

*US BWR Plants and Associated Facilities*

	<b><u>Utility</u></b>	<b><u>Plant</u></b>
<u>X</u>	Constellation Energy	Nine Mile Point 1-2
<u>X</u>	Detroit Edison Co.	Fermi 2
<u>X</u>	Energy Northwest	Columbia
<u>X</u>	Entergy	Grand Gulf
<u>X</u>	Entergy	River Bend
<u>X</u>	Entergy	FitzPatrick
<u>X</u>	Entergy	Pilgrim
<u>X</u>	Entergy	Vermont Yankee
<u>X</u>	Exelon	Clinton
<u>X</u>	Exelon	Dresden 2-3
<u>X</u>	Exelon	LaSalle 1-2
<u>X</u>	Exelon	Limerick 1-2
<u>X</u>	Exelon	Oyster Creek
<u>X</u>	Exelon	Peach Bottom 2-3
<u>X</u>	Exelon	Quad Cities 1-2
<u>X</u>	FirstEnergy Nuclear Operating Co.	Perry 1
<u>X</u>	Florida Power & Light	Duane Arnold
<u>X</u>	Nebraska Public Power District	Cooper
<u>X</u>	PPL Susquehanna LLC	Susquehanna 1-2
<u>X</u>	Progress Energy	Brunswick 1-2
<u>X</u>	PSEG Nuclear, LLC	Hope Creek
<u>X</u>	Southern Nuclear Operating Co.	Hatch 1 - 2
<u>X</u>	Tennessee Valley Authority	Browns Ferry 1-3
<u>X</u>	Xcel Energy	Monticello

**Attachment 3 – 60-Day Interim Report Notification Information per §21.21(a)(2)**

- (i) Name and address of the individual or individuals informing the Commission.

Dale E. Porter  
GE Hitachi Nuclear Energy  
Safety Evaluation Program Manager  
3901 Castle Hayne Road, Wilmington, NC 28401

- (ii) Identification of the facility, the activity, or the basic component supplied for such facility which fails to comply or contains a defect.

See Attachment 2 for a list of potentially affected plants

- (iii) Identification of the firm constructing the facility or supplying the basic component which fails to comply or contains a defect.

GE Hitachi Nuclear Energy

- (iv) Nature of the defect or failure to comply and the safety hazard which is created or could be created by such defect or failure to comply.

Calculations of Main Steam Line (MSL) choked flow rate may be non-conservative, with potential impacts to be evaluated for existing MSL high-flow setpoints and Analytical Limits (ALs). Should margins between existing MSL high-flow setpoints and newly calculated values of choked flow rate be found non-conservative, then it is possible that affected plants might have MSL high-flow trips that would not activate main steam system isolation in the event of a postulated main steam line break downstream of each set of Main Steam Isolation Valves (MSIVs).

- (v) The date on which the information of such defect or failure to comply was obtained.

A Potential Reportable Condition Evaluation in accordance with 10 CFR Part 21 was initiated on August 3, 2012.

- (vi) In the case of a basic component which contains a defect or fails to comply, the number and location of these components in use at, supplied for, being supplied for, or may be supplied for, manufactured, or being manufactured for one or more facilities or activities subject to the regulations in this part.

Any defect resulting from this discovered condition would be found in calculations of MSL choked flow rate, and in subsequent analyses to establish MSL high-flow ALs and setpoints. The evaluation of extent of condition to identify which plants might have non-conservative margin between choked flow rate and MSL high-flow AL is incomplete but ongoing.

- (vii) The corrective action, which has been, is being, or will be taken; the name of the individual or organization responsible for the action; and the length of time that has been or will be taken to complete the action.

GEH has stopped approval of analysis tasks dependent upon values of choked flow rate or MSL high-flow ALs pending resolution of this issue.

**Attachment 3 – 60-Day Interim Report Notification Information per §21.21(a)(2)**

GEH Engineering is performing a Nonconformance Assessment (NCA) to identify apparent and contributing causes for this condition. Additional corrective actions will be identified by this process. GEH intends to complete and approve this NCA by October 30, 2012.

- (viii) Any advice related to the defect or failure to comply about the facility, activity, or basic component that has been, is being, or will be given to purchasers or licensees.

GEH has no recommendations or advice at this time.

- (ix) In the case of an early site permit, the entities to whom an early site permit was transferred.

This is not an early site permit concern.