HITACHI

GE Hitachi Nuclear Energy

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M210054

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

Subject: Part 21 60-Day Interim Report Notification: Side Entry Orifice Hydraulic Loss Coefficient (SC 21-04 R0)

This letter provides GE Hitachi Nuclear Energy's (GEH) interim report regarding a 10 CFR Part 21 evaluation of hydraulic loss coefficients for certain fuel bundles as a function of location. The Side Entry Orifice (SEO) loss coefficient varies in BWR/6 plants, depending on the orientation of the SEO relative to intersecting core support beams. The SEO loss coefficient for some bundle locations are potentially underpredicted, which can result in a local overprediction of Minimum Critical Power Ratio (MCPR) margin.

The information required for this GEH 60-Day Interim Report Notification per §21.21(a)(2) is attached.

GEH will complete the evaluation efforts and provide a determination of reportability in accordance with 10 CFR Part 21 no later than June 14, 2021.

Please contact me if there are any questions.

Sincerely,

Michelle P. Catts

Michelle P. Catts
Safety Evaluation Program Manager
GE Hitachi Nuclear Energy Americas LLC

Attachments:
1. 60-Day Interim Report Notification Information per §21.21(a)(2) and Safety Communication

cc: E. Lenning, USNRC NRR/DORL/LLPB
D. Morey, USNRC NRR/DORL/LLPB
L. Dudes, USNRC Region II Administrator
J. Giessner, USNRC Region III Adminisrator

PLM Spec 006N5258

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10 CFR Part 21 Communication

SC *21-04 R0* ***April 19, 2021***

To: ***Affected and Potentially Affected Plants (Attachment 1)***

Subject: ***Fuel Support Side Entry Orifice Meta-Stable Flow for 2 Beam Locations in the BWR/6 Reactors***

[ ]	**Reportable Condition [21.21(d)]**	[X]	**60 Day Interim Report [21.21(a)(2)]**
[ ]	**Transfer of Information [21.21(b)]**	[X]	**Safety Information Communication**

Summary:

For core monitoring, GNF applies different hydraulic loss coefficients to BWR/6 fuel bundles as a function of location. The Side Entry Orifice (SEO) loss coefficient varies in BWR/6 plants, depending on the orientation of the SEO relative to intersecting core support beams. The SEO loss coefficient for some bundle locations are potentially underpredicted, which can result in a local overprediction of Minimum Critical Power Ratio (MCPR) margin. Specifically, the SEO loss coefficients for fuel bundle locations adjacent to 2-beam (corner) locations may potentially be higher than the current design basis value that is applied. The MCPR effect on potentially affected bundles that are near limits can potentially reduce this margin. GEH has not determined whether the subject condition has contributed to or could contribute to exceeding a Safety Limit, as defined in the Technical Specifications of a license for operation issued under 10 CFR Part 50. GEH has determined that this has not created a potential Substantial Safety Hazard.

GEH has not completed the evaluation of the condition described above to determine reportability under 10 CFR Part 21 and is therefore issuing this 60-Day Interim Notification in accordance with 10CFR Part 21.21(a)(2).

GEH will complete the evaluation by June 14, 2021.

Please contact me if there are any questions.

Issued by: Michelle P. Catts

Michelle P. Catts, Safety Evaluation Program Manager
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Background

In 2020, GEH issued a Reportable Condition (RC) notification [Reference 1], as well as a safety information communication to inform plants that may have been similarly affected but were not GEH customers [Reference 2]. The subject of these communications was the hydraulic loss coefficient used to calculate the pressure loss and flow rate into the Side Entry Orifice (SEO) at the fuel bundle entrance in BWR/6 plants. The issue was the SEO loss coefficient was underpredicted for some fuel bundle locations, which could result in an overprediction of MCPR margin in core monitoring applications. The overprediction was a result of flow area restrictions associated with instrument support structures in the cross beams (structural supports underneath the core plate) in BWR/6 plant designs.

The issue evaluated here is a result of follow-on actions from the 2020 RC [Reference 1] to further characterize the flow phenomena at other SEO locations. It has been discovered that the 2-beam (corner) fuel bundle locations have the potential for meta-stable, higher SEO losses.

Discussion

The BWR/6 and ABWR plant designs are similar in that they have supporting cross beams that form a grid structure underneath the core plate. The orientation of SEOs relative to the beams produces the different losses due to differences in upstream flow areas. While the ABWR shares these similarities with the BWR/6 in this area, it has differences in design features in the vicinity of the SEO, as well as different orifice diameters compared to the BWR/6. The ABWR configuration and geometry was not evaluated.

BWR/2-5 plants have a different core support structure that is more open so that multiple SEO losses are not applied to evaluations for those plants. The ESBWR core support plate design is also different, and this issue is not applicable. The SEO loss coefficients for different beam configuration are applied in core monitoring applications for GNF customers; there are no ABWRs or ESBWRs operating or being monitored at this time in the United States.

The BWR/6 SEO inlet loss area dependency is well known. GE evaluated full-scale tests of different SEO configurations in the late 1980s. In 2002 it was discovered that advanced fuel designs were more sensitive to this loss coefficient and changes were incorporated into core monitoring databanks to address the issue. In 2020, it was discovered at the IRM/SRM locations have more restrictive inlet flow areas and this was incorporated as additional change in loss coefficient into core monitoring databanks. From the 2020 discovery, there were follow on actions to further characterize the losses for the SEO configurations; it was found that meta-stable pressure losses may exist under some conditions for the 2-beam locations of the BWR/6 plant design. Under certain conditions, flow patterns may result in higher SEO pressure losses, which could lead to a situation where the actual SEO hydraulic loss at affected locations is higher than previously calculated. For US BWR/6 plants, the potential increase in the SEO loss for these locations is approximately 1.9 times the current loss value (design basis). Figure 1 shows a diagram of the geometry of interest (not to scale). The SEO locations are designated A, B, C, D or D′ and the dashed lines are lines of symmetry. The 2-beam location corresponds to C on Figure 1.

The most recent operating cycles for the four US-based BWR/6 plants are currently being evaluated with the higher SEO loss coefficient at the 2-beam location. Preliminary results show a potential effect on MCPR in the nonconservative direction, having the potential to occur at a limiting core location, that is greater than the 0.01 criterion that GEH has historically applied for reporting that a Technical Specification Safety Limit could have been exceeded as defined under 10 CFR Part 21.

Although results are preliminary and evaluations are ongoing, GEH recognizes that licensees will need to perform operability evaluations. To assist licensees in the interim, the result of GEH's assessment of Section 3.01 of Reference 3, "Scope of Operability Determinations," is provided as Attachment 3.

Conclusions

Additional time is needed for GEH to complete evaluations and determine whether the subject condition would contribute, or has contributed, to exceeding a Technical Specification Safety Limit. However, due to the nature of the preliminary results of impact on MCPR of more than 0.01, recommended interim action is provided.

Recommended Interim Actions

For affected plants that use GNF core monitoring systems, an interim action can be implemented, such as an administrative MCPR penalty, in the core monitoring system. An effective short-term measure would be to assure the limiting locations are 0.05 less than the Maximum Fraction of Limiting CPR limit (i.e., $MFLCPR_{limit} = 1.00$). This condition is met if the core wide MFLCPR is 0.05 below the limit (i.e., MFLCPR ≤ 0.95), because the 2-beam limiting locations will be bounded. Only the 2-beam locations require an adjustment to the MFLCPR limit. Note that this recommended interim measure was developed on a standalone basis conservatively applying the higher loss coefficient (giving largest CPR impact) at all 2 beam locations and does not supplant any existing MFLCPR limit reductions established for other purposes.

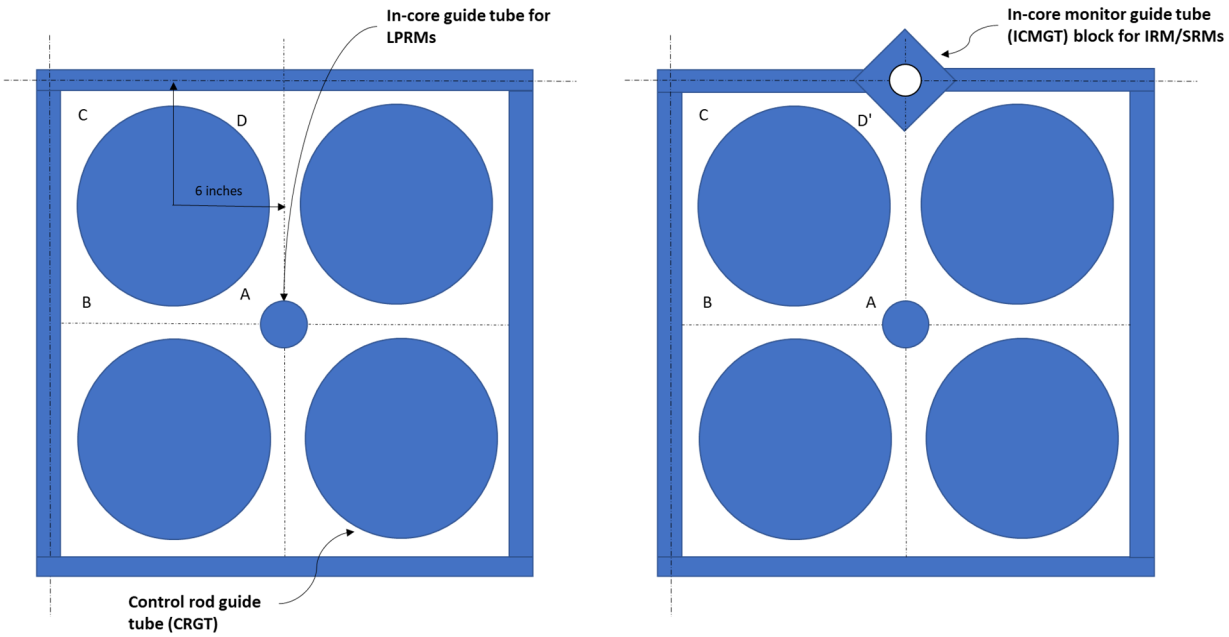

Figure 1 Illustrations of BWR/6 interior (central core) cells with surrounding support beams (not to scale)

References

1. ML 20176A432 (M200087), Subject: Non-Conservative BWR/6 Side Entry Orifice (SEO) Loss Coefficients, June 24, 2020.
2. Safety Communication 20-05, "Fuel Support Side Entry Orifice Loss Coefficient for In-Core Instrument Locations in the Core Monitoring System Databank." June 24, 2020.
3. ML19273A878, NRC Inspection Manual Chapter 0326, Operability Determinations, effective date 10/01/2019.

Attachment 1
List of Potentially Affected Plants

BWR Plants and Associated Facilities

	Utility	Plant
	Detroit Edison Co.	Fermi 2
	Energy Northwest	Columbia
SC	Entergy	Grand Gulf
SC	Entergy	River Bend
	Entergy	Pilgrim
	Entergy	Vermont Yankee
	Exelon	Nine Mile Point 1-2
SC	Exelon	Clinton
	Exelon	Dresden 2-3
	Exelon	FitzPatrick
	Exelon	LaSalle 1-2
	Exelon	Limerick 1-2
	Exelon	Oyster Creek
	Exelon	Peach Bottom 2-3
	Exelon	Quad Cities 1-2
SC	Energy Harbor Nuclear Corp..	Perry 1
	Nextera Energy Resources	Duane Arnold
	Nebraska Public Power District	Cooper
	Talen Energy	Susquehanna 1-2
	Duke Energy - Progress	Brunswick 1-2
	Public Service Enterprise Group Incorporated	Hope Creek
	Southern Nuclear Operating Co.	Hatch 1 - 2
	Southern Nuclear Operating Co.	Pooled Equipment Inventory Co.
	Tennessee Valley Authority	Browns Ferry 1-3
	Xcel Energy	Monticello

US PWR Plants

	Utility	Plant
_____	AmerenUE	Callaway
_____	Arizona Public Service	Palo Verde 1-3
_____	Entergy	Arkansas Nuclear One 1-2
_____	Entergy	Indian Point 2-3
_____	Dominion	Kewaunee
_____	Dominion	Millstone 2
_____	Dominion	Millstone 3
_____	Dominion	North Anna 1-2
_____	Dominion	Palisades
_____	Dominion	Surry 1-2
_____	Dominion	Waterford 3
_____	Duke Energy Corporation	Catawba 1-2
_____	Duke Energy Corporation	Crystal River 3
_____	Duke Energy Corporation	McGuire 1-2
_____	Duke Energy Corporation	Oconee 1-3
_____	Duke Energy Corporation	Robinson
_____	Duke Energy Corporation	Shearon Harris
_____	Exelon	Braidwood 1-2
_____	Exelon	Byron 1-2
_____	Exelon	Calvert Cliffs 1-2
_____	Exelon	Fort Calhoun
_____	Exelon	Ginna
_____	Exelon	Three Mile Island 1
_____	FirstEnergy Nuclear Operations Co.	Beaver Valley 1-2
_____	FirstEnergy Nuclear Operating Co.	Davis-Besse
_____	Florida Power & Light	Seabrook
_____	Florida Power & Light	St. Lucie 1-2
_____	Florida Power & Light	Turkey Point 3-4
_____	Florida Power & Light	Point Beach 1-2
_____	Indiana Michigan Power Corp	D C Cook 1-2
_____	Northern States Power	Prairie Island 1-2
_____	Pacific Gas & Electric Co.	Diablo Canyon 1-2
_____	PSEG Nuclear LLC	Salem 1
_____	PSEG Nuclear LLC	Salem 2
_____	South Carolina Electric & Gas Co.	Summer
_____	South Texas Project Nuclear Operating Co.	South Texas Project 1-2
_____	Southern California Edison Co.	San Onofre 2-3
_____	Southern Nuclear Operating Co.	Farley 1-2
_____	Southern Nuclear Operating Co.	Vogtle 1-2
_____	Tennessee Valley Authority	Sequoyah 1-2

	Utility	**Plant**
_____	Tennessee Valley Authority	Watts Bar 1
_____	TXU Electric Generation Co.	Comanche Peak 1-2
_____	Wolf Creek Nuclear Operating Corp.	Wolf Creek

Attachment 2 – Recent GE Hitachi Nuclear Energy 10 CFR Part 21 Communications

The following is a list of recent 10 CFR Part 21 communications that GE Hitachi Nuclear Energy (GEH) has provided to affected licensees as Reportable Conditions (RC), Transfers of Information (TI), 60-Day Interim Reports (60 Day) or Safety Information Communications (SC).

Number	Ref.	Subject	Date
SC 21-01	PRC 21-01	EC Trip Unit Rivet Failure	1/29/2021
SC 21-02	PRC 21-02	NUMAC PRNM LPRM I/V Curve Function	3/9/2021
SC 21-03	PRC 21-03	Safety Communications SC 21-03 for PRC 21-03, Transfer of Information	4/9/2021
SC 21-04	PRC 21-04	**Fuel Support Side Entry Orifice Meta-Stable Flow for 2 Beam Locations in the BWR/6 Reactors**	04/19/2021

Attachment 3
GEH's Assessment of 06.07 Scope of Operability Determinations

Item	Point to Address	GEH Assessment
a.	Possible elements of an OD include:	
(1)	The SSC affected by the condition,	Fuel assemblies are affected by the potentially degraded condition. Core monitoring system is applied to surveil fuel during operation and assure that applicable safety limits are met.
(2)	The extent of condition for all similarly affected SSCs,	There are no other affected SSCs.
(3)	The CLB requirements or commitments established for the affected SSC,	Core monitoring system provides a means to assure that fuel is operated in a manner that conforms to applicable safety limits and CLBs.
(4)	The specified safety function(s) performed by the affected SSCs,	In general, most SSCs (e.g., control blades, safety relief valves, etc.) have a function that protects nuclear fuel assemblies, which are the SSCs of concern. As long a fuel is operated within applicable limits, such as the Technical Specification Safety Limit MCPR or SLMCPR, fuel cladding integrity is maintained.
(5)	The effect or potential effect of the condition on the affected SSC's ability to perform its specified safety function(s), and	If a fuel assembly were operated beyond the Operating Limit MCPR (OLMCPR) due to incorrect modeling within the core monitoring system, then an event with a single failure has the potential to contribute to exceeding the SLMCPR.
(6)	Whether there is a reasonable assurance of operability, including the basis for the determination and any compensatory measures put in place to establish or restore operability.	The identified compensatory measures are expected to be effective so that the fuel assemblies can be operated and monitored within applicable limits. Implementation of the recommended corrective action is enough to restore the core monitoring system so that fuel can be operated as normal. The recommended interim

Item	Point to Address	GEH Assessment
		measure assures adequate margin for operability.
b.	The following things should be considered when reviewing ODs:	
(1)	Design basis events are plant-specific, and plant-specific TS, bases, and safety evaluations may contain plant-specific considerations related to operability,	Plant specific safety evaluations are unaffected by this issue. Corrective action will restore the capability to monitor and will preserve the existing TS and bases. The recommended interim measure will assure adequate margin to the existing TS and bases.
(2)	An SSC's operability requirements are based on safety analyses of specific design basis events for one mode or specified condition of operation and may not be the same for other modes or conditions of operation; therefore, all applicable modes and conditions of operation should be considered,	Corrective action will restore the capability to monitor to existing limits and conform to existing bases, which includes all applicable licensed modes of operation. The recommended interim measure will assure adequate margin to the existing limits and bases, which includes all applicable modes of operation.
(3)	The operability requirements for an SSC encompass all necessary support systems (per the TS definition of operability) regardless of whether the TS explicitly specifies operability requirements for the support functions,	The core monitoring system is applied to support fuel operation. Corrective action will restore the capability of the computer system to monitor to existing bases and TS requirements. The recommended interim measure will assure adequate margin to the existing bases and TS requirements.
(4)	In order to evaluate conditions, it is assumed in the OD that the design basis event occurs. The occurrence of multiple simultaneous design basis events should be considered only to the extent that they are required as a part of the plant's CLB, and	Corrective action will restore the capability of the core monitoring system to monitor fuel assemblies, which supports conformance to the plant's CLB. The recommended interim measure will assure adequate margin to limits and supports conformance to the plant's CLB.
(5)	Compensatory measures may be established to restore or maintain operability of an SSC. See section 06.08 of	The identified corrective action is all that is required to restore the capability of the core monitoring system. The identified

Item	Point to Address	GEH Assessment
	this IMC for additional guidance on compensatory measures.	interim measure assures adequate margin to support operation.