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August 4, 2021  
L-21-189

10 CFR 50.73(a)(2)(i)(B)

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

SUBJECT:  
Perry Nuclear Power Plant  
Docket No. 50-440, License No. NPF-58  
Licensee Event Report Submittal

Enclosed is Licensee Event Report (LER) 2021-002, "Core Monitoring System Software Modeling Error Results in Conditions Prohibited by Technical Specifications." There are no regulatory commitments contained in this submittal.

If there are any questions or if additional information is required, please contact Mr. Glendon Burnham, Manager – Regulatory Compliance, at (440) 280-7538.

Sincerely,

A handwritten signature in black ink that reads "Dawn M Bayler for Rod Penfield". The signature is written in a cursive style.

Rod L. Penfield

Enclosure:  
LER 2021-002

cc: NRC Project Manager  
NRC Resident Inspector  
NRC Region III Regional Administrator

Enclosure  
L-21-189

LER 2021-002



**LICENSEE EVENT REPORT (LER)**

(See Page 3 for required number of digits/characters for each block)

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Estimated burden per response to comply with this mandatory collection request: 80 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the FOIA, Library, and Information Collection Branch (T-6 A10M), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by e-mail to [Infocollects.Resource@nrc.gov](mailto:Infocollects.Resource@nrc.gov), and the OMB reviewer at: OMB Office of Information and Regulatory Affairs, (3150-0104), Attn: Desk Officer for the Nuclear Regulatory Commission, 725 17th Street NW, Washington, DC 20503; e-mail: [oira\\_submission@omb.eop.gov](mailto:oira_submission@omb.eop.gov). The NRC may not conduct or sponsor, and a person is not required to respond to, a collection of information unless the document requesting or requiring the collection displays a currently valid OMB control number.

<b>1. Facility Name</b> Perry Nuclear Power Plant	<b>2. Docket Number</b> 05000 - 00440	<b>3. Page</b> 1 of 4
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**4. Title**  
Core Monitoring System Software Modeling Error Results in Conditions Prohibited by Technical Specifications

5. Event Date			6. LER Number			7. Report Date			8. Other Facilities Involved	
Month	Day	Year	Year	Sequential Number	Rev No.	Month	Day	Year	Facility Name	Docket Number
06	17	2021	2021	- 002 -	00	08	04	2021	Facility Name	05000
									Facility Name	05000

<b>9. Operating Mode</b> 1	<b>10. Power Level</b> 100
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**11. This Report is Submitted Pursuant to the Requirements of 10 CFR §: (Check all that apply)**

<input checked="" type="checkbox"/> 10 CFR Part 20	<input type="checkbox"/> 20.2203(a)(2)(vi)	<input type="checkbox"/> 50.36(c)(2)	<input type="checkbox"/> 50.73(a)(2)(iv)(A)	<input type="checkbox"/> 50.73(a)(2)(x)
<input type="checkbox"/> 20.2201(b)	<input type="checkbox"/> 20.2203(a)(3)(i)	<input type="checkbox"/> 50.46(a)(3)(ii)	<input type="checkbox"/> 50.73(a)(2)(v)(A)	<input checked="" type="checkbox"/> 10 CFR Part 73
<input type="checkbox"/> 20.2201(d)	<input type="checkbox"/> 20.2203(a)(3)(ii)	<input type="checkbox"/> 50.69(g)	<input type="checkbox"/> 50.73(a)(2)(v)(B)	<input type="checkbox"/> 73.71(a)(4)
<input type="checkbox"/> 20.2203(a)(1)	<input type="checkbox"/> 20.2203(a)(4)	<input type="checkbox"/> 50.73(a)(2)(i)(A)	<input type="checkbox"/> 50.73(a)(2)(v)(C)	<input type="checkbox"/> 73.71(a)(5)
<input type="checkbox"/> 20.2203(a)(2)(i)	<input checked="" type="checkbox"/> 10 CFR Part 21	<input checked="" type="checkbox"/> 50.73(a)(2)(i)(B)	<input type="checkbox"/> 50.73(a)(2)(v)(D)	<input type="checkbox"/> 73.77(a)(1)(i)
<input type="checkbox"/> 20.2203(a)(2)(ii)	<input type="checkbox"/> 21.2(c)	<input type="checkbox"/> 50.73(a)(2)(i)(C)	<input type="checkbox"/> 50.73(a)(2)(vii)	<input type="checkbox"/> 73.77(a)(2)(i)
<input type="checkbox"/> 20.2203(a)(2)(iii)	<input checked="" type="checkbox"/> 10 CFR Part 50	<input type="checkbox"/> 50.73(a)(2)(ii)(A)	<input type="checkbox"/> 50.73(a)(2)(viii)(A)	<input type="checkbox"/> 73.77(a)(2)(ii)
<input type="checkbox"/> 20.2203(a)(2)(iv)	<input type="checkbox"/> 50.36(c)(1)(i)(A)	<input type="checkbox"/> 50.73(a)(2)(ii)(B)	<input type="checkbox"/> 50.73(a)(2)(viii)(B)	
<input type="checkbox"/> 20.2203(a)(2)(v)	<input type="checkbox"/> 50.36(c)(1)(ii)(A)	<input type="checkbox"/> 50.73(a)(2)(iii)	<input type="checkbox"/> 50.73(a)(2)(ix)(A)	

Other (Specify here, in Abstract, or in NRC 366A).

**12. Licensee Contact for this LER**

<b>Licensee Contact</b> George Dujanovic, Staff Nuclear Engineering Specialist, Regulatory Compliance	<b>Phone Number (Include Area Code)</b> 440-280-5200
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**13. Complete One Line for each Component Failure Described in this Report**

Cause	System	Component	Manufacturer	Reportable To IRIS	Cause	System	Component	Manufacturer	Reportable To IRIS

<b>14. Supplemental Report Expected</b> <input checked="" type="checkbox"/> No <input type="checkbox"/> Yes (If yes, complete 15. Expected Submission Date)	<b>15. Expected Submission Date</b> Month: _____ Day: _____ Year: _____
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**16. Abstract** (Limit to 1560 spaces, i.e., approximately 15 single-spaced typewritten lines)

On June 17, 2021, with Perry Nuclear Power Plant (PNPP) operating at 100 percent power, PNPP received a letter from General Electric – Hitachi (GEH) issuing SC 21-04, Revision 1, "Fuel Support Side Entry Orifice Meta-Stable Flow for 2 Beam Locations in the BWR/6 Reactors," identifying that the Global Nuclear Fuels (GNF) model for fuel affected by the Side Entry Orifices did not accurately account for the loss coefficients at those core locations causing a local overprediction in Minimum Critical Power Ratio (MCPR) margin. This resulted in the determination by PNPP that a condition prohibited by Technical Specifications (TSs) had existed at PNPP and this report being made in accordance with 10 CFR 50.73(a)(2)(i)(B).

The cause of the event is a legacy issue that is due to the flow geometries below the reactor core plate in the areas of Intermediate Range and Source Range neutron detector dry tubes, causing a local overprediction in MCPR margin resulting in exceeding the MCPR TS limit.

Corrective actions include updating the Cycle 19 Core Operating Limits Report (COLR) and associated documents to account for SC 21-04, Revision 1, and updating the Thermal Limit Files in the core monitoring software.



**LICENSEE EVENT REPORT (LER)  
CONTINUATION SHEET**

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1. FACILITY NAME	2. DOCKET NUMBER	3. LER NUMBER		
		YEAR	SEQUENTIAL NUMBER	REV NO.
Perry Nuclear Power Plant	05000 - 00440	2021	- 002	- 00

**NARRATIVE**

Energy Industry Identification System (EIS) codes are identified in the text as [XX].

**INTRODUCTION**

Minimum Critical Power Ratio (MCPR) is a ratio of the fuel assembly power that would result in the onset of boiling transition to the actual fuel assembly power. The operating limit MCPR is established to ensure that no fuel damage results during anticipated operational occurrences (AOOs), and that 99.9% of the fuel rods avoid boiling transition if the limit is not violated. Although fuel damage does not necessarily occur if a fuel rod actually experiences boiling transition, the critical power at which boiling transition is calculated to occur has been adopted as a fuel design criterion.

The core monitor applies the appropriate Operating Limit Minimum Critical Power Ratio (OLMCPR) based on the maximum flow dependent MCPR (MCPRF) and the power dependent MCPR (MCPRP). When this OLMCPR is divided by the calculated MCPR, this returns the Maximum Fraction of the Limiting Critical Power Ratio (MFLCPR). With MFLCPR <1.000, the Core Operating Limits Report (COLR) limits are met such that Technical Specification (TS) 3.2.2 is satisfied.

Because plant operating conditions and bundle power levels are monitored and determined relatively easily, monitoring the MCPR is a convenient way of ensuring that fuel failures due to inadequate cooling do not occur.

**EVENT DESCRIPTION**

On June 17, 2021, General Electric - Hitachi (GEH) issued Revision 1 to Safety Communication SC 21-04, "Fuel Support Side Entry Orifice Meta-Stable Flow for 2 Beam Locations in the BWR/6 Reactors." Revision 1 documents the completion of GEH's investigation. The investigation concluded that this issue is reportable under 10 CFR Part 21. Revision 1 provided updated guidance for establishing administrative limits. Perry Nuclear Power Plant (PNPP) currently limits operations to MFLCPR to less than 0.950 which is conservative with respect to the guidance of SC 21-04, Revision 1.

GEH notified site personnel in April 2021 through SC 21-04 (revision 0 Draft), that there was an issue with how the core monitoring software (3DMONICORE) calculated flow through fuel bundles in the 2 beam locations, which are fuel bundle locations with Intermediate Range Monitor (IRM)/Source Range Monitor (SRM) dry tubes. This potential problem would cause 3DMONICORE to underestimate bundle fraction limiting critical power ratio (FLCPR). TS 3.2.2 requires MCPR to be maintained above limits (or FLCPR less than 1.0). GEH recommended at that time that affected sites implement an administrative limit of limiting operations to MFLCPR to less than 0.950.

GEH has completed the evaluation of the condition to determine reportability under 10 CFR Part 21 and is a reportable condition under 10 CFR 21.21(a)(2) and a transfer of information under 10 CFR 21.21(b).

This evaluation established a 0.950 MFLCPR limit for only the 2 beam locations in the core. This limit, however, can be conservatively applied to the entire core.

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TS 3.2.2, MINIMUM CRITICAL POWER RATIO (MCPR), requires that all MCPRs shall be greater than or equal to the MCPR operating limits specified in the Core Operating Limits Report. Operations personnel verify this requirement by ensuring variable MFLCPR (Maximum Fractional Limiting Critical Power Ratio) is less than or equal to 1.000.

If any MCPR value is not within limits, it should be restored within two hours. If not restored within two hours, thermal power must be lowered to less than 23.8% within the next four hours.

The history of variable MFLCPR for the last 3 years was reviewed. The objective was to identify any period where the MFLCPR (corrected for SC 21-04) exceeded 1.0 for more than six hours.

During Cycle 17 (June 2018 through March 2019), there were no periods where MFLCPR (SC 21-04) was greater than 1.0 for longer than six hours.

During Cycle 18 (April 2019 through March 2021), there were seven instances where MFLCPR (SC 21-04) was greater than 1.0 for longer than six hours. During these instances, the requirements of TS 3.2.2 were not met, and during this time period there were no limiting transients that would be a challenge to the Safety Limit.

For Cycle 19 (April 2021), there were no periods where MFLCPR (SC 21-04) was greater than 1.0 for longer than six hours.

This condition is reportable under 10 CFR 50.73(a)(2)(i)(B) as an operation or condition prohibited by the plant's TSs.

**CAUSE**

The issues raised in SC 21-04 are a direct result of the follow-on investigation actions resulting from GEH letter SC 20-05, Revision 0, "Fuel Support Side Entry Orifice Loss Coefficient for In-Core Instrument Locations in the Core Monitoring System Databank", dated June 24, 2020. In SC 20-05, Global Nuclear Fuels (GNF)/GEH were investigating various flow geometries below the core plate when it was discovered that the Intermediate Range Monitor (IRM)/Source Range Monitor (SRM) dry tubes impact flow through neighboring bundles. During the resulting SC 20-05 follow-on actions, GEH observed that meta-stable flow conditions can occur in the bundles near the 2 beam locations.

**EVENT ANALYSIS**

A qualitative assessment of the issues identified in GEH SC 21-04, affecting Nuclear Fuel Thermal Limits, was performed. In general, if the Safety Limit for MCPR is violated, there is a potential for fuel clad failure, which means that activity is released from the fuel, although significant fuel melt or other fuel damage is not expected with a 1.031 maximum MCPR. The Probability Risk Assessment (PRA) uses Peak Clad Temperature as the definition for core damage. Violating the Safety Limits does not meet the PRA definition of Severe Accident Core Damage and does not significantly impact the Modular Accident Analysis Program (MAAP) analysis as a basis for PRA accident sequences; thus, this event is of very low safety significance.



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**CORRECTIVE ACTIONS**

**Immediate Corrective Action:**

As recommended in SC 21-04 (Revision 0 Draft) issued in April 2021, PNPP implemented an administrative limit of maintaining MFLCPR less than or equal to 0.950. PNPP Cycle 19 startup (April 2021) and subsequent operations has maintained MFLCPR less than or equal to 0.950.

**Corrective Action Summary:**

1. The Cycle 19 Core Operating Limits Report and associated documents will be updated to account for SC 21-04, Revision 1.
2. The Thermal Limit Files will be updated to account for SC 21-04, Revision 1.

**PREVIOUS SIMILAR EVENTS**

A review of previous LERs did not identify any events that were similar to the condition described in this LER.

**COMMITMENTS**

None