UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

May 22, 2020

Mr. Frank R. Payne
Site Vice President
Energy Harbor Nuclear Corp.
Perry Nuclear Power Plant
P.O. Box 97, SB306
Perry, OH 44081-0097

SUBJECT: PERRY NUCLEAR POWER PLANT, UNIT NO. 1 – ISSUANCE OF AMENDMENT NO. 188, REGARDING REVISION TO TECHNICAL SPECIFICATIONS TO ADOPT TSTF-564, "SAFETY LIMIT [MINIMUM CRITICAL POWER RATIO] MCPR" (EPID L-2019-LLA-0293)

Dear Mr. Payne:

The U.S Nuclear Regulatory Commission (the Commission) has issued the enclosed Amendment No. 188 to Renewed Facility Operating License No. NPF-58 for Perry Nuclear Power Plant, Unit No. 1 (Perry). The amendment consists of changes to the technical specifications (TS) in response to your application dated December 18, 2019.

The amendment adopts Technical Specifications Task Force (TSTF)-564, "Safety Limit [Minimum Critical Power Ratio] MCPR," Revision 2, which is an approved change to the Improved Standard Technical Specifications, into the Perry TS. The proposed amendment revises the TS safety limit on MCPR to reduce the need for cycle-specific changes to MCPR safety limit while still meeting the regulatory requirement for a safety limit.

A copy of the related Safety Evaluation is also enclosed. A Notice of Issuance will be included in the Commission's biweekly *Federal Register* notice.

Sincerely,

/RA/

Scott P. Wall, Senior Project Manager
Plant Licensing Branch III
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-440

Enclosures:
1. Amendment No. 188 to NPR-58
2. Safety Evaluation

cc: Listserv

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

ENERGY HARBOR NUCLEAR CORP.

ENERGY HARBOR NUCLEAR GENERATION, LLC

DOCKET NO. 50-440

PERRY NUCLEAR POWER PLANT, UNIT NO. 1

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 188
License No. NPF-58

1. The Nuclear Regulatory Commission (the Commission) has found that:

   A. The application for amendment filed by FirstEnergy Nuclear Operating Company, et al.,[1, 2] dated December 18, 2019, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations as set forth in 10 CFR Chapter I;

   B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;

   C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;

   D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and

   E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

[1] Effective February 27, 2020, Facility Operating License No. NPF-58 was transferred from FirstEnergy Nuclear Generation, LLC and FirstEnergy Nuclear Operating Company to Energy Harbor Nuclear Generation LLC and Energy Harbor Nuclear Corp., as the licensed owner and operator, respectively. In a letter dated February 20, 2020, Energy Harbor Nuclear Corp. requested that the NRC continue the regulatory reviews and actions on the outstanding licensing actions and applications on Docket No. 50-440 (Agencywide Documents Access and Management System Accession No. ML20054B733).
[2] Energy Harbor Nuclear Corp. is authorized to act as agent for Energy Harbor Nuclear Generation, LLC, and has exclusive responsibility and control over the physical construction, operation, and maintenance of the facility.

2. Accordingly, the license is amended by changes to the Technical Specifications, as indicated in the attachment to this license amendment, and paragraph 2.C.(2) of Facility Operating License No. NPF-58 is hereby amended to read as follows:

(2) Technical Specifications

The Technical Specifications contained in Appendix A and the Environmental Protection Plan contained in Appendix B, as revised through Amendment No. 188, are hereby incorporated into the license. Energy Harbor Nuclear Corp. shall operate the facility in accordance with the Technical Specifications and the Environmental Protection Plan.

3. This license amendment is effective as of its date of its issuance and shall be implemented within 90 days of the date of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

Nancy L. Salgado

Digitally signed by Nancy L. Salgado
Date: 2020.05.22 12:26:43 -04'00'

Nancy L. Salgado, Chief
Plant Licensing Branch III
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Attachment:
Changes to the Facility Operating License No. NPF-58 and Technical Specifications

Date of Issuance: May 22, 2020

ATTACHMENT TO LICENSE AMENDMENT NO. 188

PERRY NUCLEAR POWER PLANT, UNIT NO. 1

FACILITY OPERATING LICENSE NO. NPF-58

DOCKET NO. 50-440

Replace the following pages of the License and the Appendix A Technical Specifications (TSs) with the attached revised pages. The revised pages are identified by amendment number and contain marginal lines indicating the areas of change.

Remove Pages	Insert Pages
License	License
4	4
TSs	TSs
2.0-1	2.0-1
5.0-18	5.0-18

C. This license shall be deemed to contain and is subject to the conditions specified in the Commission's regulations set forth in 10 CFR Chapter I and is subject to all applicable provisions of the Act and to the rules, regulations, and orders of the Commission now or hereafter in effect; and is subject to the additional conditions specified or incorporated below:

(1) Maximum Power Level

Energy Harbor Nuclear Corp. is authorized to operate the facility at reactor core power levels not in excess of 3758 megawatts thermal (100% power) in accordance with the conditions specified herein.

(2) Technical Specifications

The Technical Specifications contained in Appendix A and the Environmental Protection Plan contained in Appendix B, as revised through Amendment No. 188, are hereby incorporated into the license. Energy Harbor Nuclear Corp. shall operate the facility in accordance with the Technical Specifications and the Environmental Protection Plan.

(3) Antitrust Conditions

a. Energy Harbor Nuclear Generation LLC shall comply with the antitrust conditions delineated in Appendix C to this license; Appendix C is hereby incorporated into this license.

2.0 SAFETY LIMITS (SLs)

2.1 SLs

2.1.1 Reactor Core SLs

2.1.1.1 With the reactor steam dome pressure < 686 psig or core flow < 10% rated core flow:

THERMAL POWER shall be ≤ 23.8% RTP.

2.1.1.2 With the reactor steam dome pressure ≥ 686 psig and core flow ≥ 10% rated core flow:

The Minimum Critical Power Ratio (MCPR) shall be ≥ 1.07.

2.1.1.3 Reactor vessel water level shall be greater than the top of active irradiated fuel.

2.1.2 Reactor Coolant System Pressure SL

Reactor steam dome pressure shall be ≤ 1325 psig.

2.2 SL Violations

With any SL violation, the following actions shall be completed within 2 hours:

2.2.1 Restore compliance with all SLs; and

2.2.2 Insert all insertable control rods.

5.6 Reporting Requirements

5.6.5 Core Operating Limits Report (COLR) (continued)

4. LCO 3.3.1.1, RPS Instrumentation (SR 3.3.1.1.14),

5. LCO 3.3.1.3, Oscillation Power Range Monitor (OPRM) Instrumentation, and

6. The $MCPR_{99.9\%}$ value used to calculate the LCO 3.2.2, “MCPR,” limit.

b. The analytical methods used to determine the core operating limits shall be those previously reviewed and approved by the NRC in 1). NEDE-24011-P-A, General Electric Standard Application for Reactor Fuel or 2). NEDO-32465 “Reactor Stability Detect and Suppress Solutions Licensing Basis Methodology for Reload Applications”. (The approved revision at the time reload analyses are performed shall be identified in the COLR.)

c. The core operating limits shall be determined such that all applicable limits (e.g., fuel thermal mechanical limits, core thermal hydraulic limits, Emergency Core Cooling Systems (ECCS) limits, nuclear limits such as SDM, transient analysis limits, and accident analysis limits) of the safety analysis are met.

d. The COLR, including any midcycle revisions or supplements, shall be provided upon issuance for each reload cycle to the NRC.

5.6.6 Special Reports

Deleted.

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 188 TO FACILITY OPERATING LICENSE NO. NPF-58

ENERGY HARBOR NUCLEAR CORP.

ENERGY HARBOR NUCLEAR GENERATION, LLC

PERRY NUCLEAR POWER PLANT, UNIT NO. 1

DOCKET NO. 50-440

1.0 INTRODUCTION

By application dated December 18, 2019 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML19352D673), FirstEnergy Nuclear Operating Company (FENOC) submitted a license amendment request (LAR) for Perry Nuclear Power Plant, Unit 1 (Perry), which is a boiling-water reactor (BWR).

The LAR proposed to revise the value of the technical specification (TS) 2.1.1.2 reactor core safety limit (SL) minimum critical power ratio (MCPR) and to delete reference to single- and two-loop operation. The MCPR protects against boiling transition on the fuel rods in the core. The current MCPR value is dependent on the number of recirculation loops in operation and ensures that 99.9 percent of the fuel rods in the core are not susceptible to boiling transition, which is referred to as the $MCPR_{99.9\%}$. The revised MCPR would ensure that there is a 95 percent probability at a 95 percent confidence level that no fuel rods will be susceptible to boiling transition using an SL based on critical power ratio (CPR) data statistics, which is referred to as the $MCPR_{95/95}$. The $MCPR_{95/95}$ is not dependent on the number of recirculation loops in operation. Additionally, TS 5.6.5, "Core Operating Limits Report (COLR)," would be modified to require that the COLR include the cycle-specific value for $MCPR_{99.9\%}$, which would still be used to calculate the MCPR operating limit (OL).

The proposed amendment is based on Technical Specifications Task Force (TSTF) Traveler TSTF 564, Revision 2, "Safety Limit MCPR," dated October 24, 2018 (ADAMS Accession No. ML18297A361). The U.S. Nuclear Regulatory Commission (NRC or the Commission) issued a final safety evaluation (SE) approving Traveler TSTF 564, Revision 2, on May 13, 2020 (ADAMS Accession No. ML20132A260).

By order dated December 2, 2019 (ADAMS Accession No. ML19303C953), the NRC staff approved the direct and indirect transfers of several FENOC-owned and operated plants, including Perry. By letter dated December 3, 2019 (ADAMS Accession No. ML19337B181), FENOC indicated that the entities taking control of the plants, which had previously been referred to as New HoldCo, OwnerCo, and OpCo would be named Energy Harbor Corp., Energy Harbor Nuclear Generation LLC, and Energy Harbor Nuclear Corp., respectively. Under this new set-up, Energy Harbor Corp. would indirectly own the plants as a parent company,

Energy Harbor Nuclear Generation LLC would directly own the plants, and Energy Harbor Nuclear Corp. would have authority to operate the plants.

On February 20, 2020, FENOC informed the NRC (ADAMS Accession No. ML20054B733) that:

> Upon completion of the license transfer, Energy Harbor Nuclear Corp. will adopt and endorse the outstanding commitments, licensing actions, applications, and similar items on the aforementioned docket numbers. Energy Harbor Nuclear Corp. requests NRC continuation of the regulatory reviews and actions on these items.

On February 27, 2020, Energy Harbor Nuclear Corp., informed the NRC that the transaction closed on February 27, 2020 and that it adopted and endorsed the outstanding commitments, licensing actions, applications and similar items on dockets submitted by FENOC on behalf of the licensees (ADAMS Accession No. ML20058D315). On February 27, 2020 (ADAMS ML20030A440), the NRC staff issued Amendment No. 187 to reflect the license transfer. Accordingly, Energy Harbor Nuclear Corp. is now authorized to act as agent for Energy Harbor Nuclear Generation, LLC, and has exclusive responsibility and control over the physical construction, operation, and maintenance of the facility at Perry.

1.1 Background on Boiling Transition

During steady-state operation in BWRs, most of the coolant in the core is in a flow regime known as annular flow. In this flow regime, a thin liquid film is pushed up the surface of the fuel rod cladding by the bulk coolant flow, which is mostly water vapor with some liquid water droplets. This provides effective heat removal from the cladding surface; however, under certain conditions, the annular film may dissipate, which reduces the heat transfer and results in an increase in fuel cladding surface temperature. This phenomenon is known as boiling transition or dryout. The elevated surface temperatures resulting from dryout may cause fuel cladding damage or failure

1.2 Background on Critical Power Correlations

For a given set of reactor operating conditions (pressure, flow, etc.), dryout will occur on a fuel assembly at a certain power, known as the critical power. Because the phenomena associated with boiling transition are complex and difficult to model purely mechanistically, thermal hydraulic test campaigns are undertaken using electrically heated prototypical fuel bundles to establish a comprehensive database of critical power measurements for each BWR fuel product. These data are then used to develop a critical power correlation that can be used to predict the critical power for assemblies in operating reactors. This prediction is usually expressed as the ratio of the actual assembly power to the critical power predicted using the correlation, known as the CPR.

One measure of the correlation's predictive capability is based on its validation relative to the test data. For each point *j* in a correlation's test database, the experimental critical power ratio (ECPR) is defined as the ratio of the measured critical power to the calculated critical power, or:

$$ECPR_j = \frac{Measured\ Critical\ Power_j}{Calculated\ Critical\ Power_j}$$

For ECPR values less than or equal to 1, the calculated critical power is greater than or equal to the measured critical power and the prediction is considered to be non-conservative. Because

the measured critical power includes random variations due to various uncertainties, evaluating the ECPR for all the points in the dataset (or, ideally, a subset of points that were not used in the correlation's development) results in a probability distribution. This ECPR distribution allows the predictive uncertainty of the correlation to be determined. This uncertainty can then be used to establish a limit above which there can be assumed that boiling transition will not occur (with a certain probability and confidence level).

1.3 Background on Thermal-Hydraulic Safety Limits

To protect against boiling transition, BWRs have implemented an SL on the CPR, known as the MCPR SL. As discussed in Chapter 4 of the Perry Updated Final Safety Analysis Report (UFSAR) and the Standard Technical Specifications (STSs) for General Electric BWR plant designs in NUREG-1433 and NUREG-1434,[1] the current calculation of the MCPR SL is to prevent 99.9 percent of the fuel in the core from being susceptible to boiling transition. This limit is typically developed by considering various cycle specific power distributions and uncertainties, and is highly dependent on the cycle specific radial power distribution in the core. As such, the limit may need to be updated as frequently as every cycle. Perry is a BWR Type 6 facility, so the STSs in NUREG-1434 are applicable.

The fuel cladding SL for pressurized-water reactor (PWR) designs, described in the STSs for Babcock & Wilcox, Westinghouse, and Combustion Engineering [2] plants in NUREG-1430, NUREG-1431, and NUREG-1432,[3] respectively correspond to a 95 percent probability at a 95 percent confidence level that departure from nucleate boiling (DNB) will not occur. As a result of the overall approach taken in developing the PWR limits, they are only dependent on the fuel type(s) in the reactor and the corresponding departure from nucleate boiling ratio (DNBR) correlations. The limits are not cycle-dependent and are typically only updated when new fuel types are inserted in the reactor.

The TSs for Perry also have a limiting condition for operation (LCO) that governs MCPR, known as the MCPR OL. The OL on MCPR is an LCO which must be met to ensure that anticipated operational occurrences (AOOs) do not result in fuel damage. The current MCPR OL is calculated by combining the largest change in CPR from all analyzed transients, also known as the ΔCPR, with the MCPR SL. The MCPR OL is already a COLR parameter and as such, the methodology to calculate it is included in TS 5.6.5.b. The MCPR SL (i.e., the $MCPR_{99.9\%}$.) is calculated using the same methodology as the MCPR OL.

---

[1] U.S. Nuclear Regulatory Commission, "Standard Technical Specifications, General Electric Plants BWR/4," NUREG-1433, Volume 1, "Specifications," and Volume 2, "Bases," Revision 4.0, April 2012 (ADAMS Accession Nos. ML12104A192 and ML12104A193).

U.S. Nuclear Regulatory Commission, "Standard Technical Specifications, General Electric Plants BWR/6," NUREG-1434, Volume 1, "Specifications," and Volume 2, "Bases," Revision 4.0, April 2012 (ADAMS Accession Nos. ML12104A195 and ML12104A196).

[2] Denotes applicability to Combustion Engineering plants with digital control systems only.

[3] U.S. Nuclear Regulatory Commission, "Standard Technical Specifications, Babcock and Wilcox Plants," NUREG-1430, Volume 1, "Specifications," and Volume 2, "Bases," Revision 4.0, April 2012 (ADAMS Accession Nos. ML12100A177 and ML12100A178).

U.S. Nuclear Regulatory Commission, "Standard Technical Specifications, Westinghouse Plants," NUREG-1431, Volume 1, "Specifications," and Volume 2, "Bases," Revision 4.0, April 2012 (ADAMS Accession Nos. ML12100A222 and ML12100A228).

U.S. Nuclear Regulatory Commission, "Standard Technical Specifications, Combustion Engineering Plants," NUREG-1432, Volume 1, "Specifications," and Volume 2, "Bases," Revision 4.0, April 2012 (ADAMS Accession Nos. ML12102A165 and ML12102A169).

2.0 REGULATORY EVALUATION

2.1 Description of TS Sections

2.1.1 TS 2.1.1, "Reactor Core SLs"

The SLs ensure that specified acceptable fuel design limits are not exceeded during steady state operation, normal operational transients, and AOOs.

Perry TS 2.1.1.2 currently requires that the reactor steam dome pressure greater than or equal to (≥) 686 pounds per square inch gauge (psig) and core flow ≥ 10 percent rated core flow, the MCPR shall be ≥ 1.10 for two recirculation loop operation or ≥ 1.13 for single recirculation loop operation. The MCPR SL (also referred to as $MCPR_{99.9\%}$) ensures that 99.9 percent of the fuel rods in the core are not susceptible to boiling transition.

2.1.2 TS 5.6.5, "Core Operating Limits Report (COLR)"

Perry TS 5.6.5 requires core operating limits to be established prior to each reload cycle, or prior to any remaining portion of a reload cycle. This TS requires that these limits be documented in the COLR.

2.2 Proposed Changes to the TSs

The licensee proposed to revise the MCPR SL in TS 2.1.1.2 to make it cycle independent, consistent with the method described in Traveler TSTF-564, Revision 2.

The proposed changes to the Perry TSs revise the value of the MCPR SL in TS 2.1.1.2 to 1.07, with corresponding changes to the associated TS bases. The change to TS 2.1.1.2 replaces the existing separate SLs for single- and two-recirculation loop operation with a single limit since the revised SL (also referred to as the $MCPR_{95/95}$ SL) is not dependent on the number of recirculation loops in operation.

The $MCPR_{99.9\%}$ (i.e., the current MCPR SL) is an input to the MCPR OL in LCO 3.2.2, "Minimum Critical Power Ratio (MCPR)." While the definition and method of calculation of both the $MCPR_{99.9\%}$ and the LCO 3.2.2 MCPR OL remains unchanged, the proposed TS changes include revisions to TS 5.6.5, to require the $MCPR_{99.9\%}$ value used in calculating the LCO 3.2.2 MCPR OL to be included in the cycle-specific COLR.

2.3 Applicable Regulatory Requirements and Guidance

Title 10 of the Code of *Federal Regulations* (10 CFR), Section 50.36(a)(1), requires an applicant for an operating license to include in the application proposed TSs in accordance with the requirements of 10 CFR 50.36. The applicant must also include in the application, a "summary statement of the bases or reasons for such specifications, other than those covering administrative controls." However, per 10 CFR 50.36(a)(1), these TS bases "shall not become part of the technical specifications."

As required by 10 CFR 50.36(c)(1), TSs will include safety limits, limiting safety system settings, and limiting control settings. The regulation, 10 CFR 50.36(c)(1)(i)(A), states, in part:

> Safety limits for nuclear reactors are limits upon important process variables that are found to be necessary to reasonably protect the integrity of certain of the

> physical barriers that guard against the uncontrolled release of radioactivity. If any safety limit is exceeded, the reactor must be shut down. The licensee shall notify the Commission, review the matter, and record the results of the review, including the cause of the condition and the basis for corrective action taken to preclude recurrence. Operation must not be resumed until authorized by the Commission.

As required by 10 CFR 50.36(c)(2)(i), the TSs will include LCOs, which are the lowest functional capability or performance levels of equipment required for safe operation of the facility. When an LCO of a nuclear reactor is not met, the licensee shall shut down the reactor or follow any remedial action permitted by the TSs until the condition can be met. Additionally, as required by 10 CFR 50.36(c)(5), TSs must include administrative controls, which are the provisions relating to organization and management, procedures, recordkeeping, review and audit, and reporting necessary to assure operation of the facility in a safe manner.

Criterion 10, "Reactor design," of 10 CFR Part 50, Appendix A, "General Design Criteria of Nuclear Power Plants," states:

> The reactor core and associated coolant, control, and protection systems shall be designed with appropriate margin to assure that specified acceptable fuel design limits are not exceeded during any condition of normal operation, including the effects of anticipated operational occurrences.

GDC 10 is applicable to Perry. A design evaluation of GDC Criterion 10 is included in Section 3.1.2.2.1.1 of the Perry UFSAR:

> The reactor and associated coolant, control and protection systems are designed to assure that the specified fuel design limits are not exceeded during conditions of normal or abnormal operation and therefore meet the requirements of Criterion 10.

The limits placed on the MCPR act as a specified acceptable fuel design limit to prevent boiling transition, which has the potential to result in fuel rod cladding failure, and are used to meet Criterion 10.

The NRC staff's guidance contained in Revision 2 of NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR [Light-Water Reactor] Edition" (Standard Review Plan (SRP)), Section 4.4, "Thermal and Hydraulic Design,"[4] provides the following two examples of acceptable approaches to meet SRP Acceptance Criterion 1 for establishing fuel design limits:

A. For departure from nucleate boiling ratio (DNBR), CHFR [critical heat flux ratio] or CPR correlations, there should be a 95-percent probability at the 95-percent confidence level that the hot rod in the core does not experience a DNB or boiling transition condition during normal operation or AOOs.

B. The limiting (minimum) value of DNBR, CHFR, or CPR correlations is to be established such that at least 99.9 percent of the fuel rods in the core will not experience a DNB or boiling transition during normal operation or AOOs.

[4] U.S. Nuclear Regulatory Commission, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition," NUREG-0800, Section 4.4, "Thermal and Hydraulic Design," Revision 2, March 2007 (ADAMS Accession No. ML070550060).

The NRC staff's guidance for the review of TSs is in Chapter 16.0, Revision 3, "Technical Specifications," of the SRP, dated March 2010 (ADAMS Accession No. ML100351425). As described therein, as part of the regulatory standardization effort, the NRC staff has prepared STSs for each of the LWR nuclear designs. Accordingly, the NRC staff's review considers whether the proposed changes are consistent with the applicable reference STSs (i.e., the current STSs), as modified by NRC approved travelers. The STS applicable to Perry is NUREG-1434, Revision 4.0, "Standard Technical Specifications, General Electric Plants BWR/6," Volume 1, "Specifications," and Volume 2, "Bases," (ADAMS Accession Nos. ML12104A195 and ML12104A196).

3.0 TECHNICAL EVALUATION

3.1 Basis for Proposed Change

As discussed in Section 1.3 of this SE, the current MCPR SL (i.e., the $MCPR_{99.9\%}$ SL) is dependent on the cycle-specific core design, especially including the core power distribution, fuel type(s) in the reactor, and the power-to-flow operating domain for the plant. As such, it is frequently necessary to change the MCPR SL to accommodate new core designs. Changes to the MCPR SL are usually determined late in the design process and necessitate an accelerated NRC review (i.e., LAR) to support the subsequent fuel cycle.

The licensee proposed to change the calculation for determining the MCPR SL for Perry so that it is no longer cycle-dependent, reducing the frequency of revisions and eliminating the need for NRC's review on an accelerated schedule. The proposed methodology for determining the MCPR SL aligns it with the DNBR SL used in PWRs, which ensures a 95 percent probability at a 95 percent confidence level that no fuel rods will experience DNB.

The NRC staff finds that calculating the revised MCPR SL based on the 95/95 criterion is acceptable because it meets SRP Section 4.4, Acceptance Criterion 1. The remainder of this SE evaluates whether the methodology for determining the revised MCPR SL provides the intended result and documents the review to ensure that the revised MCPR SL can be adequately determined in the core using various types of fuel, that the proposed SL continues to fulfil the necessary functions of an SL without unintended consequences, and that the proposed changes have been adequately implemented in the Perry TSs.

3.2 Revised MCPR SL Definition

As discussed in Section 1.2 of this SE, the ECPR distribution quantifies the uncertainty associated with the correlation. Traveler TSTF-564, Revision 2, provides the following formula:

$$\mathrm{MCPR}_{95/95}(i) = \mu_i + \kappa_i \sigma_i$$

where μ_i is the mean ECPR and σ_i is the standard deviation of the ECPR distribution. The statistical parameter (κ_i) is selected, based on the number of samples in the critical power database, to provide "95 percent probability at 95 percent confidence (95/95) for the one-sided upper tolerance limit that depends on the number of samples (N_i) in the critical power database." This is a commonly used statistical formula to determine a 95/95 one-sided upper tolerance limit for a normal distribution, which is appropriate for the situation under

consideration. The factor κ is generally attributed to D. B. Owen[5] and was also reported by M. G. Natrella,[6] as referenced in Traveler TSTF-564, Revision 2. Example values of κ are provided in Table 2 of Traveler TSTF-564, Revision 2. Table 1 of the traveler includes some reference values of the $MCPR_{95/95}$.

As discussed by Piepel and Cuta[7] for DNBR correlations, the acceptability of this approach is predicated on a variety of assumptions, including the assumptions that the correlation data comes from a common population and that the correlation's population is distributed normally. These assumptions are typically addressed generically when a critical power or critical heat flux correlation is reviewed by the NRC staff, who may apply penalties to the correlation to account for any issues identified. A letter from the TSTF dated May 29, 2018 (ADAMS Accession No. ML18149A320), states that such penalties applied during the NRC's review of the critical power correlation would be imposed on the mean or standard deviation used in calculating the $MCPR_{95/95}$. These penalties would also continue to be imposed in the determination of the $MCPR_{99.9\%}$, along with any other penalties associated with the process of (or other inputs used in) determining the $MCPR_{99.9\%}$ (e.g., penalties applied to the $MCPR_{99.9\%}$ SL for operation in the Maximum Extended Load Limit Line Analysis Plus (MELLLA+) operating domain).

In the SE of Traveler TSTF-564, Revision 2, the NRC staff found that the definition of the $MCPR_{95/95}$ appropriately establishes a 95/95 upper tolerance limit on the critical power correlation and that any issues in the underlying correlation will be addressed through penalties on the correlation mean and standard deviation, as necessary. Therefore, the NRC staff concludes that the method for determining $MCPR_{95/95}$ can be used to establish acceptable fuel design limits in Perry TSs.

3.3 Determination of Revised MCPR SL for Mixed Cores

Traveler TSTF-564, Revision 2, proposed that a core containing a variety of fuel types would evaluate the $MCPR_{95/95}$ for all the fresh and once-burnt fuel in the core and apply the most limiting (i.e., the largest) value of $MCPR_{95/95}$ for each of the applicable fuel types as the MCPR SL. As stated in Section 3.1 of Traveler TSTF-564, Revision 2, this is because bundles that are twice-burnt or more at the beginning of the cycle have significant MCPR margin relative to the fresh and once-burnt fuel. The justification is that the MCPR for twice-burnt and greater fuel is far enough from the MCPR for the limiting bundle that its probability of boiling transition is very small compared to the limiting bundle and it can be neglected in determining the SL. Results of a study provided in the letter from the TSTF dated May 29, 2018, indicate that this is the case even for fuel operated on short (12-month) reload cycles. As discussed in the letter from the TSTF dated May 29, 2018 twice-burnt or greater fuel bundles are included in the cycle-specific evaluation of the $MCPR_{99.9\%}$ and the MCPR OL. If a twice-burnt or greater fuel bundle is found to be limiting, it would be governed by the MCPR OL, which will always be more restrictive than both the $MCPR_{95/95}$ and the $MCPR_{99.9\%}$.

In the SE of the Traveler TSTF-564, Revision 2, the NRC staff found the justification for applying the most limiting (i.e., the largest) value of $MCPR_{95/95}$ for each of the applicable fuel types as the MCPR SL to be appropriate and determined that it is acceptable to determine the $MCPR_{95/95}$ SL for the core based on the most limiting value of the $MCPR_{95/95}$ for the fresh and once-burnt fuel in the core. In the SE of Traveler TSTF-564, Revision 2, the NRC staff also found that the

[5] D. B. Owen, "Factors for One-Sided Tolerance Limits and for Variables Sampling Plans," Sandia Corporation, SCR-607, March 1963, ADAMS Accession No. ML14031A495.

[6] M. G. Natrella, "Experimental Statistics," National Bureau of Standards, National Bureau of Standards Handbook 91 August 1963.

[7] G. F. Piepel and J. M. Cuta, "Statistical Concepts and Techniques for Developing, Evaluating, and Validating CHF Models and Corresponding Fuel Design Limits," SKI Technical Report, 93:46, 1993.

process for establishing the revised MCPR SL for mixed cores ensures that the limiting fuel types in the core will be evaluated and the limiting $MCPR_{95/95}$ will be appropriately applied as the SL. Therefore, the NRC staff finds it acceptable to determine the $MCPR_{95/95}$ SL for the core based on the most limiting $MCPR_{95/95}$ value for fresh and once-burnt fuel in the core for the Perry TSs.

3.4 MCPR Safety and Operating Limits

As discussed in the letter from the TSTF dated May 29, 2018, the $MCPR_{99.9\%}$ SL is expected to always be greater than the $MCPR_{95/95}$ SL for two reasons. First, because the $MCPR_{99.9\%}$ includes uncertainties not factored into the $MCPR_{95/95}$, and second, because the 99.9 percent probability basis for determining the $MCPR_{99.9\%}$ is more conservative than the 95 percent probability at a 95 percent confidence level used in determining the $MCPR_{95/95}$. The level of conservatism in the $MCPR_{95/95}$ SL is appropriate because the lead fuel rod in the core (i.e., the limiting fuel rod with respect to MCPR) is used to evaluate whether any fuel rods in the core are susceptible to boiling transition, which is also discussed in the letter from the TSTF dated May 29, 2018. This is consistent with evaluations performed for PWRs using a 95/95 upper tolerance limit on the correlation uncertainty as an SL.

Consistent with Traveler TSTF-564, Revision 2, the licensee is not proposing any change to LCO 3.2.2 and will continue to calculate the MCPR OL using the $MCPR_{99.9\%}$. The $MCPR_{99.9\%}$ will continue to be calculated in the same way as it is currently, using the whole core.

Consistent with Traveler TSTF-564, Revision 2, the licensee proposed to revise TS 5.6.5 to require inclusion of the cycle-specific value of the $MCPR_{99.9\%}$ in the COLR to ensure that the uncertainties being removed from the MCPR SL are still included as part of the MCPR OL. The methods used for determining $MCPR_{99.9\%}$ are included in the list of COLR references contained in TS 5.6.5. The changes to TS 5.6.5 help to ensure that the uncertainties being removed from the MCPR SL are still included as part of the MCPR OL and will continue to appropriately inform plant operation.

The NRC staff finds that the changes proposed by the licensee will retain an adequate level of conservatism in the MCPR SL in TS 2.1.1.2 and that plant- and cycle-specific uncertainties will be retained in the MCPR OL as specified in the COLR. The $MCPR_{95/95}$ represents a lower limit on the value of the $MCPR_{99.9\%}$, because the $MCPR_{99.9\%}$ should always be higher since it accounts for numerous uncertainties that are not included in the $MCPR_{95/95}$ (as discussed in the introductory paragraph to Section 3 and in Section 3.1 of Traveler TSTF-564, Revision 2).

3.5 Implementation of the Revised MCPR SL in the TSs

The licensee proposed to change the value of the SL in TS 2.1.1.2 from ≥ 1.13 for single recirculation loop operation or ≥ 1.10 for two recirculation loop operation to ≥ 1.07, consistent with the value from Table 1 of the TSTF-564, Revision 2, for the fuel type in use at Perry (i.e., Global Nuclear Fuel2 (GNF2) fuel bundles). As noted in Section 3.3 above, the licensee appropriately evaluated the fresh and once-burnt fuels in use at Perry and the NRC staff determined that the limiting $MCPR_{95/95}$ for these fuels was provided for inclusion in TS 2.1.1.2, consistent with the process described in Traveler TSTF-564, Revision 2.

The NRC staff finds that the proposed MCPR value of ≥ 1.07 in Perry TS 2.1.1.2 is acceptable because it was calculated using Equation 1 from Traveler TSTF-564, Revision 2, and reported at a precision of two digits past the decimal point with the hundredths digit rounded up. Thus, the proposed TS change is acceptable.

The licensee also proposed that Perry TS 5.6.5 require the $MCPR_{99.9\%}$ value used to calculate the LCO 3.2.2 "MCPR" limit be specified in the COLR. Thus Perry TS 5.6.5 will continue to reference appropriate NRC-approved methodologies for determination of the $MCPR_{99.9\%}$ and the MCPR OL, which will ensure that cycle-specific parameters are determined such that applicable limits are met. Therefore, the NRC staff finds the proposed change acceptable.

The NRC staff reviewed the licensee's proposed TS changes and finds that the licensee appropriately implemented the revised MCPR SL, as discussed in this SE.

3.6 NRC Staff Conclusion

The NRC staff reviewed the licensee's proposed TS changes and determined that the proposed SL associated with TS 2.1.1.2 was calculated in a manner consistent with the process described in Traveler TSTF-564, Revision 2, and was therefore acceptably modified to suit the revised definition of the MCPR SL. Under the new definition, the MCPR SL will continue to protect the fuel cladding against the uncontrolled release of radioactivity by preventing the onset of boiling transition, thereby fulfilling the requirements of 10 CFR 50.36(c)(1) for SLs. The MCPR OL in LCO 3.2.2 remains unchanged and will continue to meet the requirements of 10 CFR 50.36(c)(2) and Criterion 10 by ensuring that no fuel damage results during normal operation and AOOs. The NRC staff determined that the proposed changes to Perry TS 5.6.5 are acceptable; upon adoption of the revised MCPR SL, the COLR will be required to contain the $MCPR_{99.9\%}$, supporting the determination of the MCPR OL using current methodologies.

4.0 STATE CONSULTATION

In accordance with the Commission's regulations, the Ohio State official was notified of the proposed issuance of the amendment on April 6, 2020. The State official had no comments.

5.0 ENVIRONMENTAL CONSIDERATION

The amendment changes requirements with respect to the installation or use of facility components located within the restricted area as defined in 10 CFR Part 20. The NRC staff has determined that the amendment involves no significant increase in the amounts, and no significant change in the types, of any effluents that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that the amendment involves no significant hazards consideration, which was published in the *Federal Register* on February 11, 2020 (85 FR 7791), and there has been no public comment on such finding. Accordingly, the amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the issuance of the amendment.

6.0 CONCLUSION

The Commission has concluded, based on the considerations discussed above, that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) there is reasonable assurance that such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

Principal Contributors: Ravinder Grover, NRR/DSS
Scott P. Wall, NRR/DORL

Date of issuance: May 22, 2020

SUBJECT: PERRY NUCLEAR POWER PLANT, UNIT NO. 1 – ISSUANCE OF AMENDMENT NO. 188, REGARDING REVISION TO TECHNICAL SPECIFICATIONS TO ADOPT TSTF-564, "SAFETY LIMIT [MINIMUM CRITICAL POWER RATIO] MCPR" (EPID L-2019-LLA-0293) DATED MAY 22, 2020

DISTRIBUTION
Public
RidsNrrPMPerry Resource (hard copy)
RidsACRS_MailCTR Resource
RidsRgn3MailCenter Resource
RidsNrrDssStsb Resource
RidsNrrDssSnsb Resource
RidsNrrLASRohrer Resource
RidsRgn3MailCenter Resource

Amendment No. ML20099A102 ***via email**

OFFICE	NRR/DORL/LPL3/PM*	NRR/DORL/LPL3/LA*	NRR/DSS/SNSB/BC*	NRR/DSS/STSB/BC*
NAME	SWall	SRohrer /c/ R-	JBorromeo	VCusumano
DATE	04/08/2020	04/08/2020	04/09/2020	04/23/2020
OFFICE	OGC – NLO*	NRR/DORL/LPL3/BC*	NRR/DORL/LPL3/PM*	
NAME	NMertz	NSalgado	SWall	
DATE	05/11/2020	05/22/2020	05/22/2020	

OFFICIAL RECORD COPY