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TS 6.9.1.1

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

Hope Creek Generating Station
Renewed Facility Operating License No. NPF-57
NRC Docket No. 50-354

Subject: **Hope Creek Measurement Uncertainty Recapture (MUR) Uprate Startup Report**

PSEG Nuclear LLC hereby submits a summary MUR startup report of power ascension testing for Hope Creek in accordance with Technical Specification 6.9.1.1. The report is required since Amendment 212 to the Hope Creek Technical Specifications increased the licensed power level. The summary of testing is included in Attachment 1.

Should you have any questions regarding this submittal, please contact Brian Thomas at (856) 339-2022.

Respectfully,

Eric Carr
Site Vice President – Hope Creek Generating Station

Attachment: Hope Creek Generating Station Measurement Uncertainty Recapture - Increase in Licensed Power Level Startup Test Report, July 2018

cc: Administrator, Region I, NRC
Project Manager, NRC
NRC Senior Resident Inspector, Hope Creek
Mr. P. Mulligan, Chief, NJBNE
PSEG Corporate Commitment Tracking Coordinator
Hope Creek Commitment Tracking Coordinator

ATTACHMENT
LR-N18-0083

Hope Creek Generating Station
Measurement Uncertainty Recapture

Increase in Licensed Power Level
Startup Test Report
July 2018

1.0 Introduction

The NRC approved Amendment 212 to the Hope Creek Technical Specifications on April 24, 2018, which increased the licensed power level of Hope Creek by approximately 1.6% to 3902 MWth. Hope Creek Technical Specification 6.9.1.1 requires submittal of a startup report following amendment to the license involving a planned increase in power level. This startup report addresses the testing discussed in the license amendment request (LAR) H17-03 for the Measurement Uncertainty Recapture (MUR) uprate (LR-N17-0044, Enclosure 6, Section 10.4, dated July 7, 2017). The following sections provide a description of the results of the testing.

2.0 Background

On May 4, 2018, the station commenced activities associated with the performance of the MUR Power Ascension Testing. On May 24, 2018, the new MUR rated thermal power of 3902 MWth was reached. The purpose of testing was to confirm acceptable plant performance following MUR-related changes made in Refueling Outage (RF) 21, and for operation at a power level of 3902 MWth in accordance with LAR H17-03 Enclosure 5, Commitment 5. This represented an increase of approximately 1.6 percent above the previous licensed thermal power level of 3840 MWth.

The Power Ascension Testing focused on a number of objectives including control and knowledge of reactor coolant chemistry, maintaining personnel exposures ALARA, measurement and evaluation of core thermal power and fuel thermal margins, and testing the digital feedwater level control (DFCS) and electro-hydraulic control (DEHC) systems for proper level and pressure control. Balance of plant system monitoring was accomplished by System Monitoring plans. In accordance with the MUR LAR, baseline test information was taken at the 93.5% and 98.4% power plateaus. This information was used to predict margins for subsequent tests at MUR conditions.

3.0 Test Acceptance Criteria

Similar to original startup testing, each test's acceptance criteria were developed from several considerations such as safety analysis assumptions or engineering expectations. The following paragraphs describe each kind of criterion used, and the actions to be taken in the event an individual criterion was not satisfied.

Level 1

Criteria associated with plant safety. Criteria that may result in a Level 1 condition include any related event that causes an unexpected reactivity transient, such as that associated with reactor water level, pressure, core flow, temperature, or control rod position; and any event that is reportable or potentially reportable to the NRC, such as reactor scram, ECCS actuation, an uncontrolled radiation release or other condition of noteworthy concern. If a Level 1 test criterion is not satisfied, the test will be placed on hold and the plant placed in a safe condition based upon prior testing. Plant emergency, abnormal, operating or test procedures, or the Technical Specifications, may guide the decision on the direction to be taken. Resolution of the

problem must immediately be pursued by appropriate equipment adjustments or through engineering support if needed. Following resolution, the applicable test portion must be repeated to verify that the Level 1 requirement is satisfied.

Level 2
Criteria associated with normal plant surveillance testing, plant operating procedures, rounds, alarm responses, etc. The limits stated in this category are usually associated with expectations of system transient performance, where performance can be improved by equipment adjustments. If a Level 2 test criterion is not satisfied, plant operating conditions or test plans would not necessarily be altered. An investigation of the related parameters, as well as the measurement and analytical methods, would be performed. Following the evaluation and resolution of the Level 2 test criterion failures, the applicable test portion must be repeated or evaluated as acceptable.

4.0 Test Summary and Results

The following section is a summary of those test results performed up to and at 100% RTP (3902 MWth). Up to 100% power, all Level 1 and Level 2 test criteria were met or evaluated as satisfactory. As discussed in section 4.6, there was one instance of the test being placed on hold such that equipment and performance evaluations could be completed prior to the resumption of test activities.

4.1 Radiation Surveys

Level 1: The radiation doses of plant origin and the occupancy times of personnel in radiation zones shall be controlled consistent with the guidelines of the Standards for Protection Against Radiation outlined in 10CFR20 (Ref. GEH Task T1005).
Level 2: None.

Radiation surveys were taken at the 98.4% baseline and at 100% RTP. All doses were within expected values and Level 1 limits met. Radiation levels trended as-expected with reactor power; and were acceptable up to and including operation at MUR power.

4.2 Core Performance

Core performance data including thermal limits were predicted and determined for the two baseline power plateaus and MUR power. Level 1 limits are tied to the Technical Specifications. There are no Level 2 limits associated with the test.

Core performance data was taken at the 93.5% and 98.4% baselines, and at MUR RTP. On 5/24/18, at 98.4% RTP and a Core Flow of 99.2 Mlbm/hr, thermal limits were:

MAPRAT	0.755
MFLCPR	0.857
MFLPD	0.973

Following power ascension to MUR RTP, on 5/24/18, at 100% RTP and a Core Flow of 100.9 Mlbm/hr, station thermal limits were:

MAPRAT	0.746
MFLCPR	0.866
MFLPD	0.955

These limits and their margins were consistent with core power, conditions, and predictions. There is sufficient margin to remain at MUR power and no core performance anomalies were seen during testing.

4.3 Chemical and Radiochemical

Chemistry data was taken at the 98.4% power plateau and at MUR power. Level 1 limits are tied to normal Technical Specification limits and/or Chemistry Program limits.

At 98.4% RTP and 100% RTP, all Level 1 limits were met.

4.5 Pressure Regulator

The purpose of this test was to demonstrate adequate DEHC pressure control in response to pressure step changes as large as +/- 3 psig. The following criteria were applicable to these tests.

Level 1:	The decay ratio is less than 1.0 for each process variable that exhibits oscillatory response to pressure control system changes.
Level 2:	Process variables must meet a decay ratio of 0.25. The peak neutron flux (margin to scram) must be a minimum of 7.5%. Reactor Pressure must remain below 1016 psig. Time between setpoint bias change and peak pressure is <10 seconds.

DEHC testing was performed at the 93.5% and 98.4% power plateaus. Pressure step changes were performed up to 3 psig and all Level 1 and 2 criteria were met. No anomalies were observed and no need for any system tuning identified. Decay ratios were below 0.25, the scram avoidance margin was greater than the 7.5%, and peak pressures were below 1016 psig. Given the system response seen at these two baseline power plateaus with all criteria met and as discussed below in the DFCS testing section, it was determined that there was no need to perform additional testing or tuning at the MUR power level. The performance of additional

pressure step changes at a slightly higher power level increases the risk of a plant transient unrelated to the DEHC control system response. Therefore the risk of further testing was not justified. The testing performed supports the conclusion that the DEHC system is well-tuned for operation at MUR power.

4.6 Feedwater System Testing

The purpose of this test was to demonstrate that the DFCS has acceptable response to reactor water level setpoint changes up to 3-inches in 3-element control and single element control at MUR conditions. The following criteria were applicable to these tests.

Level 1:	The decay ratio is less than 1.0 for reactor water level.
Level 2:	Maintain at least a 7.5% margin to the Average Power Range Monitor (APRM) Simulated Thermal Power (STP) flow biased scram setpoint. The decay ratio should be less than 0.25 for reactor water level. The overshoot should be less than 5 inches.

DFCS testing was performed at approximately 93.5% and 98.4% power. Reactor pressure vessel (RPV) level setpoint changes up to 3 inches were performed in both 3 element and single element control (93.5% only). Excellent DFCS response was observed to the test step changes and an unintended larger feedwater transient which occurred due to a trip of the 'A' Reactor Feedwater Pump (RFP) during testing at 98.4% power. The RFP trip was unrelated to the MUR uprate. All Level 1 and Level 2 criteria were met for the DFCS testing. Based on the responses observed, no tuning was determined to be required. The testing data margins supported that the DFCS was well tuned to support MUR operation. However, since there was an unexpected trip of the 'A' RFP during the 98.4% testing, further discussion of the test results follows.

The 93.5% DFCS baseline testing was performed consisting of -/+ 3 inch level step changes in both 3-element and single-element control modes. In all four steps, DFCS responded very well in that no discernable decay ratio was observed (no oscillatory behavior). The characteristic response consisted of a slight overshoot (a maximum of 1.3 inches versus a Level 2 criterion of 5 inches) followed by a controlled return to the selected water level without any additional over or undershoot waves. Peak power on the highest reading APRM during the transient was approximately 94% (0.5% power above the 93.5% test plateau). With the APRM STP upscale flow biased trip setpoints at 114%, this provided a 20% margin to scram.

The 98.4% DFCS baseline testing consisted of a 3-inch level step change in 3-element control. During performance of this test a trip of the 'A' RFP occurred. The resulting transient consisted of a rapid decline of water level from 32 inches to a low of 28.7 inches due to the loss of the 'A' RFP (a 33% step loss of feedwater flow). The remaining two RFPs increased their speed to return water level to normal (set at 35 inches at the time) and in doing so, level peaked by an average of the three narrow range indicators to between 39-40 inches, meeting the 5-inch overshoot criteria for the 3-inch level step change (for the much larger transient).

Evaluation of the larger transient concluded that the response of the DFCS to a small step increase and decrease in water level (3 inches) was met by the much larger actual transient (33% loss of feedwater flow). Evaluation of the DFCS transient concluded that all Level 1 and 2 test criteria associated with water level and DFCS response were met. Subsequent evaluation of the cause of the 'A' RFP trip concluded that although triggered by the change in demand, the 'A' RFP trip was unrelated to the MUR changes. Re-performance of the 98.4% DFCS step changes was determined not to be required since the level response would be less severe than the response obtained when the 'A' RFP tripped.

A technical evaluation was performed that concluded that there was no need to perform a third test closer to MUR power. The performance of the DFCS testing at 93.5% and 98.4% power level, particularly considering the response to a large feedwater transient, supports the conclusion that the DFCS is appropriately tuned for the MUR power level. The performance of an additional level step change at a slightly higher power level could result in another plant transient unrelated to the MUR changes.

Thus, it was concluded that the DFCS system is well tuned and able to handle feedwater level transients at MUR conditions.

4.7 Moisture Carryover

Moisture carryover was obtained at 98.4% RTP and at 100% MUR RTP. Data trending is used as a secondary means to provide indication of any potential steam dryer issues. It is also monitored to ensure it remains below GEH analyzed limits.

Level 1: Moisture carryover shall remain less than 0.30% by weight.
Level 2: Moisture carryover should be less than or equal to 0.1% by weight.

Moisture carryover was sampled at 98.4% RTP and was 0.02% by weight. Sampling at 100% RTP yielded a similar moisture carryover of 0.02% by weight. Trends did not identify any steam dryer issues. The results are consistent with expectations and this data met the Level 2 (and Level 1) criteria with considerable margin; thus, there is no evidence of any steam dryer concern at MUR conditions.

4.8 MUR System Performance & Monitoring Plans

The purpose of this testing was to monitor MUR affected systems and ensure system parameters remain within expected design limits as power ascension proceeded. There were no Level 1 criteria associated with these systems. There were selected Level 2 hold criteria comprised of critical plant parameters and based on operating history.

The System Monitoring Plans were successfully completed at the 93.5%, 98.4%, and 100% power plateaus. No challenges to Level 2 limits were identified.

4.9 First Stage SCRAM Bypass

The purpose of this test was to validate the relationship between reactor power and the turbine first stage pressure scram bypass. Level 1 criteria is that the bypass must clear by the TS 24% reactor power requirement. Level 2 criteria is that the bypass must clear less than the allowable value of 108.1 psig.

Testing of the first stage Scram bypass set-point commenced at approximately 18% power and was taken until 24% power. The results of this test demonstrated that the bypasses cleared at 20.7% on the plant computer. This meets all acceptance criteria and does not require optimization.

5.0 Conclusion

Based on the evaluation of testing performed at 93.5%, 98.4%, and 100% MUR RTP, Hope Creek can safely remain at the MUR rated core thermal power of 3902 MWt.