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Subject: GLOBAL NUCLEAR FUEL (GNF2) STARTUP REPORT
HOPE CREEK GENERATING STATION
FACILITY OPERATING LICENSE NPF-57
DOCKET NO. 50-354

PSEG Nuclear LLC hereby submits a summary report of plant startup for the Hope Creek Generating Station in accordance with the requirements of Technical Specification (TS) 6.9.1.1. This report is required because Hope Creek transitioned to Global Nuclear Fuel GNF2 design for Cycle 21. The report is included as Attachment 1. This letter and the attached report satisfy the TS 6.9.1.3 90 day reporting requirement.

If you have any questions or comments on this transmittal, please contact Frank Safin at (856) 339-1937.

There are no regulatory commitments in this letter.

Sincerely,

David Mannai
Sr. Director Regulatory Operations

Attachment 1: Hope Creek Generating Station Cycle 21 Startup Report, February 2017

dlr

cc: Mr. Daniel H. Dorman, Regional Administrator - USNRC Region I
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ATTACHMENT 1

Hope Creek Generating Station
Cycle 21
Startup Report
February 2017

Contents

1.0 Introduction

Hope Creek Generating Station transitioned from the Global Nuclear Fuel GE14 fuel design to the Global Nuclear Fuel GNF2 fuel design in Cycle 21. Both GE14 and GNF2 fuel designs consist of a 10X10 lattice with two large central water rods and 92 fuel rods. Both designs have 14 Part-Length-Rods (PLR) with the differences between the two designs being in the location and type of the PLR and in the radius of the fuel pellets. GE14 has 14 PLR, all of the same length, whereas the GNF2 14 PLR are comprised of six rods that are shorter in length than the remaining eight. The GNF2 design has a slightly larger fuel pellet radius allowing for an increase in UO2 mass. The principal improvement as a result of these differences is an enhanced fuel utilization efficiency, which allows the Hope Creek GNF2 reload fuel assembly to have a lower initial enrichment.

Hope Creek Technical Specification 6.9.1.1 requires a submittal of a startup report following the installation of fuel that has a different design, or has been manufactured by a different fuel supplier. This startup report will address each of the initial startup tests identified in the Updated Final Safety Analysis Report (UFSAR) that could be impacted by the introduction of a new fuel design. The fuel transition project was performed over a two-year period. During Hope Creek's twentieth refueling outage (RF20), that began on 10/14/2016 and was completed on 11/11/2016, 212 GNF2 fuel bundles were loaded. The following sections provide a description of the test results for those initial startup tests described in the Hope Creek UFSAR that were affected by the introduction of the GNF2 fuel design.

2.0 Control Rod Drive System

The description of the initial startup testing for the control rod drive system is provided in the Hope Creek UFSAR section 14.2.12.3.5. The operability of the control rod system may be impacted by the introduction of a new fuel design. The new fuel design could cause additional friction on control rod movement, which may impact the scram speeds.

2.1 Control Rod Scram Time

The control rod drive (CRD) scram times were measured in accordance with procedure HC.RE-ST.BF-0001(Q), "Control Rod Scram Time Surveillance" (Reference 5.1). The objective of this test was to verify that the CRD scram times meet all Technical Specification (TS) acceptance criteria. The measured scram times were compared against acceptance criteria for the purpose of determining control rod drive system performance. The acceptance criteria for the individual scram time to notch position 05 and no more than 13 operable control rods shall be slow, are given in the Hope Creek TS 3.1.3.2 and 3.1.3.3, respectively. A summary of the results for TS 3.1.3.2 is provided in Table 2.1-1 and no control rods were declared slow for TS 3.1.3.3. The results indicate that the measured scram times are faster than the acceptance criteria, which demonstrates that the introduction of the GNF2 fuel design did not have an adverse effect on control rod drive system performance.

Table 2.1-1: Individual Scram Time

Notch Position	Most Limiting Scram Insertion time to Notch 05 (seconds)	Acceptance Criteria (Seconds)
05	2.849	≤ 7.000

3.0 Full Core Shutdown Margin

The description of the initial startup testing for the full core shutdown margin demonstration is provided in the Hope Creek UFSAR section 14.2.12.3.4. The core neutronic characteristics and the ability of the vendor design tools to accurately model the core in cold conditions may be impacted by the introduction of a new fuel design. The Cycle 21 startup testing demonstrated that the shutdown margin was greater than 0.38% Δk/k, and the cold reactivity anomaly was within ±1.0% Δk/k, as required by Technical Specifications (TS).

3.1 In-Sequence Critical

The in-sequence critical was performed by withdrawing the control rods in a Banked Position Withdrawal Sequence (BPWS), until criticality was achieved as part of the shutdown margin demonstration that was accomplished in accordance with procedure HC.RE-ST.ZZ-0005(Q), "Reactivity Anomaly Surveillance" (Reference 5.2). The objective of the test was to evaluate the vendor's PANAC11 methods used in the design and licensing of Cycle 21. The in-sequence critical test was performed on 11/10/2016 at a temperature of 250°F. The results for the critical control rod configuration are shown in Table 3.1-1. The Beginning-Of-Cycle (BOC) 21 cold target keff is also provided in Table 3.1-1. The results show that the difference between the BOC 21 cold target keff that was established by the vendor's methods, and the cold critical keff calculated during the test is within the expected range observed from previous Hope Creek in-sequence critical calculations. The differences are acceptable and are within the data used to establish the Cycle 21 shutdown margin design criteria.

Table 3.1-1: In-sequence Critical Results

Predicted Cold BOC Target keff	Measured Cold BOC keff
0.99900	0.99854

3.2 Shutdown Margin Demonstration

The core shutdown margin (SDM) was demonstrated in accordance with procedure HC.RE-ST.ZZ-0007(Q), "Shutdown Margin Surveillance" (Reference 5.3). The objective of the test was to demonstrate that the core would remain subcritical by at least 0.38% Δk/k throughout the cycle at cold xenon free conditions, with the strongest worth control rod withdrawn. The core SDM was demonstrated during the first in-sequence critical. The demonstrated SDM for Cycle 21 was 1.205% Δk/k, which meets the Technical Specification minimum requirement of 0.38% Δk/k.

3.3 Core Cold Reactivity Anomaly Evaluation

The core reactivity anomaly was evaluated in accordance with procedure HC.RE-ST.ZZ-0005(Q), "Reactivity Anomaly Surveillance" (Reference 5.2). The objective of the test was to demonstrate that the core reactivity is within ±1.0% Δk/k of the predicted core reactivity. The reactivity anomaly test was performed at cold conditions during the SDM demonstration. The predicted SDM at BOC was 1.26% Δk/k and the demonstrated SDM was 1.21% Δk/k, resulting in a difference of 0.05% Δk/k. The result from the test was within the Technical Specification requirement of ± 1.0% Δk/k.

4.0 Core Performance

The description of the initial startup testing to evaluate the core performance, with respect to thermal limits, is provided in the Hope Creek UFSAR section 14.2.12.3.16. The objective of the test is to calculate the principal thermal and hydraulic parameters associated with core behavior. The initial test evaluated the thermal limits at various power levels and compared the thermal limits at rated power to the predicted values in the Cycle Management Report (Reference 5.4). The core performance tests and evaluations performed during the Cycle 21 power ascension were the hot reactivity anomaly evaluation, thermal limits evaluation and core thermal hydraulics evaluation.

4.1 Core Hot Reactivity Anomaly Evaluation

The core hot reactivity anomaly was evaluated in accordance with procedure HC.RE-ST.ZZ-0005(Q), "Reactivity Anomaly Surveillance" (Reference 5.5). The objective of the test was to demonstrate that the core reactivity is within ±1.0% Δk/k of the predicted core reactivity. The hot reactivity anomaly test was performed at 100% power equilibrium conditions at a cycle exposure of 907.7 Mwd/stu. The predicted keff was 1.0078, and the monitored keff from the CMS was 1.00643, resulting in a difference of 0.13% Δk/k. The result from the test was within the Technical Specification requirement of ±1.0% Δk/k.

4.2 Thermal Limits

The thermal limits, given in Table 4.2-1, were obtained from the core monitoring system (CMS) during the BOC power ascension. The thermal limits were of an acceptable magnitude at each power and flow condition and trended as expected for the actual power, flow and control rod pattern conditions experienced during the startup.

Table 4.2-1: CMS Thermal Limits

Date / Time	Power (% rated)	Core Flow (% rated)	MFLCPR	MFLPD	MAPRAT
11/12/16 23:31	35.31	48.18	0.703	0.520	0.296
11/13/16 23:31	71.49	70.80	0.845	0.798	0.582
11/14/16 23:31	88.60	85.71	0.910	0.759	0.620
11/18/16 23:31	88.37	90.87	0.824	0.867	0.710
11/19/16 23:32	88.93	91.68	0.824	0.869	0.713
11/21/16 23:32	99.76	97.70	0.851	0.862	0.750
11/22/16 23:32	99.89	101.35	0.838	0.866	0.754

The thermal limits at full power conditions were compared against the predicted values from the Cycle Management Report (CMR) as shown in Table 4.2-2 (Reference 5.4). The CMS data was obtained from an edit generated on 12/03/2016 23:32 at a cycle exposure of 496.5 Mwd/Stu. The differences are acceptable and are within the Cycle 21 design margin criteria specified by PSEG Nuclear, LLC.

Table 4.2-2: Cycle Management Report Predictions to CMS Thermal Limits Comparison

	CMS	CMR
Cycle Exposure (MWd/st)	496.5	500.0
MFLCPR	0.834	0.811
MFLPD	0.875	0.804
MAPRAT	0.765	0.683

4.3 Core Thermal Hydraulic Evaluation

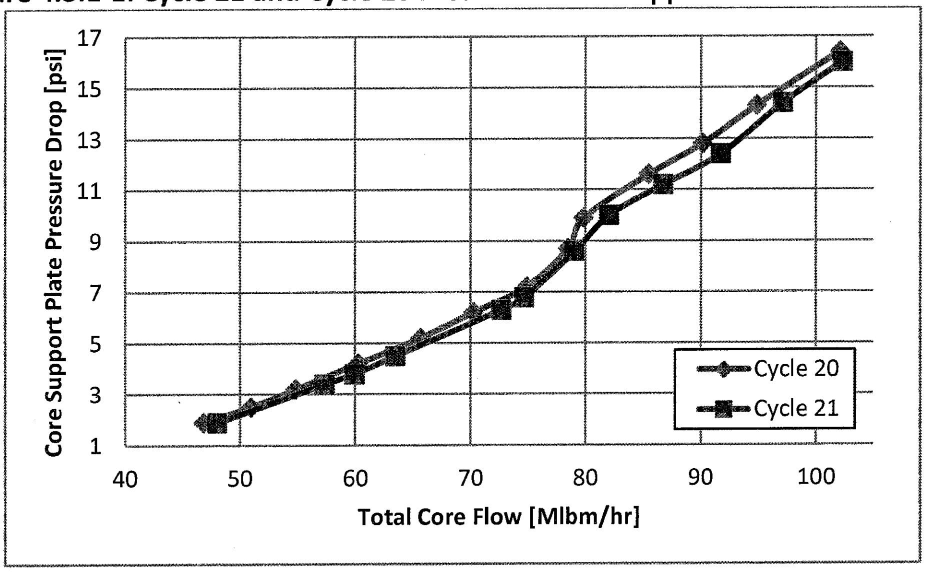
The introduction of the GNF2 fuel design into the Hope Creek core has the potential to affect the thermal-hydraulic performance of the core. One of the vendor's thermal-hydraulic design bases is that the GNF2 reload fuel shall be hydraulically compatible with the resident GE14 fuel. The basis being that by ensuring hydraulic compatibility of the loaded fuel assemblies, the core thermal-hydraulic performance will remain unchanged by the introduction of the new fuel design. The core thermal-hydraulic performance evaluation is comprised of the following activities:

* A comparison of the measured Core Support Plate Pressure Drop between Cycle 21 and Cycle 20 startup.
* A comparison of recirculation system loop data that was recorded during the startups of Cycle 20 and 21.

4.3.1 Cycle 21 and 20 Measured Core Support Plate Pressure Drop Comparison

The measured core support plate pressure drops, obtained during the Cycle 21 and 20 startups, are shown in Figure 4.3.1-1 (Reference 5.6). The measured data provide further evidence that the thermal-hydraulic performance of the Hope Creek core has not been adversely affected by the introduction of the GNF2 fuel design. The comparison demonstrates that the two fuel designs, GE14 and GNF2, are hydraulically compatible.

Figure 4.3.1-1: Cycle 21 and Cycle 20 Measured Core Support Plate Pressure Drop



4.3.2 Cycle 21 and 20 Recirculation Pump Data and Core Flow Comparison

During reactor startup, data is recorded at various pump speeds in accordance with procedure HC.OP-FT.BB-0001 (Q), "Jet Pump Data Collection". Additional data was also independently collected from the Plant Process Computer (PPC) to supplement the Cycle 21 data collection. The collection of data from both the HC.OP-FT.BB-0001 procedure and the PPC is summarized in HCG.5-0295 (Reference 5.6). The Cycle 21 and 20 data is provided in Figures 4.3.2-1 through 4.3.2-5, and shows no anomalous behavior of the recirculation pumps. The introduction of GNF2 fuel assembly has not affected the recirculation pump performance. This indicates that the overall hydraulic resistance of the core has not changed, which is the result of having hydraulically compatible fuel loaded in the core.

Figure 4.3.2-1: Cycle 21 and 20 Recirculation Pump A Flow versus Pump Speed

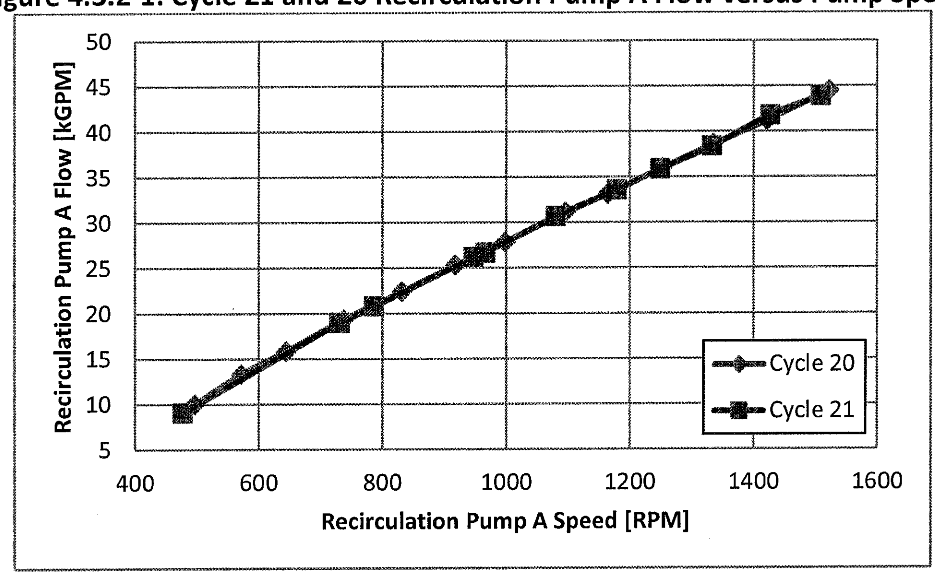


Figure 4.3.2-2: Cycle 21 and 20 Recirculation Pump B Flow versus Pump Speed

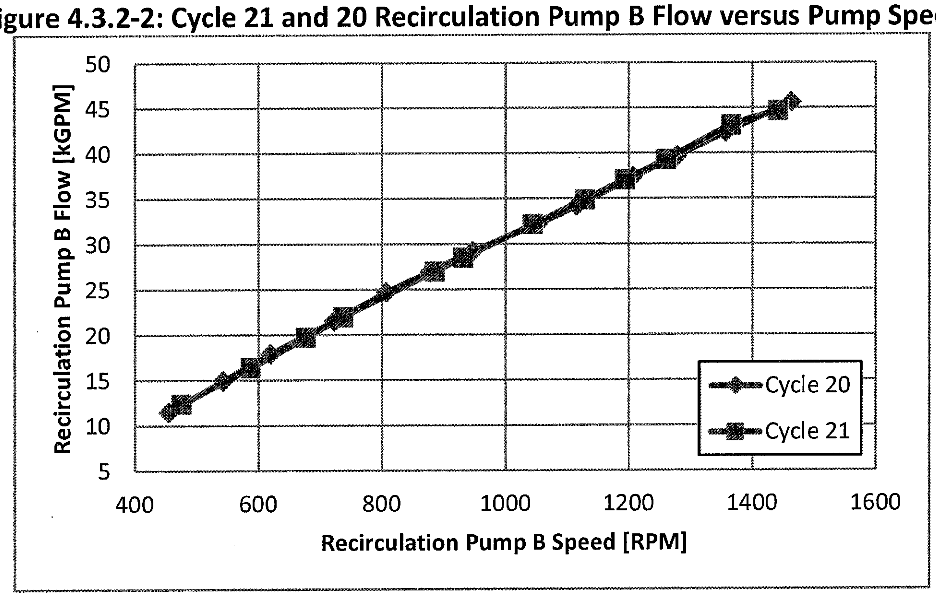


Figure 4.3.2-3: Cycle 21 and 20 Recirculation Pump A Head versus Pump Flow

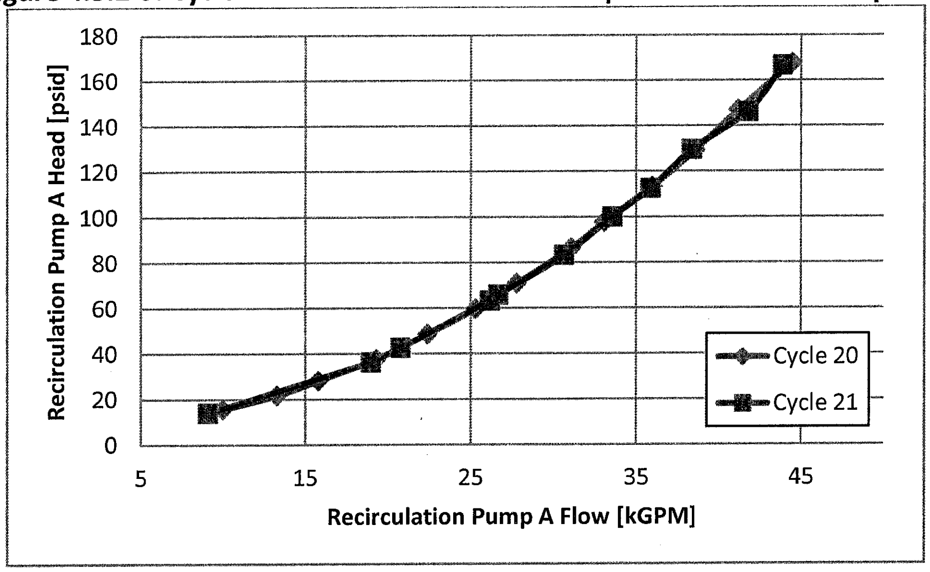


Figure 4.3.2-4: Cycle 21 and 20 Recirculation Pump B Head versus Pump Flow

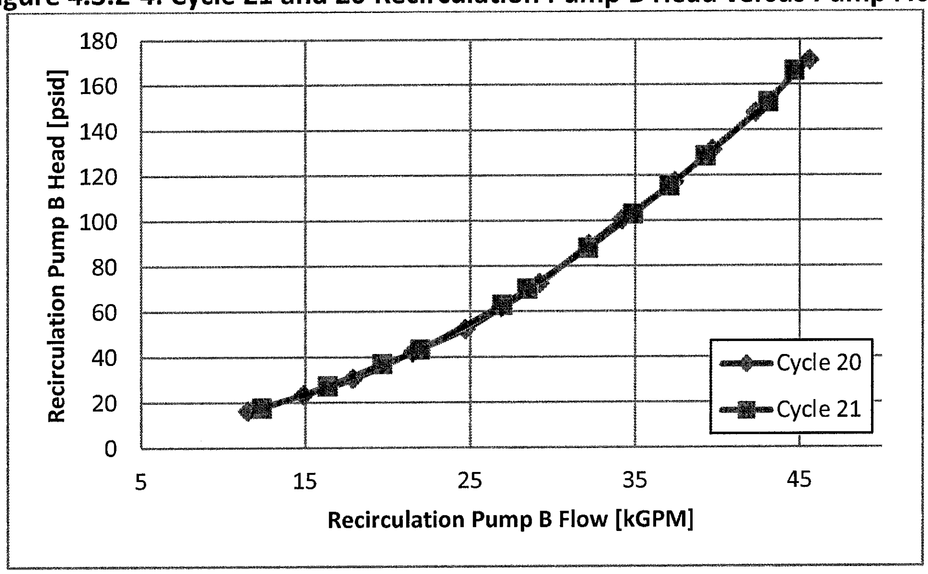
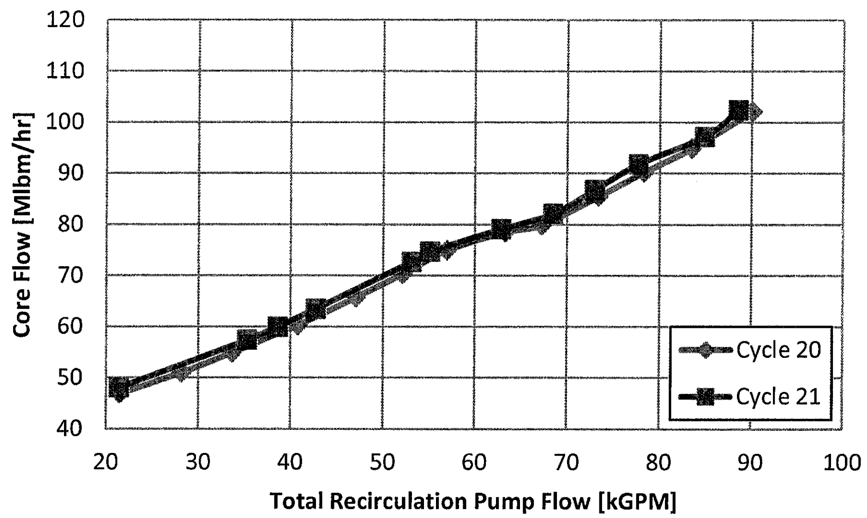


Figure 4.3.2-5: Cycle 21 and 20 Core Flow versus Recirculation Pump Flow



5.0 References

5.1 HC.RE-ST.BF-0001(Q), "Control Rod Scram Time Surveillance", 12/Nov/2016. (ACN JMT1205160045)

5.2 HC.RE-ST.ZZ-0005(Q), "Reactivity Anomaly Surveillance", 10/Nov/2016. (ACN JCD1113160019)

5.3 HC.RE-ST.ZZ-0007(Q), "Shutdown Margin Surveillance", 10/Nov/2016. (ACN JCD1113160020)

5.4 HCC21CMR, "Cycle Management Report Hope Creek Cycle 21", 3/Nov/2016.

5.5 HC.RE-ST.ZZ-0005(Q), "Reactivity Anomaly Surveillance", 20/Dec/2016 (ACN JMT1223160007).

5.6 HCG.5-0295, "Hope Creek Cycle 21 Startup Report – Core Thermal Hydraulic Evaluation Data", 06/Feb/2017.