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GENERAL ELECTRIC FUEL (GE14) 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 6.9.1.1. This report is required since fuel manufactured by General Electric was loaded for Cycle 13. The report is included as Attachment 1.

If you have any questions or comments on this transmittal, please contact Michael Mosier at (856) 339-5434.

Sincerely,

Christina L. Perino
Regulatory Assurance Director

Attachment

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ATTACHMENT 1

Hope Creek Generating Station

Cycle 13
Startup Report

April 2005

Table of Contents

List of Tables

List of Figures

1.0 Introduction

Hope Creek Generating Station transitioned from the Westinghouse BWR SVEA 96+ fuel design to the General Electric GE14 fuel design in Cycle 13. The GE14 fuel is a 10x10 design with two large central water rods, consisting of 92 fuel rods. The SVEA 96+ fuel is a 10x10 water cross design consisting of 96 fuel rods. 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 Final Safety Analysis Report 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 twelfth refueling outage (RF12), that began on 10/24/2004 and was completed on 01/26/2005, 164 GE14 fuel bundles were loaded. Additionally, the core monitoring system (CMS) was replaced during RF12. The following sections provide a description of the test results for those initial startup tests described in the Hope Creek FSAR that were affected by the introduction of the GE14 fuel design (Reference 6.1).

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 FSAR 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". The objective of this test was to verify that the CRD scram times meet all Technical Specification 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, core average scram times to notch positions 45, 39, 25, and 05, and 2x2 array average scram times to notch positions 45, 39, 25, and 05, are given in the Hope Creek Technical Specifications 3.1.3.2, 3.1.3.3, and 3.1.3.4 respectively. A summary of results from the test is provided in Tables 1, 2 and 3. The results indicate that the measured scram times are faster than the acceptance criteria which demonstrates that the introduction of the GE14 fuel design did not have an adverse effect on control rod drive system performance.

Table 1. Individual Scram Time

Notch Position	Most Limiting Scram Insertion Time to Notch 05 (Seconds)		Acceptance criteria (Seconds)
05	2.652	≤	7.00

Table 2. Average Scram Times

Notch Position	Measured Core Average Scram Time (Seconds)		Acceptance criteria (Seconds)
45	0.268	≤	0.43
39	0.571	≤	0.86
25	1.304	≤	1.93
05	2.414	≤	3.49

Table 3. Array Average Scram Times

Notch Position	Most Limiting 2x2 Scram Time (Seconds)		Acceptance criteria (Seconds)
45	0.290	≤	0.45
39	0.628	≤	0.92
25	1.443	≤	2.05
05	2.652	≤	3.70

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 FSAR 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 13 startup testing demonstrated that the shutdown margin was greater than 0.38% $\Delta k/k$, and the cold reactivity anomaly was within ±1.0% $\Delta k/k$

3.1 In-Sequence Criticals

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-0007(Q), "Shutdown Margin Surveillance". The objective of the test was to evaluate the vendor's PANAC11 methods used in the design and licensing of Cycle 13. The in-sequence critical test was performed on 01/18/2005 at a temperature of 164°F.

The results for the critical control rod configuration are shown in Table 4. The BOC13 cold target k_{eff} is also provided in Table 4. The results show that the difference between the BOC13 cold target k_{eff} that was established by the vendor's methods, and the cold critical k_{eff} 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 13 shutdown margin design criteria.

Table 4. In-sequence Critical Results

Measurement	PANAC11
BOC Cold Target k_{eff}	1.00100
In-sequence Critical k_{eff}	1.00126

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". 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 13 was 1.56% 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". 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 1.65% Δk/k and the demonstrated SDM was 1.69% Δk/k, resulting in a difference of -0.04% 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 FSAR 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 6.2). The core performance tests and evaluations performed during the Cycle 13 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 reactivity anomaly was evaluated in accordance with procedure HC.RE-ST.ZZ-0005(Q),"Reactivity Anomaly Surveillance". 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 308 Mwd/Mtu. The predicted k_{eff} was 1.0055, and the monitored k_{eff} from the CMS was 1.0079, resulting in a difference of -0.24% 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 5, 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 5. CMS Thermal Limits

Date/Time	Power (%)	Flow (%)	MFLCPR	MFLPD	MAPRAT
1/27/2005 17:01	22.0	44.3	0.339	0.196	0.226
1/29/2005 03:02	30.3	45.2	0.446	0.275	0.321
1/29/2005 06:01	40.3	54.3	0.505	0.324	0.376
2/01/2005 00:01	50.4	65.9	0.549	0.433	0.514
2/01/2005 12:01	66.2	64.4	0.715	0.460	0.547
2/04/2005 21:31	75.0	79.3	0.677	0.521	0.603
2/08/2005 07:32	90.3	90.9	0.773	0.646	0.742
2/12/2005 15:32	100.0	98.4	0.860	0.648	0.738

The thermal limits at full power conditions were compared against the predicted values from the Cycle Management Report (CMR) as shown in Table 6. The CMS data was obtained from an edit generated on 02/22/2005 22:02, at a cycle exposure of 500.1 Mwd/Stu. The differences are acceptable, and are within the Cycle 13 design margin criteria specified by PSEG.

Table 6. Cycle Management Report Predictions to CMS Thermal Limits Comparison

	CMR	CMS
Exposure Mwd/Stu	500	500.1
MFLCPR	0.871	0.859
MFLPD	0.771	0.713
MAPRAT	0.670	0.624

4.3 Core Thermal Hydraulic Evaluation

The introduction of the GE14 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 GE14 reload fuel shall be hydraulically compatible with the resident SVEA96+ 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 and calculated Core Support Plate Pressure Drop.
- A comparison of the measured Core Support Plate Pressure Drop between Cycle 13 and Cycle 12 startup.
- A comparison of recirculation system loop data that was recorded during the startups of Cycle 12 and 13.

4.3.1 Core Support Plate Pressure Drop Comparison

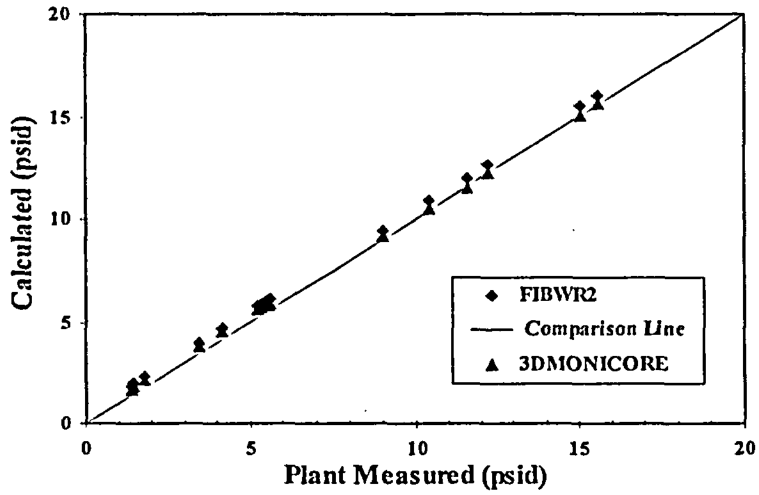
Steady state thermal-hydraulic calculations were performed with the computer code FIBWR2, and the CMS (3DMONICORE) at various operating conditions during the Cycle 13 startup (Reference 6.3). The FIBWR2 code and the vendor's thermal-hydraulic code were the design tools used to ensure hydraulic compatibility in the design of the Hope Creek Cycle 13 GE14 fuel assembly. A good comparison between the calculated and measured core support plate pressure drops provides evidence that the fuel assemblies are hydraulically compatible.

The operating conditions, measured data and calculated results are presented in Table 7. The results show good agreement between the measured and calculated pressure drops. FIBWR2 and CMS calculated core support plate pressure drops are within 0.6 psid and 0.5 psid of measured data, respectively. Figure 1 presents a graphical representation of the results presented in Table 7.

Table 7. Core Support Plate Pressure Drop Comparison

Power (% of Rated)	Flow (% of Rated)	Measured (psid)	FIBWR2 (psid)	3DMONICORE (psid)
16.00	42.51	1.39	1.81	1.67
20.01	42.84	1.42	1.83	1.67
23.93	44.00	1.47	1.96	1.79
35.85	45.49	1.79	2.30	2.12
41.68	60.53	4.14	4.73	4.59
45.43	65.94	5.22	5.79	5.65
47.78	55.02	3.44	3.95	3.82
50.41	65.82	5.36	5.89	5.72
59.63	64.99	5.52	6.02	5.83
66.32	64.27	5.60	6.09	5.86
66.79	63.95	5.54	6.04	5.79
67.26	80.38	9.00	9.41	9.14
82.03	83.00	10.40	10.88	10.48
89.54	86.08	11.58	12.02	11.52
90.07	88.44	12.25	12.67	12.24
99.97	97.31	15.02	15.51	15.02
100.02	99.38	15.59	16.07	15.59

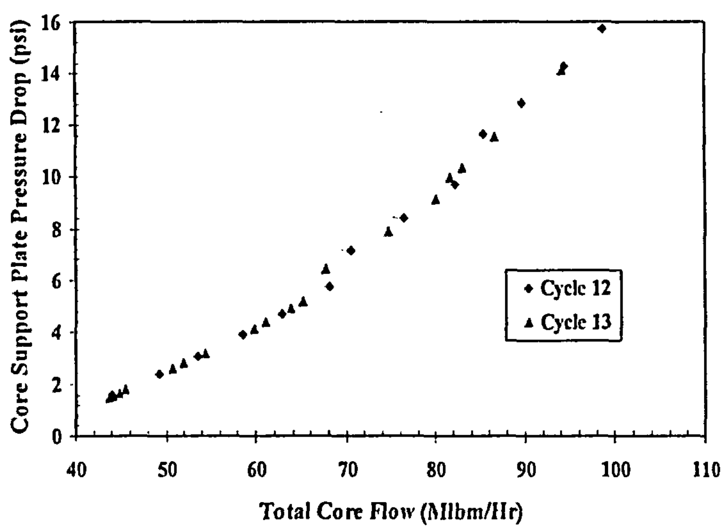
Figure 1. Calculated versus Measured Core Support Plate Pressure Drop



4.3.2 Cycle 13 and 12 Measured Core Support Plate Pressure Drop Comparison

The measured core support plate pressure drops, obtained during the Cycle 13 and 12 startups, are shown in Figure 2. The measured data provide further evidence that the thermal-hydraulic performance of the Hope Creek core has not been affected by the introduction of the GE14 fuel design. The excellent comparison is indicative of the hydraulic compatibility of the two fuel designs, GE14 and SVEA-96+.

Figure 2. Cycle 13 and Cycle 12 Measured Core Support Plate Pressure Drop



4.3.3 Cycle 13 and 12 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". The Cycle 13 and 12 data are provided in Figures 3 through 6, and shows that no anomalous behavior of the recirculation pumps. The introduction of GE14 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 3. Cycle 13 and 12 Recirculation Pump A Flow versus Pump Speed

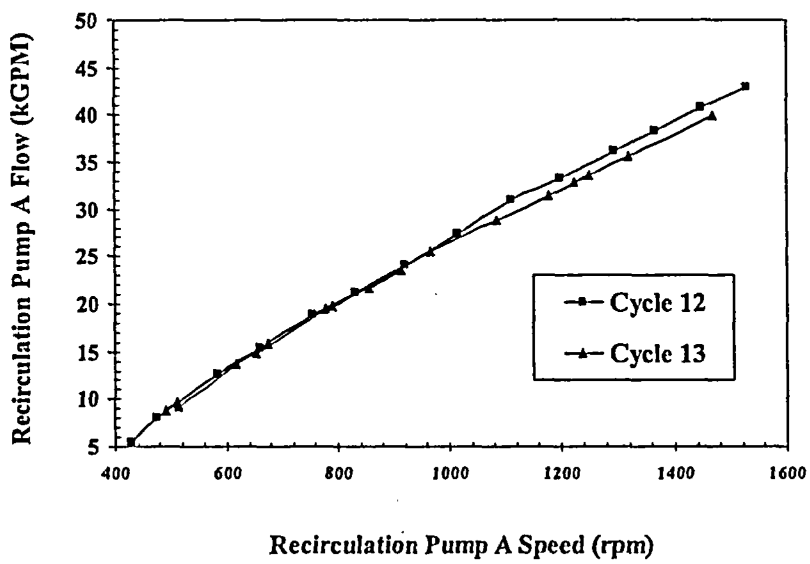


Figure 4. Cycle 13 and 12 Recirculation Pump B Flow versus Pump Speed

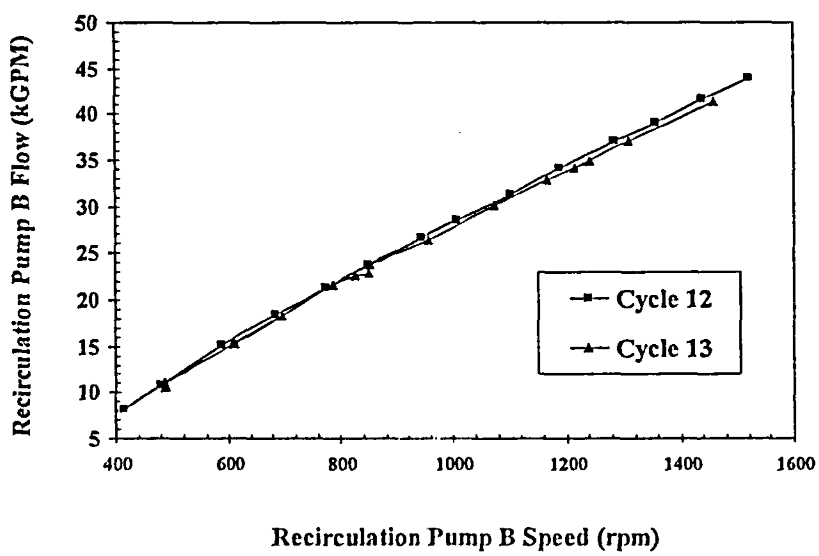


Figure 5. Cycle 13 and 12 Recirculation Pump A Head versus Pump Flow

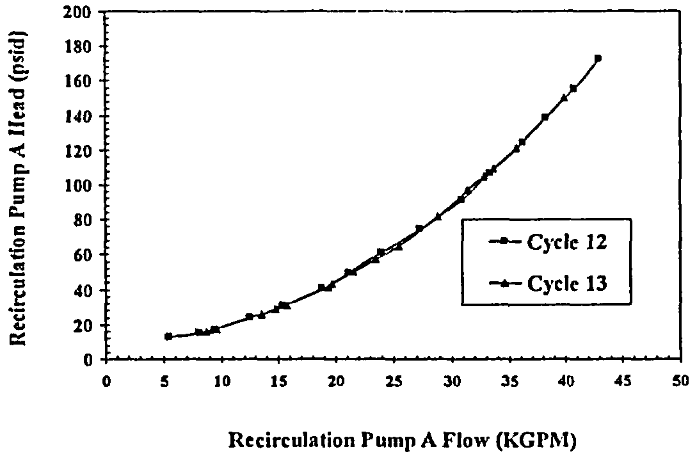


Figure 6. Cycle 13 and 12 Recirculation Pump B Head versus Pump Flow

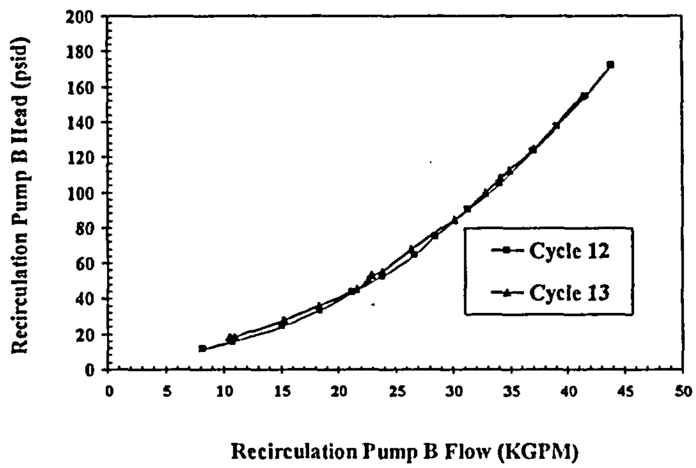
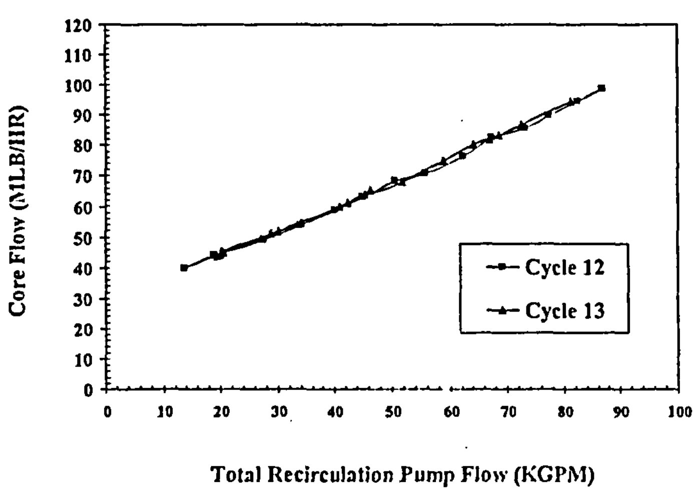


Figure 7. Cycle 13 and 12 Core Flow versus Recirculation Pump Flow



5.0 NSSS Process Computer

The description of the initial startup testing to evaluate the performance of the process computer under plant operating conditions is provided in the Hope Creek FSAR section 14.2.12.3.11. The CMS thermal limit results (thermal limit performance discussed in Section 4.2 of this report) were tested during the Cycle 13 BOC power ascension.

6.0 References

6.1 NFS-0245, HCGS Cycle 13 Evaluation of the UFSAR Chapter 14 Initial Cycle Startup Test.

6.2 NFS-0242, Cycle Management Report For Hope Creek Generating Station Cycle 13.

6.3 HCG.6-0004, Cycle 13 Startup Thermal Hydraulic Analysis.