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United States Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555

Gentlemen:

POWER UPRATE TEST SUMMARY
SALEM GENERATING STATION - UNIT 1
FACILITY OPERATING LICENSE DPR-70
DOCKET NO. 50-272

PSEG Nuclear LLC hereby submits a summary report of plant startup and power escalation testing for Salem Unit 1 in accordance with the requirements of Technical Specification 6.9.1.1. The report is required because Amendment 243 to the Salem Unit 1 Technical Specifications increased the licensed power level. The summary of testing is included in Attachment 1.

Attachment 1 also contains a summary of the core design, startup physics testing and beginning-of-cycle power ascension flux mapping results for Salem Unit 1 Cycle 15.

Should you have any questions regarding this submittal, please contact Paul Duke at (856) 339-1466.

Sincerely,

G. Salamon
Manager - Nuclear Safety & Licensing

Attachment

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ATTACHMENT 1
SALEM UNIT 1 CYCLE 15 STARTUP PHYSICS AND 1.4% POWER UPRATE TEST REPORT

Salem Unit 1 began its fifteenth cycle of operation on May 19, 2001 when the unit was synchronized to the grid and is projected to complete this cycle of operation on October 11, 2002. On June 27, 2001 (approximately 1250 MWD/MTU cycle burnup) the licensed rated thermal power level for Salem Unit 1 was increased from 3411 MWt to 3459 MWt (a 1.4% increase). The burnup at the end of Cycle 15 is predicted to be approximately 19200 MWD/MTU.

The feed fuel region, designated as Region 17, consists of 48 assemblies enriched to 4.6 w/o U^{235} and 28 assemblies enriched to 4.8 w/o U^{235}. Region 17 also uses 576 fresh wet annular burnable absorber (WABA) rods and 8384 at 1.35X (2.12 mg/in B^{10}) integral fuel burnable absorber rods (IFBA). Region 17 is the second Salem Unit 1 reload to use the Westinghouse Robust Fuel Assembly (RFA) fuel design which includes intermediate flow mixer (IFM) grids, annular fuel pellets at the top and bottom six inches of the fuel rod and a protective bottom grid (a debris mitigation feature).

The reload core design was verified during the reactor startup physics testing and initial power ascension program. The startup physics/initial power ascension program included the following tests:

1. Rod Bank measurements using the Dynamic Rod Worth Measurement (DRWM) technique.
2. Critical boron concentration measurement.
3. Temperature coefficient measurement.
4. Power distribution measurements using the INCORE flux mapping system.

The 1.4% power uprate program was verified via INCORE flux mapping results to assure compliance with Technical Specification power distribution limits.

Salem Unit 1 Cycle 15 was the second cycle at Salem Unit 1 to utilize the DRWM bank measurement technique. Critical boron, bank worth, and temperature coefficient measurement results are provided in Tables 1, 2, and 3 respectively. Since the review criteria are typically more limiting than the acceptance criteria for measured to predicted comparisons, only comparisons to the review criteria are provided.

TABLE 1

Salem Unit 1 Cycle 15 Beginning of Life (BOL), Hot Zero Power (HZP), All-Rods-Out (ARO), Critical Boron Measurement			
Measured Value (ppm)	**Design Value (ppm)**	**Review Criteria Range (+/- 50 ppm)**	**Pass/Fail**
1862	1838	1788 to 1888	Pass

TABLE 2

Salem Unit 1 Cycle 15 Dynamic Rod Worth Measurement (DRWM) Results				
Rod Bank	**Measured Worth (pcm)**	**Design Value (pcm)**	**Review Criteria**	**Pass/Fail**
D	708.5	704.7	± 15%	Pass
C	683.2	630.6	± 15%	Pass
B	524.5	512.4	± 15%	Pass
A	680.9	698.1	± 15%	Pass
SD	524.8	492.0	± 15%	Pass
SC	240.2	249.6	± 15%	Pass
SB	751.9	752.5	± 15%	Pass
SA	1069.9	1045.7	± 15%	Pass
Total	5184.4	5085.0	± 8%	Pass

TABLE 3

Salem Unit 1 Cycle 15 BOL HZP ARO Isothermal Temperature Coefficient (ITC) Measurement and Inferred Most Limiting Moderator Temperature Coefficient (MTC)	
Parameter	
ITC Measured Value (pcm/°F)	-4.35
ITC Design Value (pcm/°F)	-3.86
Review Criteria Range (±2 pcm/°F)	-1.86 to -5.86
Pass/Fail	Pass
MTC Inferred Value* (pcm/°F)	-2.24
MTC Acceptance Value (pcm/°F)	< 0
Pass/Fail	Pass

* Measured MTC value is corrected to the most limiting burnup for MTC (~3000 MWD/MTU)

Because of the satisfactory completion of startup physics testing for Salem Unit 1 Cycle 15, power ascension was initiated. INCORE flux map peaking factor measurement results ($F_{\Delta H}$, F_Q, F_{xy}) with appropriate uncertainties applied as a function of core power level are provided in Tables 4, 5, and 6. Each part power flux map provided peaking factor results that met the Technical Specification limits for the flux map power level. The hot-full-power (HFP) flux map was taken on May 30, 2001. This flux map showed acceptable margin to peaking factor limits, with 6.7% margin to the $F_{\Delta H}$ limit, 6.1% margin to the F_{xy} limit and 19.8% margin to the F_Q Technical Specification limit.

TABLE 4

Salem Unit 1 Cycle 15 Nuclear Enthalpy Rise Hot Channel Factor ($F_{\Delta H}$) as a Function of INCORE Map Power Level Near BOL			
Test Conditions (Core Power Level)	**Measured Value**	**Required Value 1.65[1.0+0.3(1-P)]**	**Pass/Fail**
18.3%	1.619	< 2.054	Pass
71.0%	1.574	< 1.794	Pass
99.9%	1.540	< 1.650	Pass

TABLE 5

Salem Unit 1 Cycle 15 Maximum Heat Flux Hot Channel Factor ($F_Q(z)$) as a Function of INCORE Map Power Level Near BOL			
Test Conditions (Core Power Level)	**Measured Value**	**Required Value***	**Pass/Fail**
18.3%	2.0473	< 4.5480	Pass
71.0%	1.8908	< 3.2704	Pass
99.9%	1.8261	< 2.2763	Pass

* Corresponds to limit at axial height with most limiting F_Q value.

TABLE 6

Salem Unit 1 Cycle 15 Maximum Computed Radial Peaking Factor (F_{xy}) as a Function of INCORE Map Power Level and Rodded Condition for Surveilled Core Axial Heights			
Test Conditions (Core Power Level)	**Measured Value**	**Required Value**	**Pass/Fail**
18.3%	Rodded = N/A	Rodded = N/A	Pass
	Unrodded = 1.7370	Unrodded = < 2.229	
71.0%	Rodded = N/A	Rodded = N/A	Pass
	Unrodded = 1.7137	Unrodded = < 1.946	
99.9%	Rodded = N/A	Rodded = N/A	Pass
	Unrodded = 1.6817	Unrodded = < 1.791	

From the beginning of Salem Unit 1's fifteenth cycle of operation through June 26, 2001, the core was operated at a maximum licensed rated thermal power level of 3411 MWt. On June 27, 2001 (approximately 1250 MWD/MTU cycle burnup) the licensed rated thermal power level for Salem Unit 1 was increased from 3411 MWt to 3459 MWt (a 1.4% increase). INCORE flux map results were obtained at equilibrium conditions prior to and soon after the power uprate program was implemented. The INCORE flux map results were reviewed to assure the measured change in certain core physics parameters, between pre and post power uprate conditions, were consistent with prediction. In addition, the INCORE flux map results obtained at the uprated power level were compared to Technical Specification limits to assure compliance. Table 7 below shows a comparison between the predicted and measured change in certain core physics parameters for the pre-uprate and post-uprate at Salem Unit 1. The pre-uprate results are at a cycle burnup of 208 MWD/MTU, while the post-uprate results are at a cycle burnup of 1818 MWD/MTU. All parameters include appropriate uncertainties.

TABLE 7

Comparison of the Change in Measured and Predicted Core Physics Results Between Pre and Post Power Uprate Conditions for Salem Unit 1 Cycle 15

Parameter	Design Value Pre-Uprate	Design Value Post-Uprate	Change in Design Value Pre to Post Uprate	Measured Value Pre-Uprate	Measured Value Post-Uprate	Change in Measured Value Pre to Post Uprate
Boron	1211	1237	+26	1213	1242	+29
$F_{\Delta H}$	1.509	1.503	-0.40%*	1.540	1.561	1.36%**
F_Q	1.728	1.828	5.79%*	1.8379	1.9260	4.79%**
F_{xy}	1.647	1.630	-1.03%*	1.6817	1.7096	1.66%**
Axial Offset (AO)	0.44	-2.11	-2.55%***	1.692%	0.585%	-1.11%***

* Change in Design Value Pre to Post Uprate = [(Design Value Post-Uprate – Design Value Pre-Uprate) / Design Value Pre-Uprate]*100

** Change in Measured Value Pre to Post Uprate = [(Measured Value Post-Uprate – Measured Value Pre-Uprate) / Measured Value Pre-Uprate]*100

*** For Axial Offset, the Change in Design Value Pre to Post Uprate = [Design Value Post-Uprate – Design Value Pre-Uprate] additionally, the Change in Measured Value Pre to Post Uprate = [Measured Value Post-Uprate – Measured Value Pre-Uprate]

The INCORE flux map results obtained at the uprated power level (3459 MWt) were also compared to Technical Specification limits to assure compliance. Tables 8, 9, and 10 compare measured peaking factor results against Technical Specification limits. All Technical Specification limits were met at the uprated power level.

TABLE 8

Salem Unit 1 Cycle 15 Nuclear Enthalpy Rise Hot Channel Factor ($F_{\Delta H}$) at 1818 MWD/MTU, HFP (3459 MWt), ARO, Equilibrium Poison Conditions			
Test Conditions (Core Power Level)	**Measured Value**	**Required Value 1.65[1.0+0.3(1-P)]**	**Pass/Fail**
100%	1.561	< 1.650	Pass

TABLE 9

Salem Unit 1 Cycle 15 Maximum Heat Flux Hot Channel Factor ($F_Q(z)$) at 1818 MWD/MTU, HFP (3459 MWt), ARO, Equilibrium Poison Conditions			
Test Conditions (Core Power Level)	**Measured Value**	**Required Value***	**Pass/Fail**
100%	1.9260	< 2.40	Pass

*Corresponds to limit at axial height with highest F_Q value.

TABLE 10

Salem Unit 1 Cycle 15 Maximum Computed Radial Peaking Factor (F_{xy}) at 1818 MWD/MTU, HFP (3459 MWt), ARO, Equilibrium Poison Conditions			
Test Conditions (Core Power Level)	**Measured Value**	**Required Value**	**Pass/Fail**
100%	Rodded = N/A	Rodded = N/A	Pass
	Unrodded = 1.7096	Unrodded = < 1.790	