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PSEG
Nuclear LLC

United States Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555

Cycle 15 Startup Test Report Summary
Salem Generating Station - Unit 2
Facility Operating License DPR-75
Docket No. 50-311

Enclosed for your information is the Public Service Electric and Gas (PSEG) Salem Unit 2 Cycle 15 Startup Test Report. This report is submitted in accordance with Technical Specification Sections 6.9.1.1 and 6.9.1.3.

Technical Specification 6.9.1.1 requires testing data to be transmitted to the NRC within 90 days following: 1) receipt of an operating license, 2) an amendment to the license following a planned increase in power level, 3) installation of fuel that has a different design or has been manufactured by a different supplier, and 4) modifications that may have significantly altered the nuclear, thermal, or hydraulic performance of the plant.

During the most recent Salem Unit 2 Refueling Outage, 2R14, the reactor vessel head was replaced. In addition, four Control Rod Drive Mechanisms (CRDMs) were relocated. As a result of these modifications that have the potential to "significantly alter the nuclear, thermal, or hydraulic performance of the plant", PSEG is transmitting startup physics testing results, Beginning of Cycle (BOC) power ascension results, and Reactor Coolant System (RCS) flow measurement results for Salem Unit 2 Cycle 15. A summary of these results can be found in Attachment 1.

Test data was reviewed in accordance with the applicable procedures to verify compliance with Technical Specification limits and were found satisfactory.

Should you have any questions regarding this submittal, please contact Tom Ross at (856) 339-1222.

Sincerely,

Thomas P. Joyce
Site Vice President
Salem Units 1 and 2

IE24

Attachment (1)

cc Mr. S. J. Collins, Administrator - Region I
U. S. Nuclear Regulatory Commission
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U. S. Nuclear Regulatory Commission
ATTN: Mr. Stewart Bailey, Project Manager – Salem and Hope Creek Stations
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USNRC Senior Resident Inspector - Salem (X24)

Mr. K. Tosch, Manager IV
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PO Box 415
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ATTACHMENT 1
SALEM UNIT 2 CYCLE 15 STARTUP PHYSICS AND RCS FLOW TEST REPORT

Salem Unit 2 began its fifteenth cycle of operation on May 11, 2005, when it was synchronized to the grid and will complete this cycle of operation in the Fall of 2006. The burnup at the end of Cycle 15 is predicted to be approximately 19550 MWD/MTU. During the recent refueling outage (2R14), the reactor vessel head was replaced. In addition, four Control Rod Drive Mechanisms (CRDMs) were relocated (see letter from PSEG Nuclear to NRC, LR-N04-0369, 08/19/2004).

The feed fuel region, designated as Region 17, consists of 40 assemblies enriched to 4.003 w/o U^{235} and 36 assemblies enriched to 4.399 w/o U^{235}. This feed region also uses 432 fresh wet annular burnable absorber (WABA) rods and 8480 1.35X (2.1125 mg B^{10}/in) integral fuel burnable absorber rods. Region 17 is the fifth Salem Unit 2 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, a protective bottom grid (a debris mitigation feature), and thicker guide tubes and instrument tubes relative to the previous V5H design.

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,
5. RCS flow measurement,

Salem Unit 2 Cycle 15 was the fifth cycle at Salem Unit 2 to utilize the DRWM bank measurement technique. Westinghouse used the DRWM data found in this attachment to confirm the validity of the original sensitivity study performed in WCAP-13360, which provides further evidence that continued use of DRWM with the new Salem Unit 2 Rod Control Cluster Assemblies (RCCA) pattern, remains appropriate.

Critical boron, bank worth, and temperature coefficient measurement results are provided in Tables 1, 2, and 3, respectively, where the comparisons are made to either the review or acceptance criteria or both. The review criteria provide the expected range of the measured to predicted comparisons. The acceptance criteria are based on Technical Specification limits related to maximum reactivity anomaly for shutdown margin confirmation and the least negative moderator temperature coefficient. The rodworth acceptance limit is based on the Reload Safety Evaluation assumption related to the rodworth uncertainty assumed for the cycle specific shutdown margin confirmation. All review and acceptance criteria limits have been met for Salem 2 Cycle 15 startup physics testing.

TABLE 1

Salem Unit 2 Cycle 15 Beginning of Life (BOL), Hot Zero Power (HZP), All-Rods-Out (ARO), Critical Boron Concentration Measurement			
Measured Value (ppm)	**Design Value (ppm)**	**Review Criteria Range (+/- 50 ppm)***	**Pass/Fail**
1783	1789	1739 to 1839	Pass

*Acceptance Criteria of +/-1000 pcm (+/-156 ppm) also met

TABLE 2

Salem Unit 2 Cycle 15 Dynamic Rod Worth Measurement (DRWM) Results				
Rod Bank	**Measured Worth (pcm)**	**Design Value (pcm)**	**Review Criteria**	**Pass/Fail**
D	712.6	695.3	± 15%	Pass
C	856.5	852.6	± 15%	Pass
B	866.2	886.7	± 15%	Pass
A	552.5	541.6	± 15%	Pass
SD	404.2	382.2	± 15%	Pass
SC	397.3	384.7	± 15%	Pass
SB	943.2	935.0	± 15%	Pass
SA	669.8	645.0	± 15%	Pass
Total	5402.3	5323.1	± 8%**	Pass

** Acceptance criteria of >0.9 times Design Total Rodworth (4791 pcm) also met

TABLE 3

Salem Unit 2 Cycle 15 BOL HZP ARO Isothermal Temperature Coefficient (ITC) Measurement and Inferred Most Limiting Moderator Temperature Coefficient (MTC)	
Parameter	
Average ITC Measured Value (pcm/°F)	-4.78
ITC Design Value (pcm/°F)	-4.24
Review Criteria Range (± 2 pcm/°F)	-6.24 to -2.24
Pass/Fail	Pass
MTC Inferred Value* (pcm/°F)	-1.75
MTC Acceptance Value (pcm/°F)	< 0
Pass/Fail	Pass

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

Due to the satisfactory completion of startup physics testing for Salem Unit 2 Cycle 15, power ascension was commenced. 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, which met the Technical Specification limits for the flux map power level. The hot-full-power (HFP) flux map was taken on May 16, 2005. This flux map showed acceptable margin to the peaking factor limits, with 10.9% margin to the $F_{\Delta H}$ limit, with 11.1% margin to the F_{XY} limit, and 26.4% margin to the F_Q Technical Specification limit.

TABLE 4

Salem Unit 2 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**
30.0%	1.575	≤ 1.997	Pass
45.0%	1.543	≤ 1.922	Pass
99.2%	1.473	≤ 1.654	Pass

TABLE 5

Salem Unit 2 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**
30.0%	1.946	≤ 4.701	Pass
45.0%	1.831	≤ 4.581	Pass
99.2%	1.780	≤ 2.419	Pass

* Corresponds to limit at axial height with the lowest F_Q margin.

TABLE 6

Salem Unit 2 Cycle 15 Most Limiting Measured Radial Peaking Factor (F_{XY}) as a Function of INCORE Map Power Level and Rodded Condition for Surveillance Core Axial Heights Near BOL			
Test Conditions (Core Power Level)	**Measured Value**	**Required Value**	**Pass/Fail**
30.0%	Rodded = 1.856	Rodded ≤ 2.577	Pass
	Unrodded = 1.652	Unrodded ≤ 2.118	
45.0%	Rodded = 1.808	Rodded ≤ 2.481	Pass
	Unrodded = 1.627	Unrodded ≤ 2.039	
99.2%	Rodded = N/A	Rodded ≤ N/A	Pass
	Unrodded = 1.559	Unrodded ≤ 1.754	

The Reactor Coolant System (RCS) Flow Rate is measured once per cycle via a precision heat balance measurement in accordance with Technical Specification 4.2.5.2. Because the new reactor vessel head could potentially change the RCS flow characteristics, it is prudent to compare the total RCS flow before and after the reactor vessel head was replaced. This comparison is documented in Table 7 and shows that the total RCS flow rate continues to be above the Technical Specification limit. The slight decrease in total RCS flow from Cycle 14 to Cycle 15 of -1.5% is within the flow measurement uncertainty of ± 2.4%. This decrease may also be attributed to a slight increase in the amount of steam generator tube plugging performed during the outage.

TABLE 7

Comparison of the Change in Measured Reactor Coolant System (RCS) Flow Before and After the Replacement of the Reactor Vessel Head During Refueling Outage 2R14				
Parameter	**Measured Salem 2 Cycle 14**	**Measured Salem 2 Cycle 15**	**TS Limit* (gpm)**	**Change in Measured Value Pre- and Post Rx Vessel Head Replacement**
Precision Total RCS Flow Measurement (gpm)	366,165	360,709	≥341,000	-1.5%

* Includes a 2.4% flow uncertainty plus a 0.1% measurement uncertainty due to feedwater venturi fouling.

The following tests were satisfactorily completed with the as left condition for control rods meeting the acceptance criteria provided by the applicable Salem surveillance procedures. These surveillances are contained in the Salem TS Section 4.1.3, Reactivity Control Systems and UFSAR Table 14.3-1:

- Rod Position Indication - Hot Full Flow Calibration
- Rod Control System – CRDM Current Testing
- Rod Drop Time
- Rod Withdrawals

In addition, a Visual Examination for leakage (VT-2), at normal Reactor Coolant System operating temperature and pressure, was successfully completed on the Salem Unit 2 replacement Reactor Vessel Head.