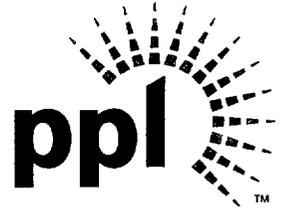


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**OCT 12 2001**

U. S. Nuclear Regulatory Commission  
Attn: Document Control Desk  
Mail Station OP1-17  
Washington D.C. 20555

**SUSQUEHANNA STEAM ELECTRIC STATION  
UNIT 2 FEEDWATER FLOW METER POWER  
UPRATE STARTUP REPORT  
PLA-5375**

**Docket No. 50-388**

The purpose of this letter is to transmit the Susquehanna Steam Electric Station Unit 2 "Feedwater Flow Meter Power Uprate Startup Report" pursuant to Section 4.5.1 of the Susquehanna Steam Electric Station Technical Requirements Manual.

Please contact Mr. M. H. Crowthers at (610) 774-7766, if there are any questions concerning this submittal.

Sincerely,

A handwritten signature in black ink, appearing to be "R. G. Byram", written over a circular stamp or mark.

R. G. Byram

Attachment

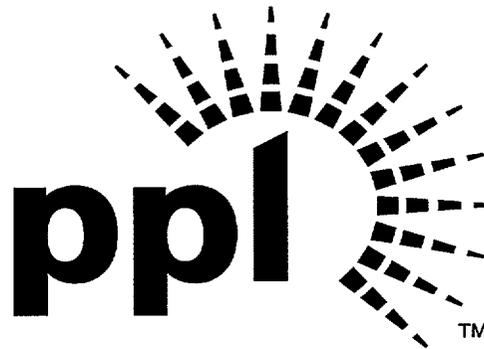
Copy: NRC Region I  
Mr. S. L. Hansell, NRC Sr. Resident Inspector  
Mr. R. G. Schaaf, NRC Project Manager

IE 26.

**PPL Susquehanna, LLC**

**Susquehanna Steam Electric Station**

**Unit 2**



**Feedwater Flow Meter Power Uprate  
Startup Report**

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Sections of this report were prepared by:

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T. VanVreede	Senior Engineer (Project & Modification Services: Project Manager)

## **1.0 Introduction**

### **1.1 Report Abstract**

This Feedwater Flow Meter Project Uprate Startup Report is written based on the requirements of the Susquehanna Technical Requirements Manual (TRM) Section 4.5.1. It is a summary report of power escalation testing that was performed following issuance of Amendment No. 169 to License No. NPF-22, which approved a 1.4 percent increase in the thermal power level on Unit 2.

Per TRM 4.5.1.2, this report addresses each of the startup tests conducted as part of this uprate and includes a description of the measured values of the operating conditions or characteristics obtained during the test program and a comparison of these values with design predictions and specifications. In addition, Section 3.2 states why other testing included in FSAR Chapter 14, Initial Test Program, was not performed as part of this uprate.

Per TRM 4.5.1.3, this report is being submitted within 90 days following completion of the Power Uprate Test Program, which was conducted on July 13, 2001.

### **1.2 Susquehanna Power Uprate Design Parameters**

Susquehanna Unit 2 is a General Electric BWR/4. The original design power rating for the unit was 3439 MWt. It was originally licensed for operation at 3293 MWt. A previous 4.5% power uprate increased the licensed operating Rated Thermal Power to 3441 MWt. This uprate was based on a designed Maximum Power level of 3510 MWt and includes a 2% power margin required per Appendix K to Title 10 Part 50 of the Code of Federal Regulations.

This 2% margin is intended to allow a standard 95% confidence interval that the design rating of the plant will not be exceeded, and was based on evaluations of the existing instrumentation. A Leading Edge Flow Meter (LEFM  $\checkmark^{\text{TM}}$ ) supplied by Caldon, Inc., was installed in Unit 2 during the Spring 2001 outage as a more accurate means for measuring feedwater

flow. Feedwater flow is used as an input to the core thermal power calculation. The increased accuracy of the LEFM<sup>✓</sup><sup>TM</sup> instrument results in an increased accuracy of the calorimetric calculation (less than  $\pm 0.6\%$  of core thermal power, based on a standard 95% confidence interval evaluation) versus the previously installed venturi flow instrument (2.0% of core thermal power). This improvement in uncertainty in the core thermal power calculation allows operation at 3489 MWt with no decrease in the confidence level that the actual operating power level is less than the power level required to be assumed in the ECCS accident analyses by 10 CFR 50, Appendix K.

The improved core thermal power measurement accuracy obviates the need for the full 2% power margin required to be assumed in Appendix K analysis, thereby allowing an increase in the thermal power available for electrical generation. The LEFM<sup>✓</sup><sup>TM</sup> instrumentation improves the certainty that actual reactor core thermal power remains at or below the value assumed in the Appendix K analyses.

All design parameters remain within the analysis previously conducted to increase the maximum design power to 3510 MWt. A design evaluation has concluded that the increased flow, temperatures, and pressures are within the capacities of supporting systems and components.

### **1.3 Power Uprate Test Program**

The power uprate implementation commenced with the unit operating at the previous 100% level of 3441 MWt and culminated with the unit operating in steady state at the new 100% power level of 3489 MWt. Compared to the Initial Test Program, and to the previous Power Uprate Test Program, this power uprate requires only limited startup tests. The tests required are described in Section 10.7 "Summary of Start-Up Tests" of the SSES Power Uprate Topical Report NE-2000-001N Rev. 1 previously submitted to the NRC in PLA-5276 (February 5, 2001) and as modified by PLA-5300 (May 22, 2001). These tests, which are described in FSAR Chapter 14.3 and Section 3.0 of this report are listed below:

- Pressure Regulator Test
- Recirculation System Flow Calibration
- Steady State Data Collection
- Main Steam Line Rad Monitor

In addition, other Unit 2 start-up tests were performed as part of our normal General Operating Procedures, Reactor Engineering Test Procedures, and Surveillances.

No instruments required recalibration for the increased core thermal power operation, therefore, specific testing of recalibrated instruments was not required.

In accordance with the Susquehanna procedure program, a special test procedure was developed to conduct the power uprate start up testing. A detailed review by the Station's Plant Operations Review Committee (PORC) was performed on the governing test procedure, and on each of the specific test procedures. The Test Directors were from the Nuclear Systems Engineering (NSE) group and met the requirements for being a Test Director as established by station procedures.

Issues and conditions found during the testing were identified and tracked in accordance with the Condition Report process.

The conduct of the startup test program for this uprate was considered a "Special, Infrequent or Complex Test/Evolution." Consequently, the testing had additional Management controls and oversight.

Testing of the LEFM device itself was previously completed, and therefore, is not within the scope of this report.

#### **1.4 Power Uprate Test Program Scope**

The Power Uprate Test Program was developed by reviewing the following documents:

- FSAR Chapter 14.2
- FSAR Chapter 14.3
- PLA-5726 dated February 5, 2001
- PLA-5300 dated May 22, 2001

The results of the Test Program were used to determine the acceptability of operating the unit at the uprated power level.

Existing plant programs and procedures were used to control the startup test program.

## 2.0 Summary

The Susquehanna Unit 2 Power Uprate Test Program was performed to assure that the feedwater LEFM<sup>✓</sup>™ flow measurement modification was successful. The test program was implemented according to an established Station Schedule, with minor test exceptions. The test program established an overall increase in net electrical output that was slightly greater than anticipated. The plant equipment responded as expected to the increases in Reactor Power, and demonstrated that the unit can operate safely at the uprated power conditions.

Key events related to the Power Uprate included:

- |                    |  |
|--------------------|--|
| March - April 2001 | The LEFM <sup>✓</sup> ™ system is installed in the outage and placed in an operating but not operable condition for monitoring, testing, and adjustment. |
| June 5             | LEFM <sup>✓</sup> ™ placed into operable status, maintained power at 3441 MWt.   |
| July 6             | NRC issued Amendment No. 169 to License No. NPF-22.  |
| July 11            | Conducted pre- startup test program briefing with all parties involved in uprate.  |
| July 12            | Commenced power uprate startup test program.   |
| July 13            | Power uprate startup test program completed.   |

## 3.0 Power Uprate Test Procedure Abstracts And Test Results

### 3.1 Test Abstracts

The following tests were performed to assure adequate performance at the increased core thermal power conditions:

## **Pressure Regulator Test**

### **Purpose:**

The purpose of this test was to confirm that pressure regulation performance and margins are acceptable.

### **Results:**

The following results were achieved by this test:

- The Electro-Hydraulic Control (EHC) System provided a fast and stable response to pressure and steam disturbances.
- The Main Turbine Control Valves (CV) 1, 2 and 3 were full open with CV4 modulating system pressure at ~ 95 to 100% Reactor Power.
- It was confirmed from a review of the Steam Line Flows that no Limit Cycles occurred which produced a steam flow magnitude in excess of  $\pm 0.5\%$  of rated steam flow.
- It was confirmed from extrapolated data that adequate margins to scram exist for Peak Neutron Flux, Peak Vessel Pressure, Heat Flux and Peak Steam Line Flows.
- The variation in Incremental Flow Regulation was confirmed to be acceptable in the range of 85-99%. The variation in Incremental Flow Regulation in the range of 85-97% did not meet acceptance criteria and was documented in a Condition Report. This criterion was later dispositioned to be acceptable for that range.
- A review of Feedwater Flow Test data accumulated during the entire testing period indicated that no 3<sup>rd</sup> Harmonic frequencies exist in the EHC System which would cause pressure oscillations in the Control Valve Hydraulic System. This also confirmed that the installed 2<sup>nd</sup> Steam Line Resonance Compensator (SLRC) settings did not require further adjustment beyond their initial settings.
- The final Load Limit setting was returned to the as found condition, as it was determined that the present setting was acceptable.
- The Control Valve Total Position did not exceed the predicted by more than 1.5% and met the acceptance criteria.

## **Recirculation System Flow Calibration**

### **Purpose:**

The purpose of this calibration was to perform a complete calibration of the installed recirculation system flow instrumentation. This includes specific signals to the plant process computer.

### **Results:**

The Core Flow Calibration was completed at 3480 MWt with core flow at 98.5 Mlbm/Hr. All of the following Acceptance Criteria were satisfied.

- The difference between Indicated Jet Pump Loop flows and Calculated Jet Pump Loop flows shall not be greater than 2%.
- The difference between calculated Calibrated Jet Pump Loop flows and indicated total Core Flow shall not be greater than 3%.
- The difference between Indicated Total Core Flow and Calculated Total Core Flow shall not be greater than 1%.

## **Steady State Data Collection**

### **Purpose:**

The purpose of this data collection effort was to obtain required data for evaluation of plant parameters at various power levels. This data was necessary:

- To identify if there are significant inconsistencies between actual and predicted parameters,
- To evaluate thermal performance monitoring activities, and
- For fuel cycle specific bench marking of the training simulator.

During the power ascension from 3097 MWt to 3489 MWt Reactor power, data was collected to monitor the response of various systems and to calculate BOP performance parameters.

## **Results**

Plant Data was acquired at power level plateaus of approximately 3097 MWt, 3441 MWt, 3465 MWt, and 3489 MWt power. Select performance parameters were evaluated at each plateau and extensive PICSY data files were collected for use in future data analysis and SSES Simulator use.

All evaluated plant parameters above 3441 MWt fell within the expected tolerance bands.

### **Main Steam Line Radiation Monitor**

#### **Purpose:**

The purpose of this data collection effort was to obtain data to determine if the setpoint of the main steam line radiation monitor needed to be adjusted after power was increased to the uprated 100% power level.

#### **Results:**

Main Steam Line radiation monitor data was collected on July 19, 2001, following an isolation of the Hydrogen Water Chemistry injection system with the plant operating at the new 100% rated thermal power. It was determined that no main steam line radiation monitor trip setpoint adjustments were necessary.

## **3.2 Initial Startup Tests Not Re-Performed**

An Engineering analysis (SSES Power Uprate Licensing Topical Report NE-2000-001N Rev. 1) was performed for each system to determine the impact of the power uprate. As documented in the analysis, the system changes as a result of this uprate did not challenge the tests previously conducted as part of the Initial Test Program, previous Power Uprate Test Program, or surveillance test programs. Therefore, only those tests identified in Section 3.1 were required to be conducted.