TRM 6.1

Progress Energy

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

H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2
DOCKET NO. 50-261/LICENSE NO. DPR-23

CYCLE-22 STARTUP TEST REPORT

Ladies and Gentlemen:

Following Refueling Outage-21, H. B. Robinson Steam Electric Plant (HBRSEP), Unit No. 2, implemented a power uprate of 1.7% as approved by License Amendment No. 196.

Technical Requirements Manual 6.1, "Startup Report," requires submittal of a summary report of plant startup and power escalation testing following an amendment to the license involving a planned increase in power level, installation of fuel that has a different design or has been manufactured by a different fuel supplier, or modifications that may have significantly altered the nuclear, thermal, or hydraulic performance of the plant.

The attachment summarizes the relevant testing conducted during startup and power escalation to demonstrate satisfactory plant performance at the new licensed power level of 2339 megawatts thermal. Detailed test data are available on site.

If you have any questions concerning this matter, please contact me.

Sincerely,

C. T. Baucom
Supervisor – Licensing/Regulatory Programs

IE26

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JMG/jmg

Attachment: H.B. Robinson Steam Electric Plant, Unit No. 2, Cycle-22 Startup Test Report

c: Mr. L. A. Reyes, NRC, Region II
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NRC Resident Inspectors

H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2

CYCLE-22 STARTUP TEST REPORT

Background

Development of the H. B. Robinson Steam Electric Plant (HBRSEP), Unit No. 2, power uprate startup testing program was based on the scope of the modifications performed and industry experience from startup testing following 10 CFR 50, Appendix K power uprates.

Plant modifications during Refueling Outage (RO)-21 associated with the power uprate included:

a) Modification of the Feedwater (FW) Regulating Valves (FRV) to increase their flow capacity;
b) Replacement of the High Pressure (HP) Turbine rotor;
c) Installation of the Caldon Leading Edge Flow Meter (LEFM) Check Plus™ FW flow measurement system;
d) Replacement of the shell-side relief valves for the #3, #4, #5 and #6 FW heaters; and,
e) Rescaling of various control and protection instrumentation to reflect operation at the new licensed power level of 2339 megawatts thermal (MWt).

During reactor startup and power ascension to the new licensed power level, data were collected and testing was performed at selected plateaus to compare plant response to design predictions. Power was restricted to the previous licensed power level of 2300 MWt so that operating performance parameters could be projected for the uprated power conditions before the previous full power rating was exceeded. Steady-state data were evaluated against design predictions, and any identified discrepancies resolved prior to proceeding with power ascension.

Power Uprate Testing

1. Feedwater Control System/Feedwater Regulating Valve Testing

The FW System Regulating Valves (FRV) were modified during RO-21 to increase their flow capacity in order to ensure adequate FW flow under power uprate conditions.

Post-modification testing of the FRVs included monitoring of the FW System during power ascension and collection of data at various power levels to verify that the flow characteristics of the valves met the design requirements. Steam Generator (SG) level perturbation testing was performed at approximately 45% power and approximately 87% power to verify that the FW Control System with the modified FRVs responded correctly to changes in SG level. Post-modification testing verified that the FW Control System and FRVs met the design requirements for operation at the uprated power level.

2. High Pressure Turbine Testing

The High Pressure (HP) Turbine rotor was replaced during RO-21 with a new design that has improved efficiency and improved structural and material properties. The Turbine Electro-Hydraulic Control (EHC) System was also modified to open all four Turbine Governor Valves simultaneously to provide full arc admission of steam to the HP Turbine, as opposed to the partial arc admission utilized with the previous HP Turbine.

Selected Turbine parameters, such as vibrations, pressures and temperatures, were closely monitored during Turbine startup and synchronization to the grid, and at selected power levels during power ascension.

Proper operation of the EHC System was verified by monitoring Turbine Governor Valve position and other EHC System parameters during Turbine startup and synchronization to the grid, and at selected power levels during the power ascension.

Performance testing was also performed to verify heat balance predictions at the uprated power conditions. Most of these parameters met the vendor acceptance criteria at the various power plateaus. Parameters outside of original vendor acceptance criteria were evaluated to be within acceptable design margins.

3. Feedwater Ultrasonic Flow Measurement System Testing

A Caldon LEFM Check Plus™ FW flow measurement system was installed during RO-21. The improved accuracy and reduced uncertainty associated with the LEFM Check Plus™ system was the basis for the HBRSEP, Unit No. 2, Appendix K power uprate. By letter dated May 16, 2002, HBRSEP, Unit No. 2, stated that a core power level measurement uncertainty of 0.3% power was determined to be a bounding value for calorimetric calculations utilizing the Caldon LEFM Check Plus™ system.

Prior to exceeding the previous licensed power level of 2300 MWt, data were collected and evaluated to verify that the total calorimetric uncertainty was less than or equal to the 0.3% value. All acceptance criteria for the testing were met, and the 0.3% core power level measurement uncertainty was determined to be bounding.

4. Secondary Plant Parameter and Performance Testing

By letter dated May 16, 2002, HBRSEP, Unit No. 2, stated that the evaluation of FW heater operation at the previous licensed power level and under power uprate conditions identified some FW heater components that marginally exceeded the flow guidelines recommended by the Heat Exchanger Institute (HEI). In each case, flow rates marginally exceeded the HEI guidelines at the previous licensed power level of 2300 MWt and were predicted to also marginally exceed the HEI guidelines as a result of the power uprate. Many of the FW heater components that were determined to exceed HEI guidelines were measured and inspected under the provisions of the Flow Accelerated Corrosion (FAC) program prior to RO-21. These measurements and inspections identified no adverse effects for the FW heater components operating above the HEI guidelines. In the May 16, 2002, letter, HBRSEP, Unit No. 2, committed to inspect those FW heater components that exceeded the HEI guidelines and which had not been recently measured and inspected. These measurements and inspections were performed during RO-21, and no adverse effects were identified for the FW heater components operating above the HEI guidelines. The information from the RO-21 inspections, as well as the previous inspections, have been incorporated into the FAC program. Based on the inspection data from RO-21 and previous outages, operation at the previous licensed power level with some FW heater components marginally exceeding the HEI guidelines produced no adverse consequences. Due to only a slight increase in FW heater flow, and favorable experience with the FW heater components under the previous operating conditions, it has been evaluated that there will be no adverse affect on the FW heaters caused by the power uprate.

In the May 16, 2002, submittal, HBRSEP, Unit No. 2, identified that the shell-side relief valves for FW heaters 3 through 6 had insufficient capacity according to the HEI guidelines. In accordance with commitments in the May 16, 2002, letter, the shell-side relief valves for FW heaters 3 through 6 were replaced during RO- 21 with relief valves that meet the HEI guidelines.

Key secondary plant parameters were monitored during power ascension. Data were collected at 90%, 98.3%, and 100% of the uprated power for comparison to the predicted values obtained from design documents. Performance testing was also performed to verify heat balance predictions at the uprated power conditions.

The majority of the monitored parameters met their acceptance criteria. Parameters that did not meet their design predictions were evaluated and found to be acceptable.

Walk-downs of the Balance of Plant (BOP) systems were performed by the System Engineers following the power increase to the new licensed power level (2339 MWt) to identify any excessive pipe vibration and movement or other system abnormalities. No problems were identified by these walk-downs.

5. Electrical and Miscellaneous Heat Exchanger Testing

This testing was performed to verify adequate performance of the Isophase Bus Duct Coolers, Main Generator Hydrogen Cooling System, Exciter Cooling System, and 480 VAC and 4 KV motors. The inlet and outlet temperatures, as well as various other parameters of the Isophase Bus Duct Coolers, Main Generator Hydrogen Coolers, and Exciter Coolers, were monitored at 50%, 90%, 98.3%, and 100% of the uprated power. These coolers performed well during the power ascension and met their design requirements.

The operating currents of affected 480 VAC and 4 KV motors were monitored at various plateaus during ascension to 100% uprated power. The 480 VAC motors for the Service Water Pumps were monitored because these pumps supply cooling water to both safety-related and BOP heat exchangers, and therefore were affected by the power uprate. The 4 KV motors monitored included the Condensate Pumps, Heater Drain Pumps, and Main FW Pumps. These motors were found to operate within acceptable limits.

6. Nuclear Steam Supply System (NSSS) Data Collection

The objective of this monitoring was to collect NSSS data during power ascension to allow comparison of NSSS parameters to acceptance criteria from design documents. Data were collected at 30%, 50%, 70%, 90%, 98.3%, and 100% of the uprated power. Parameters monitored included Reactor Coolant System temperatures, Pressurizer pressures, and steam line pressures.

These parameters were verified to be within the bounds of the power uprate evaluation.

7. Startup Physics Testing

The objectives of the Startup Physics Tests were to demonstrate that during reactor operation the measured core physics parameters would be within the assumptions of the Updated Final Safety Analysis Report (UFSAR) accident analyses, within the limits of the plant's Technical Specifications (TS), and within the limits of the Cycle-22 reload analysis. The testing program consisted of a series of tests performed at various stages of plant startup, including criticality, low power physics testing, and during power ascension.

Based on analysis of the startup physics testing results, it was determined that the measured core parameters were within the Cycle-22 design calculations. Measurements of nuclear characteristics and checks of related instrumentation associated with the power uprate met acceptance criteria limits and the requirements of the UFSAR, Core Operating Limits Report, and TS.

A deviation between the Excore Nuclear Instrumentation System Axial Flux Difference (NIS AFD) indication and the incore axial power distribution measurements was observed, but was determined to be the result of a planned replacement of the part length shield assemblies. The Excore NIS AFD indication was recalibrated to match the incore power distribution measurements as required by TS Surveillance Requirement 3.3.1.3.