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T.S. 6.9.1.1

August 22, 2011

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

Limerick Generating Station, Unit 2
Facility Operating License Nos. NPF-85
NRC Docket No. 50-353

Subject: LGS Unit 2 Summary Report for MUR Power Change

The LGS Unit 2 Summary Report for Measurement Uncertainty Recapture (MUR) Project which was implemented on May 24 for Unit 2 following receipt of NRC License Amendment dated 4/8/11. Power level for Unit 2 was raised from 3458 MWt to 3515 MWt (1.65%).

There are no commitments contained in this letter.

If you have any questions or require additional information, please do not hesitate to contact us.

Sincerely,

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Vice President - LGS
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Enclosure: Limerick Generating Station Units 2 Summary Report for MUR Power Change

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Limerick Generating Station

UNIT 2
CYCLE 12
STARTUP REPORT

SUBMITTED TO
THE U.S. NUCLEAR REGULATORY COMMISSION
PURSUANT TO
FACILITY OPERATING LICENSE NPF-85

August
2011

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1.0 Summary

This Startup Test Report is submitted to the Nuclear Regulatory Commission (NRC) in accordance with the requirements of Limerick Generating Station (LGS) Technical Specifications (TS) 6.9.1.1 through 6.9.1.3. The report summarizes the startup testing performed on LGS Unit 2 following implementation of MUR Thermal Power Optimization (TPO) Uprate during Cycle 12. The uprate was implemented in accordance with Amendment 164 of the Facility Operating License No. NPF-85.

The result of MUR Uprate is an increase in reactor power equal to 1.65% of the original rated thermal power. All testing identified within the LGS Updated Final Safety Analysis Report (UFSAR) Chapter 14.2 is addressed and evaluated for applicability to the change to the licensed thermal power as required by Technical Specifications. Test applicability was determined in accordance with Project Task Report "Exelon Nuclear Limerick Units 1 and 2 Thermal Power Optimization" Task T1005: Startup Test Specifications, Rev 0.

The new 100% power (3515 MWth/1175 MWe) was first achieved on May 25, 2011.

There was one Special Procedure (SP) written and performed in combination with various Surveillance Tests (STs) described in this report, to successfully achieve the new rating. No adjustments were required to control systems. All systems performed in a stable manner during the transient testing. The unit is operating well at rerated conditions.

1.1 Purpose

This Startup Test Report summarizes the testing performed on Limerick Generating Station (LGS) Unit 2 following the implementation of MUR Uprate. The result of MUR Uprate is an increase in reactor power equal to 1.65% of the original rated thermal power. All testing identified within the LGS Updated Final Safety Analysis Report (UFSAR) Chapter 14.2 was addressed and evaluated for applicability to this increased licensed power rating as required by Technical Specification 6.9.1.1. The Uprated Startup Test Program Plan documents these evaluations and describes in detail the tests performed for MUR TPO Uprate. Each test performed for MUR TPO Uprate is described herein, including the test purpose, description, acceptance criteria and results. This report is submitted in accordance with the requirements of Technical Specification 6.9.1.1.

1.2 Acceptance Criteria

Level 1 Acceptance Criteria is associated with plant safety. If a Level 1 criterion is not satisfied, the plant will be put in a suitable hold condition judged to be satisfactory and safe until resolution is obtained. Tests compatible with this hold condition may be continued. Following resolution, applicable tests must be repeated to verify that the requirements of Level 1 criteria are now satisfied.

Level 2 criteria are associated with expectations relating to the performance of systems. If a level 2 criterion is not satisfied, operating and test plans would not necessarily be altered. Investigation of the measurements and the analytical techniques used for predictions would be started.

Any acceptance criteria failure must be documented on a Test Exception Report (TER).

1.3 Testing Requirements

Each of the tests listed in LGS UFSAR Chapter 14.2 were evaluated for applicability for the MUR TPO Uprate as designated in the UFSAR. Testing was performed and results were evaluated in accordance with the Project Task report "Exelon Nuclear Limerick Units 1 and 2 Thermal Power Optimization" Task T1005: Startup Test Specifications, Rev. 0. All tests are numbered as designated in the UFSAR.

2.0 UFSAR Chapter 14.2 Tests Not Required

2.1 STP-3, Fuel Loading

The objective of this test is to load fuel safely and efficiently to the full core size.

The MUR Power Uprate does not affect the performance of systems needed to satisfy the objectives of this test.

2.2 STP-4, Full Core Shutdown Margin

The objective of this test is to demonstrate that the reactor is sufficiently subcritical throughout the fuel cycle, with any single control rod withdrawn.

Shutdown margin for Cycle 12 has been calculated per normal plant procedures during initial startup following 2R11 and is satisfactory. The MUR Power Uprate does not affect Full Core Shutdown Margin.

2.3 STP-5, Control Rod Drive System

The objectives to this test are (1) to demonstrate that the Control Rod Drive (CRD) System operates properly over the full range of primary coolant operating temperatures and pressures, and (2) to determine the initial operating characteristics of the CRD system.

The MUR Power Uprate does not affect the performance of systems needed to satisfy the objectives of this test.

2.4 STP-6, Source Range Monitor Performance and Control Rod Sequence

The objective of this test is to determine that the operational neutron sources, Source Range Monitoring instrumentation, and control rod withdrawal sequences provide adequate information to achieve criticality and power increases in a safe and efficient manner.

The MUR Power Uprate does not affect the performance of systems needed to satisfy the objectives of this test.

2.5 STP-9, Water Level Reference Leg Temperature

The objective of this test is to demonstrate the calibration and agreement of the installed reactor vessel water level instrumentation at normal operating pressure and temperature.

The MUR Power Uprate does not affect the performance of systems needed to satisfy the objectives of this test.

2.6 STP-10, Intermediate Range Monitor Performance

The objective of this test is to adjust the Intermediate Range Monitoring (IRM) System to obtain an optimum overlap with the SRM and Average Power Range Monitoring (APRM) systems.

The MUR Power Uprate does not affect the performance of systems needed to satisfy the objectives of this test.

2.7 STP-11, Local Power Range Monitoring Calibration

The objective of this test is to calibrate the Local Power Range Monitor (LPRM) system.

The MUR Power Uprate does not affect the performance of systems needed to satisfy the objectives of this test.

2.8 STP-13, Plant Monitoring System Performance Verification

The objective of this test is to demonstrate the ability of the Plant Monitoring System (PMS) to provide accurate information pertaining to plant process variables under operating conditions.

The MUR Power Uprate does not affect the performance of systems needed to satisfy the objectives of this test.

2.9 STP-14, RCIC System Performance Verification

The objectives of this test are (1) to verify the proper operation of the Reactor Core Isolation Cooling (RCIC) System over its expected operating pressure range, (2) to demonstrate reliability in automatic starting without the aid of ac power with the exception of the RCIC dc/ac inverters, and (3) to verify the operation of RCIC beyond its design basis of operation with extended loss of ac power.

The MUR Power Uprate does not affect the performance of systems needed to satisfy the objectives of this test.

2.10 STP-15, HPCI System Performance Verification

The objectives of this test are (1) to verify the proper operation of the High Pressure Coolant Injection (HPCI) System over its expected operating pressure and flow ranges, and (2) to demonstrate reliability in automatic starting from cold standby when the reactor is at rated pressure conditions.

The MUR Power Uprate does not affect the performance of systems needed to satisfy the objectives of this test.

2.11 STP-16, Selected Process Temperatures Verification

The objective of this test is to assure that the measured bottom head drain temperature corresponds to bottom head coolant temperature during normal operation.

The MUR Power Uprate does not affect the performance of systems needed to satisfy the objectives of this test.

2.12 STP-17, System Expansion

This test verifies that safety related piping systems and other piping systems as identified in the FSAR expand in an acceptable manner during plant heatup and power escalation. Specific objectives are to verify that: (1) piping thermal expansion is as predicted by design calculations; (2) snubbers and spring hangers remain within operating travel ranges at various piping temperatures; and (3) piping is free to expand without interference.

The MUR Power Uprate does not affect the performance of systems needed to satisfy the objectives of this test.

2.13 STP-18, TIP Uncertainty

The objective of this test is to determine the reproducibility of the traversing in-core probe system readings.

The MUR Power Uprate does not affect the performance of systems needed to satisfy the objectives of this test.

2.14 STP-20, Steam Production

The objective of this test is to demonstrate that the Nuclear Steam Supply System (NSSS) can provide steam sufficient to satisfy all appropriate warranties as defined in the NSSS contract.

The MUR Power Uprate does not affect the performance of systems needed to satisfy the objectives of this test.

2.15 STP-24, Main Turbine Valves Surveillance Test

The objectives of this test are to demonstrate acceptable procedures and maximum power levels of periodic surveillance testing of the main turbine control, stop and bypass valves without producing a reactor scram.

The MUR Power Uprate does not affect the performance of systems needed to satisfy the objectives of this test. Procedures have been updated to perform the tests 4% lower in power than prior to the MUR Uprate implementation. Valve testing is now performed at a lower thermal power than prior to the uprate allowing for additional margin to scram setpoints.

2.16 STP-25, Main Steam Isolation Valves Performance Verification

The objectives of this test are (1) to functionally check the Main Steam Isolation Valves (MSIVs) for proper operation at selected power levels, (2) to determine the MSIV closure times, and (3) to determine the maximum power level at which full closure of a single MSIV can be performed without causing a reactor scram. The full isolation is performed to determine the reactor transient behavior that results from the simultaneous full closure of all MSIVs at high power level.

The MUR Power Uprate does not affect the performance of systems needed to satisfy the objectives of this test.

2.17 STP-26, Main Steam Relief Valves Performance

The objectives of this test are (1) to verify that the relief valves function properly (can be manually opened and closed), (2) to verify that the relief valves reseat properly after actuation and are leak-tight, (3) to verify that there are no major blockages in the relief valve discharge piping and (4) to demonstrate system stability to relief valve operation.

The MUR Power Uprate does not affect the performance of systems needed to satisfy the objectives of this test.

2.18 STP-27, Turbine Trip and Generator Load Rejection Demonstration

The objectives of this test are (1) to determine the response of the reactor system to a turbine trip or generator load rejection; and (2) to evaluate the response of the bypass, SRV, and the reactor protection systems.

The MUR Power Uprate does not affect the performance of systems needed to satisfy the objectives of this test.

2.19 STP-28, Shutdown from Outside the Main Control Room Demonstration

The objectives of this test are to demonstrate that the reactor (1) can be safely shutdown from outside the Main Control Room (MCR), (2) can be maintained in a Hot Standby condition from outside the MCR and (3) can be safely cooled from hot to cold shutdown from outside the MCR. In addition, it will provide an opportunity to demonstrate that the procedures of Remote Shutdown are clear and comprehensive and that the operational personnel are familiar with their application.

The MUR Power Uprate does not affect the performance of systems needed to satisfy the objectives of this test.

2.20 STP-29, Recirculation Flow Control Demonstration

The objectives of this test are (1) to demonstrate the flow control capability of the plant over the entire pump speed range and (2) to determine that the controllers are set for the desired system performance and stability.

The MUR Power Uprate does not affect the performance of systems needed to satisfy the objectives of this test.

2.21 STP-30, Recirculation System

The objectives of this test are to:

- Determine transient responses and steady-state conditions following recirculation pump trips at selected power levels.
- Obtain jet pump performance data.
- Demonstrate that no recirculation system cavitation occurs in the operation region of the power/flow map.

The MUR Power Uprate does not affect the performance of systems needed to satisfy the objectives of this test.

2.22 STP-31, Loss of Turbine-Generator and Offsite Power

This test objective is to demonstrate the performance of the reactor and plant electrical equipment and systems, during the loss of auxiliary power transient.

The MUR Power Uprate does not affect the performance of systems needed to satisfy the objectives of this test.

2.23 STP-32, Essential HVAC System Operation and Containment Hot Penetration Temperature Verification

The objectives of this test are to demonstrate, under actual/normal operating conditions, that the various Heating Ventilation and Air Conditioning systems will be capable of maintaining specified ambient temperatures and relative humidity within the following areas:

- Primary Containment (drywell suppression chamber)
- Reactor Enclosure and Main Steam Tunnel
- MCR
- Control Enclosure
- Radwaste Enclosure

In addition, this test shall verify that the concrete temperature surrounding Main Steam and Feedwater containment penetrations remains within specified limits.

The MUR Power Uprate does not affect the performance of systems needed to satisfy the objectives of this test.

2.24 STP-33, Piping Steady-State Vibration Measurements

The objective of this test is to verify that the steady state vibration of NSSS, Main Steam, Reactor Recirculation and selected BOP piping systems is within acceptable limits.

The MUR Power Uprate does not affect the performance of systems needed to satisfy the objectives of this test.

2.25 STP-34, Offgas System Performance Verification

The objective of this test is to verify that the Offgas System operates within the TS limits and expected operating conditions.

The MUR Power Uprate does not affect the performance of systems needed to satisfy the objectives of this test.

2.26 STP-35, Recirculation Flow Calibration

The objective of this test is to perform a complete calibration of the recirculation system flow instrumentation, including specific signals to the plant monitoring system.

The MUR Power Uprate does not affect the performance of systems needed to satisfy the objectives of this test.

2.27 STP-36, Piping Dynamic Transient

The objectives of this test are to verify that the following piping systems are adequately designed and restrained to withstand the following transient loading conditions:

- Main Steam - Main Turbine Stop Valve/Control Valve closures at approximately 20-25%, 60-80%, and 95-100% of rated thermal power.
- Main Steam and Relief Valve Discharge - Main Steam Relief Valve actuation.
- Recirculation - Recirculation Pump trips and restarts.
- HPCI steam supply - HPCI turbine trips.
- Feedwater - Reactor feed pump trips/coastdowns.

The MUR Power Uprate does not affect the performance of systems needed to satisfy the objectives of this test.

2.28 STP-70, Reactor Water Cleanup System Performance Verification

The objective of this test is to demonstrate specific aspects of the mechanical operability of the Reactor Water Cleanup System.

The MUR Power Uprate does not affect the performance of systems needed to satisfy the objectives of this test.

2.29 STP-71, Residual Heat Removal System Performance Verification

The objective of this test is to demonstrate the ability of the Residual Heat Removal (RHR) System to remove residual and decay heat from the nuclear system so that the refueling and nuclear servicing can be performed. Additionally, this test will demonstrate the ability of the RHR System to remove heat from the suppression pool.

The MUR Power Uprate does not affect the performance of systems needed to satisfy the objectives of this test.

3.0 UFSAR Chapter 14.2 Tests Required

3.1 STP-1, Chemical and Radiochemical

Objectives

The objectives of this test are to maintain control of and knowledge about the quality of the reactor coolant chemistry and radiochemistry at TPO conditions.

Description

Samples will be taken and measurements made at TPO test conditions to determine 1) the chemical and radiochemical quality of reactor water and reactor feedwater and 2) gaseous release.

Acceptance Criteria

Level 1

a) Chemical factors defined in the Technical Specifications (Technical Requirements Manual, COLR, or Fuel Warranty, as applicable) must be maintained within the limits specified.
b) The activities of gaseous and liquid effluents must be known and must conform to license limitations.

Level 2

Water quality must be known at all times and must remain within guidelines of the station's chemistry program.

None

Results

During LGS Unit 2 Cycle 12, following the MUR TPO Uprate, reactor coolant chemistry parameters as well as radioactive gaseous waste releases and radioactive liquid waste releases were maintained within the limits set forth in the LGS Unit 2 TS. The following is a list of chemistry related surveillance tests (ST) satisfactorily performed since operating at the new TPO power level.

- ST-5-041-800-2, "Reactor Coolant Chemistry"
- ST-5-041-885-2, "Dose Equivalent I-131 Determination"
- ST-5-061-570-0, "Radwaste Discharge Permit"
- ST-5-070-885-2, "Isotopic Offgas Analysis"
- ST-5-076-810-2, "Unit 2 South Stack Monthly Noble Gas Sampling and Analysis"
- ST-5-076-815-2, "Unit 2 South Stack Weekly Iodine and Particulate Analysis"

In addition to the surveillance tests, routine tests and normal analysis were performed. Results are as follows:

PARAMETER	ACTUAL DATA (100% CLTP)	ACTUAL DATA (TPO)	ACCEPTANCE CRITERIA
Primary Rx Coolant Iodine	8.94 x 10^{-6} µCi/gm	8.811 x 10-6 µCi/gm	≤0.2µCi/gm
Primary Rx Coolant Conductivity	.130 µmhos/cm	.130 µmhos/cm	≤1.0 µmhos/cm
Primary Rx Coolant Chloride	< 0.31 ppb	< 0.31 ppb	≤200 ppb

Fuel Warranty Appendix I - Water Quality Requirements are all met. A comparison of data recorded at 100% CLTP and TPO conditions is provided below.

Parameter		100% CLTP	TPO	Continual Limit (max)
Total Feedwater Copper Concentration		0.011 ppb	0.011 ppb	0.5 ppb
Feedwater Iron Concentration	Insoluble	0.120 ppb	0.123 ppb	10 ppb
	Soluble	0.005 ppb	0.006 ppb	1 ppb
Total Metals		0.600 ppb	0.556 ppb	15 ppb

3.2 STP-2, Radiation Measurements

Objective

The objective of this test is to monitor radiation at the TPO conditions to assure that personnel exposures are maintained ALARA, that radiation survey maps are accurate, and that radiation zones are properly posted.

Acceptance Criteria

Level 1

The radiation doses of plant origin and occupancy times of personnel in radiation zones shall be controlled consistent with the guidelines of the standards for protection against radiation outlined in lOCFR20.

Level 2

None

Results

Plant surveys were performed at the TPO power level. Spot checks were performed to validate routine surveys. Postings at steam-affected areas were updated as necessary to reflect the new TPO conditions. Based on the observed results, no additional surveys were determined to be necessary. Affected postings and survey maps were updated as necessary. Radiation doses and occupancy times of personnel are consistent with the guidelines of the Standard for Protection Against Radiation outlined in 10CFR20.

3.3 STP-12, Average Power Range Monitoring Calibration

Objective

The objective of this test is to calibrate the Average Power Range Monitor (APRM) system to the TPO power level.

Acceptance Criteria

Level 1

a) The APRM channels must be calibrated consistent with Technical Specifications.

b) Technical Specifications (Technical Requirements Manual, COLR, or Fuel Warranty, as applicable) limits on APRM scram and rod block setpoints shall not be exceeded.

Level 2

None

Results

APRM Calibrations or Gain Adjustments were performed at the new TPO power level. ST-6-107-887-2, "APRM Gain Determination and Adjustment," was completed satisfactorily and the APRM scram and rod block setpoints were not exceeded.

3.4 STP-19, Core Performance

Objectives

The objective of this test is to evaluate the core thermal power and core flow and evaluate whether core performance parameters are within limits to ensure a careful, monitored approach to the TPO power level.

Description

Routine measurements of reactor and system parameters are taken near 95% and 100% of CLTP along the constant rod pattern line that will be used to increase to maximum TPO power. Core thermal power measurements will be performed using the more accurate heat balance methods indicated in the NRC approved TPO submittal. Core performance parameters are calculated using accepted methods to ensure current licensed and operational practice are maintained. Fuel thermal margin and other core performance parameters will be projected to the TPO power level from the 100% CLTP test conditions. Power increase above CLTP is along a constant rod pattern line in one progression to TPO power level following the station's standard power ascension practices. Measured reactor parameters and calculated core performance parameters at TPO power level are evaluated by comparison to limits specified in Technical Specifications and projected values.

Acceptance Criteria

Level 1

a) All core performance parameters shall be within the limits specified in Technical Specifications

1. CMFLPD (Core Maximum Fraction of Limiting Power Density)
2. CMFCPR (Core Maximum Fraction of Critical Power Ratio)
3. CMAPRAT (Core Maximum Average Planar Ratio)

b) Steady state reactor power shall be limited to maximum value of the lesser of either the TPO power level or the MELLLA Boundary as indicated on the Power/Flow Map.
c) Core flow shall not exceed its maximum value depicted on the Power/Flow Map.

Level 2

None

Results

Core monitor cases were run at each power level to monitor core performance parameters, ensuring they remained within the Technical Specifications throughout the approach to the TPO power level. Values for each of the core performance parameters at each of the test plateaus are given below and are to be maintained less than or equal to 1.0 per Technical Specifications.

Core Performance Parameter	Reactor Power (MWth)			
	3285	3458	3487	3515
CMFLPD	0.800	0.824	0.831	0.833
CMFCPR	0.871	0.857	0.858	0.854
CMAPRAT	0.651	0.686	0.696	0.700

Steady state reactor power and core flow are maintained within the bounds of the Power/Flow map in accordance with plant operating procedures.

3.5 STP-22, Pressure Regulator Response

Objective

The objective of this test is to confirm the adequacy of the pressure control settings for TPO operations by inducing transients in the reactor pressure control system using the pressure regulators and gather data to determine incremental regulation.

Description

Turbine Pressure Controller Setpoint

Prior to commencing TPO baseline testing (in the 95% CLTP test condition), the turbine pressure controller setpoint will be adjusted to achieve desired reactor pressure when projected to TPO uprate conditions and then held constant throughout the TPO power ascension. This provides the most meaningful evaluation of turbine steam flow margin at TPO conditions.

Note: With the small TPO power change, holding the turbine pressure controller setpoint constant establishes a consistent basis for measuring the performance of the reactor and especially TCVs as they open during the TPO power ascension. Achieving normal operating reactor dome pressure in the TPO test condition permits direct evaluation between CLTP and TPO operating conditions.

Description of Pressure Regulator Testing

Note: This testing may produce core power excursions due to the vessel pressure changes. The power levels of these operational transients have the potential to exceed the steady-state power level of the test condition. A margin to licensed thermal power should be established to avoid exceeding the licensed thermal power limit.

In each test condition, testing of the pressure control system response to pressure setpoint step changes is accomplished by first making a down setpoint step change, followed by an up setpoint step change after conditions stabilize, in accordance with the following setpoint change sequence.

1. –3 psi
2. +3 psi

When testing is completed for one pressure regulator, the other pressure regulator is selected and the pressure setpoint step testing is repeated. For the testing performed at TPO conditions, power was established with margin to the licensed thermal power limit to ensure the licensed thermal power was not exceeded.

Incremental Regulation Data Collection

Average main steam line flow versus pressure regulator output is taken in increments of 2% of uprated power or less during ascension to TPO power. Collect data from Generator minimum load to TPO power or from 95% of CLTP, if data already exists up to this power level. Subsequent to the TPO power ascension, the variation in the slope of a curve plotted on linear graph paper must show that the incremental regulation meets the Level 2 criteria.

Level 1

The transient response of any pressure control system related variable to any test input must not diverge.

Level 2

a) Pressure control system-related variables may contain oscillatory modes of response. In these cases, the decay ratio of each controlled mode of response must be ≤ 0.25.
b) Pressure control system deadband, delay, etc., shall be small enough that steady state limit cycles, if any, shall produce turbine steam flow variations no larger than ± 0.5% of rated flow.
c) The variation in incremental regulation (ratio of the maximum to the minimum value of the quantity, "incremental change in pressure control signal/incremental change in steam flow," for each flow range) shall meet the following:

% of Steam Flow Obtained with Valves Wide Open	Variation
0 to 85%	≤ 4:1
85 to 97%	≤ 2:1
97 to 99%	≤ 5:1

Results

Pressure regulator stability testing was performed at 95% CLTP, 100% CLTP, and TPO power levels. The data obtained during each test condition is summarized below. The system responded to the pressure transients as expected with no signs of divergence or oscillations. Decay ratios were zero for all step changes on both pressure regulators. Pressure response time and margin to scram setpoints were satisfactory in all cases. No limit cycles were observed. All Level 1 and Level 2 acceptance criteria were satisfied.

The Pressure Regulator Incremental Regulation Determination was performed previously from Generator Synchronization to 100% CLTP in 2% power increments and was satisfactory. Data was collected for the TPO uprate at each of the test plateaus from 95 % CLTP to TPO conditions. The variation in incremental regulation was verified to be within the acceptance criteria for all test conditions.

"A" Pressure Regulator Step Change Data

Power Level (MWth)	Step Size (+/-)	Peak Pressure (psig)	Pressure Response Time	Peak Power (%)	Steady State Cycles	Decay Ratio
3285	-3	1024.8	4 sec	92.9	0	0
3285	+3	1029.9	4 sec	94.0	0	0
3458	-3	1034.2	4 sec	97.8	0	0
3458	+3	1038.8	4 sec	98.7	0	0
3487	-3	1035.1	4 sec	98.2	0	0
3487	+3	1040.2	5 sec	99.3	0	0

"B" Pressure Regulator Step Change Data

Power Level (MWth)	Step Size (+/-)	Peak Pressure (psig)	Pressure Response Time	Peak Power (%)	Steady State Cycles	Decay Ratio
3285	-3	1024.8	3 sec	93.1	0	0
3285	+3	1029.9	3 sec	94.0	0	0
3458	-3	1035.1	5 sec	97.8	0	0
3458	+3	1039.2	5 sec	98.8	0	0
3487	-3	1035.5	3 sec	98.1	0	0
3487	+3	1039.9	4 sec	99.2	0	0

3.6 STP-23, Feedwater Control System Response

Objectives

The purpose of this test is to verify the feedwater control system has been adjusted to provide acceptable reactor water level control for TPO operating conditions.

Description

Feedwater Control System Testing

Note: This testing may produce core power excursions due to the feedwater addition. The power levels of these operational transients have the potential to exceed the steady-state power level of the test condition. A margin to licensed thermal power should be established to avoid exceeding the licensed thermal power limit.

At each test condition, reactor water level setpoint changes are introduced into the feedwater control system in accordance with the following setpoint change sequence: -1 in., +1 in., -2 in., + 2 in., -3 in., + 3 in.

The normal feedwater control system mode is three-element control, with single element control only being used for temporary backup situations. The feedwater control system in three-element control mode should be adjusted, not only for stable operational transient level control (i.e., decay ratio), but also for stable steady-state level control (i.e., minimize water level limit cycles.) In single element control mode, the system adjustments must achieve the operational transient level control criteria, but for steady state level control the temporary backup nature of this mode should be considered.

Acceptance Criteria

Level 1

The transient response of any feedwater level control system- related variable to any test input must not diverge.

Level 2

a) Level control system-related variables may contain oscillatory modes of response. In these cases, the decay ratio of each controlled mode of response must be ≤ 0.25.
b) The turbine speed regulation variation between the three feed pumps must match within ± 6% of rated speed.

Results

Feedwater Stability Testing was performed at 95% CLTP, 100% CLTP, and TPO power level. One, two, and three inch positive and negative level setpoint changes were input and system response was monitored. These step changes were performed in three element control. No tuning or adjustments were necessary. Previous testing of the Feedwater Level Control System is sufficient to demonstrate control capability of the control system in single element control mode through 100% TPO power level, so no single element testing was performed. All acceptance criteria related to system stability were satisfied.

Speed regulation variation between the three reactor feed pumps was verified to match to within ± 6% of each other at the each test plateau from 95% CLTP to TPO conditions.

4.0 Other Tests Performed

4.1 STP-1B, Steam Dryer/Separator Performance

Objective

The objective of this test is to evaluate steam dryer/separator performance at TPO conditions by measuring main steam line (MSL) moisture content.

Note: Task T0306, Steam Dryer/Separator Performance, performs a specific evaluation of Limerick steam dryer/separator performance at TPO conditions. T0306 provides confirmation of the steam dryer moisture content functional performance specification for the TPO. Steam dryer/separator performance testing is recommended to confirm the T0306 analytical results and demonstrate acceptable performance at TPO.

Description

Steam dryer/separator performance (i.e., moisture carryover) is determined by performing a tracer test similar to that performed in the original startup test program or by other equivalent plant procedure. Refer to SIL-639 (Ref. 4) for information on MSL moisture content measurement in operating BWRs. For this testing, MSL moisture content is considered equivalent to the steam dryer moisture carryover. Testing at 100% TPO satisfies this testing recommendation. Optional testing at 100% TPO on the MELLLA Boundary permits the T0306 analytical prediction to be confirmed acceptable at the limiting operating conditions of low core flow at high thermal power. Optional testing at the 100% TPO and ICF corner allows MSL moisture content to be compared to the steam dryer performance at the limiting operating condition of high core flow at high thermal power. Other test condition power/flow operating points may be tested as deemed appropriate prior to achieving the 100% TPO power test conditions to demonstrate the test methodology or confirm acceptable steam moisture content at operating conditions prior to achieving 100% TPO.

Level 1

None

Level 2

MSL moisture content shall not be in excess of the steam dryer functional performance design specification for long-term operations.

Results

Moisture carryover readings were taken at both 100% CLTP and TPO power levels. At 100% CLTP, moisture carryover was measured to be 0.005% and at TPO power level, moisture carryover was 0.010%. The design limit for moisture carryover is to be less than or equal to 0.1%.

4.2 STP-101, Plant Parameter Monitoring and Evaluation

Objective

The objective of this test is to evaluate that power-dependent parameters remain within limits to ensure a careful, monitored approach to the TPO level. The power-dependent parameters monitored are those of systems and equipment affected by the TPO power increase.

Description

Routine measurements of the power-dependent parameters (i.e., pressures, temperatures, flows, vibration) of systems and equipment affected by the TPO, are taken at 95% and 100% of CLTP. Parameters will be calculated using accepted methods to ensure current licensed and operational practices are maintained. Measured and calculated power-dependent parameters are used to project those values in the TPO test condition prior to increasing power above CLTP. Once the TPO power test condition is achieved, each actual value will be evaluated against operational limits and its predicted value to confirm the change as expected with the TPO power increase is acceptable.

Level 1

All power-dependent parameters shall be within the limits specified in Technical Specifications (TRM, COLR, or Fuel Warranty, as applicable).

Level 2

None

Results:

System monitoring was performed at each of the test plateaus. All power-dependent parameters were confirmed to be within the limits specified in Technical Specifications (Technical Requirements Manual, COLR, or Fuel Warranty as applicable) at each power level. All acceptance criteria related to power-dependent systems parameters was satisfactory.