NEXTera ENERGY SEABROOK

August 25, 2011

Docket No. 50-443
SBK-L-11162

United States Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555-0001

Seabrook Station
Cycle 15 Startup Report

In accordance with the requirements of Technical Specification 6.8.1.1, enclosed is the Cycle 15 Startup Report for Seabrook Station. Also enclosed is a description of changes to the Loose Parts Monitoring System required to be included with the Startup Report in accordance with Regulatory Guide 1.133, Loose-Part Detection Program for the Primary System of Light-Water-Cooled Reactors.

Should you require further information regarding this matter, please contact Mr. Paul V. Gurney, Reactor Engineering Supervisor, at (603) 773-7776.

Sincerely,

NextEra Energy Seabrook, LLC

Michael O'Keefe
Licensing Manager

cc: NRC Region I Administrator
G. E. Miller, NRC Project Manager, Project Directorate I-2
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ENCLOSURE 1 TO SBK-L-11162

SEABROOK STATION

UNIT NO. 1

STARTUP TEST REPORT

CYCLE 15

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1.0 CHRONOLOGICAL SUMMARY

Operation/testing milestones were completed as follows:

CYCLE 15 FUEL LOAD COMPLETED	4/16/11
SPT COMPLETED	5/17/11
INITIAL CRITICALITY	5/23/11
ON LINE	5/23/11
30% PAT COMPLETED	5/24/11
50% PAT COMPLETED	5/24/11
80% PAT COMPLETED	5/25/11
94% PAT COMPLETED	5/26/11
FULL POWER	5/26/11

2.0 CORE DESIGN SUMMARY

The Cycle 15 core is designed to operate for 21,000 MWD/MTU. 80 fresh fuel assemblies were loaded into the Cycle 15 core. 40 have an enrichment of 4.30 w/o and 40 have an enrichment of 4.70 w/o. In addition, the top and bottom 6 inches have an enrichment of 2.6 w/o creating an axial annular blanket. By comparison, Cycle 14 utilized 84 fresh fuel assemblies, 24 with an enrichment of 4.40 w/o and the remaining 60 at 4.80 w/o, both with a similar 2.6 w/o axial annular blanket configuration.

The fuel mechanical design used in the Cycle 15 core is the Westinghouse Robust Fuel Assembly (RFA) design. All fuel utilizes ZIRLO for fuel clad, control rod guide tubes and instrument thimbles. The top and bottom grids are Inconel-718. The six low-pressure drop mid-zone and three intermediate flow mixer grids are ZIRLO with ZIRLO sleeves. In addition, all fuel contains a Performance^{+} debris mitigation grid located at the bottom end plug of the fuel rod.

The Cycle 15 core was designed for a rated thermal power (RTP) condition of 3648 MWt.

3.0 SUBCRITICAL PHYSICS TESTING SUMMARY

This was the third application of Subcritical Physics Testing (SPT) at Seabrook. The following testing sequence was performed with the reactor in MODE 3 using a laptop computer based Data Analysis System (DAS).

1. Rod Worth Measurement: Total control bank and shutdown bank worth was measured using the Subcritical Rod Worth Measurement (SRWM) technique with the DAS.

2. Boron Endpoint Measurement: The boron endpoint was analytically determined by the DAS using the SRWM data.

3. Isothermal Temperature Coefficient Measurement (ITC): This was determined using the DAS in conjunction with a Reactor Coolant temperature change. The Moderator Temperature Coefficient (MTC) was calculated from the ITC Data.

All acceptance criteria were met and the results are presented in Table 1.

4.0 POWER ASCENSION TESTING SUMMARY

Testing was performed at specified power plateaus of 30%, 50%, 80%, 94%, and 100% Rated Thermal Power (RTP). Power changes were governed by operating procedures and fuel preconditioning guidelines.

Thermal-hydraulic parameters, nuclear parameters and related instrumentation were monitored throughout the Power Ascension. Data was compared to previous cycle power ascension data at each test plateau to identify calibration or system problems. The major areas analyzed were:

1. Core Performance Evaluation: Flux mapping was performed at 30%, 50%, and 100% RTP using the Fixed Incore Detector System. The resultant peaking factors and power distribution were compared to Technical Specification limits to verify that the core was operating within its design limits. All analysis limits were met and the results are summarized in Table 2.

2. Nuclear Instrumentation Indication: Overlap data was obtained between the Intermediate Range and Power Range channels. Secondary plant heat balance calculations were performed to verify the Nuclear Instrumentation indications.

3. RCS Delta-T Indication: All RCS ΔT loops were initially scaled using cycle 14 values. Data from 30%, 50%, 80% and 94% RTP met prescribed acceptance criteria. Data was evaluated at 100% RTP and the ΔT loops were re-scaled.

4. Upper Plenum Anomaly Evaluation: In early 1992, Westinghouse notified Seabrook Station that it might be susceptible to a phenomenon known as the Upper Plenum Anomaly (UPA). The UPA is primarily characterized by a periodic step change of 1°F to 2°F in hot leg temperature and a corresponding change in steam flow. Cycle 15 data collected at 100% RTP identified the presence of UPA. The 100% RTP data confirmed that instrumentation changes to the delta-T loops implemented in early 2005 successfully mitigated the impact of UPA events on the delta-T instrumentation.

5. RCS Temperatures: Data was obtained for the Narrow Range Loop temperatures. Evaluations for Delta-T (°F) and T_{AVG} / T_{REF} Indication were performed. The data was as expected.

6. Steam, feedwater venturi, and feedwater ultrasonic flows: Data was obtained for the steam, feedwater venturi, and feedwater ultrasonic flows. Evaluations for deviations were performed. The data was as expected.

7. Steam Generator Pressures: Data was obtained for the steam generator pressures. Evaluations for deviations between redundant channels on individual steam generators were performed. The data was as expected.

8. Turbine Impulse Pressure (T_{REF}): The scaling of T_{REF} was evaluated during the power ascension and found acceptable for continued power increase to 100%. Once steady state 100% RTP conditions were reached, the turbine impulse pressure was evaluated and determined to be acceptable.

9. Incore/Excore Calibration: Scaling factors were calculated from flux map data using the single point calibration methodology. The nuclear instrumentation power range channels were re-scaled at 50% and 100% RTP.

10. RCS Flow: The RCS flow was measured at the 94% RTP plateau using elbow tap measurements to minimize the effects of observed hot leg streaming. The calculated RCS flow value met the Technical Specification requirements.

TABLE 1

SUBCRITICAL PHYSICS TEST RESULTS: CYCLE 15

ITEM	MEASURED (M)	PREDICTED (P)	RESULT	ACCEPTANCE CRITERIA
CONTROL AND SHUTDOWN BANK TOTAL ROD WORTH: (pcm)	6469	6539	(M/P)x100 98.9%	>90%
BORON END POINT: HZP ALL RODS OUT	2061 ppm	2073 ppm	72 pcm	± 1000 pcm
ALL RODS OUT MTC (pcm/°F)	-1.07	N/A	N/A	<+ 4.089 *

NOTE: * COLR limit is +4.089 pcm/°F for BOC 15.

TABLE 2

POWER ASCENSION FLUX MAP RESULTS: CYCLE 15

ITEM	MAP 1	MAP 2	MAP 3
DATE OF MAP	5/23/11	5/24/11	5/26/11
POWER LEVEL (%)	29.3	48.5	99.8
CONTROL BANK D POSITION (steps)	158	190	226
F_Q	2.3539	2.3740	1.9030
$F_{\Delta H}$	1.5998	1.5571	1.4929
MAXIMUM INCORE TILT	1.0139	1.0129	1.0142
MAXIMUM MEASURED TO PREDICTED POWER DISTRIBUTION ERROR (%)	9.44	8.215	7.639
ABSOLUTE AVERAGE MEASURED TO PREDICTED POWER DISTRIBUTION ERROR (%)	2.853	2.587	2.194

ENCLOSURE 2 TO SBK-L-11162

Loose Parts Monitor Alert Level

Background:

The Seabrook Loose Parts Monitoring System (LPMS) was replaced during OR14 with a new computer-based system furnished by Mistras Group, Inc. (formerly known as Physical Acoustics Corporation) to address obsolescence issues. The entire LPMS system was replaced including sensors, pre-amplifiers and Control Room cabinet. Existing plant cables were re-used to the extent feasible.

The replacement system contains 16 active channels monitoring the same locations as the previously installed system. (The previous system had 12 active channels and four installed spare channels.) The pre-amplifiers for the replacement system have been installed outside of containment to allow access for maintenance and surveillance during plant operation.

The computer system and peripheral equipment is installed in a cabinet located in the Main Control Room. The LPMS actuates a VAS alarm to alert the control room operating crew to the presence of suspected loose parts. The LPMS Human Machine Interface (HMI) includes a touchscreen display, keyboard and mouse. The touchscreen display provides system level graphics and detailed alarm information for the control room operating crew. The touchscreen also provides diagnostic and historical displays for Plant Engineering and Maintenance personnel to facilitate maintenance and surveillance activities.

The alert levels and alert logic configured into the new LPMS are updated from the levels and logic performed by the original LPMS. In accordance with Position C.3.(2)(a) of RG 1.133, Revision 1 details of the new systems alert levels and alert logic are submitted as an amendment to the Seabrook Loose Part program description.

LPMS Alert Level Determination:

LPMS alert levels are established by setting multiple user configurable parameters to indicate the presence of a suspect loose part. The parameters are set based on factors such as the steady state background noise (Average Signal Level), other transient noise sources seen by the LPMS, and the characteristics of the waveform data collected during testing with the impact simulator.

The first configurable parameter is the Hit Detection Threshold Level which is set to differentiate acoustic events from the background noise. This level is set to a value that is above the normal range of the Average Signal Level and the periodic noise spikes that would constitute false hits for each channel. Signals that exceed this threshold are then subject to three additional screening criteria before the system produces a Loose Part Alarm. The objective of the three screening criteria is to differentiate between signals caused by loose parts and signals caused by other noise sources to minimize false alarms.

Screening Criterion 1: Compares the Amplitude and Energy of the acoustic event data against configurable ranges for each of these parameters. The configurable ranges are based upon data collected during impact testing and Vendor recommendations based on their experience.

Screening Criterion 2: Compares Acoustic Emission Features of the acoustic event against configurable ranges for parameters such as signal duration and rise time. Duration is the time the signal is above the Hit Threshold and Rise Time is the time from when the signal first exceeded the Hit Threshold until the signal reaches its peak Amplitude. The configurable ranges are based upon data collected during impact testing and Vendor recommendations based on their experience.

Screening Criterion 3: Compares frequency features of the acoustic event data to configurable frequency feature alert levels. The software calculates the Fast Fourier Transform (FFT) for the waveform data and can determine two Partial Power features (PP1 and PP2). These features represent the percent of total signal power within a defined frequency range. Seabrook uses PP1 to discriminate between noise and impacts. The PP1 alert level is based upon data collected during impact testing.

Seabrook LPMS Alert Levels:

Cold Impact Testing was performed with the plant in Mode 5 with minimal background noise to verify the response of the LPMS to simulated impacts with an energy of 0.5 ft.-lbs. Hot Impact Testing was performed with the plant in Mode 3 to verify the response of the LPMS to simulated impacts with the plant at NOP/NOT with normal operational background noise to more closely replicate the plant conditions at 100% power. The alert levels determined through this testing are presented below:

The hit detection threshold can be set on a channel by channel basis. The hit detection threshold was set to a value higher than the background noise to minimize the processing of "hits" by the system. This was done by adjusting threshold values until the number of false hits due to periodic noise spikes essentially stopped.

Channel No.	Sensor Location	Hit Detection Threshold Setting (dB)
1	Reactor Vessel Head	56
2	Reactor Vessel Head	56
3	Reactor Vessel Bottom	56
4	Reactor Vessel Bottom	56
5	SG A Below Tube Sheet	52
6	SG A Above Tube Sheet	52
7	SG A On Tube Sheet	52
8	SG B Below Tube Sheet	52
9	SG B Above Tube Sheet	52
10	SG B On Tube Sheet	52
11	SG C Below Tube Sheet	52
12	SG C Above Tube Sheet	52
13	SG C On Tube Sheet	52
14	SG D Below Tube Sheet	52
15	SG D Above Tube Sheet	52
16	SG D On Tube Sheet	52

Based on the design of the Mistras LPMS, the LP detection thresholds are set to the same value for all 16 channels. The settings are as follows:

Parameter	Value
Loose Parts Alarm-Amplitude Low	56 dB
Loose Parts Alarm-Amplitude High	98 dB
Loose Parts Alarm-Energy Low	75 energy counts
Loose Parts Alarm-Energy High	10,000 energy counts
Loose Parts Alarm-Signal Duration Low	1500 µsec.
Loose Parts Alarm-Signal Duration High	10,000 µsec.
Loose Parts Alarm-Signal Rise Time Low	200 µsec.
Loose Parts Alarm-Signal Rise Time High	800 µsec.
Loose Parts Alarm-Partial Power 1 (PP1)	5-30KHz
Loose Parts Alarm-PP1 Threshold	>80%

The above settings are utilized for operation in Modes 1 & 2, the modes in which the LPMS is required to be functional in accordance with Technical Requirement #3.

Seabrook LPMS Sensitivity:

Seabrook determined the system sensitivity by conducting cold impact testing as discussed above. All sensor channels were shown to respond to impacts $\leq$ 0.5 ft.-lbs. at $\geq$ 3 ft. displacement in a consistent manner, with a small error margin. The cold impact testing was conducted with the plant in Mode 5 with no significant background noise.

Hot impact testing was conducted with the plant in Mode 3 at NOT/NOP conditions to determine changes in sensor response due to pressure and temperature changes in the primary system. During this testing normal operational noise was present; it was found that this background noise, as measured by the LPMS, was at or above the signal levels measured during cold impact testing. During hot impact testing, it was determined that some sensors did not respond to impacts of $\leq$ 0.5 ft.-lbs. at a displacement of $\geq$ 3 ft. so the impact energy was increased to 1.0 $\pm$ 0.2 ft-lbs. At this impact energy level, sensors up to 12 ft. away were able to detect and measure the impact in the presence of the normal plant background noise.